FOOD

AND ITS

ADULTERATIONS.

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FOOD

AND ITS

ADULTERATIONS;

COMPRISING THE REPORTS OF THE

ANALYTICAL SANITARY COMMISSION OF "THE LANCET"

FOR THE YEARS 1851 TO 1854 INCLUSIVE,

REVISED AND EXTENDED:

BEING RECORDS OF THE RESULTS OF SOME THOUSANDS OF ORIGINAL MICROSCOPICAL AND CHEMICAL ANALYSES OF THE SOLIDS AND FLUIDS CONSUMED BY ALL CLASSES OF THE PUBLIC;

AND CONTAINING

THE NAMES AND ADDRESSES OF THE VARIOUS MERCHANTS, MANUFACTURERS, AND TRADESMEN OF WHOM THE ANALYSED ARTICLES WERE PURCHASED.

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DOCTOR OF MEDICINE IN THE UNIVERSITY OF LONDON; LICENTIATE OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON; FELLOW OF THE ROYAL MEDICAL AND CHIRURGICAL SOCIETY; FELLOW OF THE MEDICAL SOCIETY OF LONDON; FELLOW OF THE LINNÆAN SOCIETY; MEMBER OF THE COUNCIL OF THE BOTANICAL SOCIETY OF LONDON; CORRESPONDING FELLOW OF THE MEDICAL SOCIETY OF MUNICH AND OF THE NATURAL HISTORY SOCIETIES OF MONTREAL AND DUBLIN; LECTURER ON MEDICINE AT THE ROYAL FREE HOSPITAL MEDICAL COLLEGE; PHYSICIAN TO THE ROYAL FREE HOSPITAL.

Illustrated by One hundred and fifty-nine Engravings,

SHOWING THE MINUTE STRUCTURES OF THE GREATER NUMBER OF THE VEGETABLE SUBSTANCES EMPLOYED AS ARTICLES OF FOOD, ALSO THOSE OF THE MAJORITY OF THE SUBSTANCES USED FOR ADULTERATION.

LONDON:

LONGMAN, BROWN, GREEN, AND LONGMANS.

1855.

Dedication.

TO

SIR BENJAMIN HALL, Bart., M.P.,

PRESIDENT OF THE GENERAL BOARD OF HEALTH.

Sir,

The fact has at length become recognised that the sanitary condition of the people is the great social question of the day, for it is one which vitally affects the interests, the well-being, and even the safety of every individual throughout these realms, rich and poor, high and low, but especially the latter.

One statistical fact only need be cited to show its vast importance, not merely in this country, but throughout the whole world; this is, that more persons have died, and still continue to die, from the neglect of proper sanitary precautions, and from living in violation of the fundamental laws and rules of health, than have ever fallen in battle.

The causes which tend to impair health and to shorten life are numerous, and surround us daily. The majority of them may, however, be referred to certain heads,—as foul air, impure water, and adulterated food and drink. Amongst these causes, the last is assuredly not an unimportant one, as is abundantly demonstrated by the various facts recorded in the pages of this work, now dedicated to you.

From your position as Chief Minister of Health for this country, evidence is doubtless brought before you daily of the magnitude of the interests involved in the question of Sanitary Reform; of this I am aware you are fully sensible, and not only so, but that you are animated with the determination to exert to the utmost the powers entrusted to you, view to the improvement of the sanitary condition of the people, and, by improving this, to contribute to their well-being in a variety of ways.

Called to take the lead in the sanitary movement, at an important and critical period of its progress, you have already been the means of effecting much good; and doubtless, when sufficient time has elapsed for maturing your views, a still larger amount of benefit to the public will result.

The importance of Sanitary Reform is fully recognised by the people, who are quite prepared to support any measures that may be requisite for carrying it into effect; and I trust that Parliament will be found equally so when appealed to, as it will doubtless be, during the next session. It must have been apparent to all who had anything to do with carrying out sanitary measures during the epidemic which has just passed from amongst us, that the powers of the General Board of Health, as at present constituted, are wholly inadequate to deal successfully with an emergency of this kind; they are equally so even for ordinary exigencies connected with the Public Health.

I have been led to dedicate this work to you because, treating as it does of an important branch of Public Hygeine, it appeared to me that you, as the Head of Sanitary Reform in this country, were of all others the fittest person to whom it should be addressed; moreover, you have already announced your intention of dealing with the question of Adulteration.

I have the honour to remain,

With great respect,

Your Obedient Servant,

ARTHUR HILL HASSALL.

8. Bennett-street, St. James'-street,
Dec. 1854.

INTRODUCTION.

Sufficient will be found recorded in the pages of this work to show that the subject of the Adulteration of Articles of Food and Drink is one of extreme and even of national importance. Considered in relation to the various substances employed in Medicine, it assumes, if possible, a still higher and graver interest.

The magnitude and importance of this question have been, to some extent at least, already acknowledged, as shown by the publication, first of Accum's Treatise, and subsequently by the works of Mitchell, Normandy, Chevalier, and MM. Jules Garnier and Harel, as well as by the several enactments which have been passed from time to time and in different countries for the purpose of suppressing adulteration. Hitherto, however, the subject has never received that amount of attention which, for a variety of reasons, it so strongly demands. This has arisen partly from the fact that the extent of the evil has only recently been made fully known, and this chiefly through the investigations recorded in the present work. Now that the magnitude of the mischief has been demonstrated, and the methods by which the several adulterations practised may be discovered with ease and certainty pointed out, we may, it is to be hoped, expect that but a very short period will be permitted to elapse before the subject will be duly considered and discussed, with a view to some effective legislation.

The adulterations practised differ in kind as well as in degree. One form of adulteration consists in the addition of substances usually of greatly inferior value, for the sake of bulk and weight, the choice being determined by the cheapness of the substitute, and its fitness for the peculiar adulteration required. This is the principal and most frequent description of adulteration practised.

Another form of adulteration consists in the addition of colouring matters of various kinds, with a view to heighten the colour, and, as it is considered, to improve the appearance of the articles, as well as to conceal other forms of adulteration. This is a very prevalent adulteration, and it is the most objectionable and reprehensible of all, because substances are frequently employed, for the purpose of imparting colour, possessing highly deleterious and even in some cases poisonous properties, as various preparations of lead, copper, mercury, and arsenic. Of the use of these substances many instances are recorded in the pages of this work.

A third description of adulteration consists in the admixture of substances for the purpose of imparting smell, flavour, pungency, and other properties.

We will now enumerate the principal substances proved by actual observation and analysis to be employed for each of the three purposes above mentioned, viz., to add weight and bulk, to impart colour, and for the sake of smell, pungency, &c.

The substances employed for the purpose of adding *weight and bulk* to the different articles, Reports upon which are given in this work, are as follow:—In the case of

Arrow-root - -	Sago, Potato, and Tapioca Starches, and various mixtures and combinations of these with the inferior Arrow-roots.
Anchovies - -	Dutch, French, and Sicilian fish.
Bread - - -	Mashed Potatoes, Water.
Butter - - -	Water.
Cinnamon - - -	Cassia, and most of the articles mentioned under Spices.
Coffee - - -	Chicory, roasted Wheat, Rye and Potato Flours, Burnt Beans, Acorns, Mangel-wurzel.
Chicory - - -	Roasted Wheat and Rye Flours, Burnt Beans, Acorns, Mangel-wurzel, Carrot, Sawdust, Mahogany Sawdust, Burnt Sugar.
Cocoa and Chocolate	Maranta, East India, Tacca or Tahiti Arrow-roots; Tous les Mois; the Flours of Wheat, Indian Corn, Sago, Potato, and Tapioca, and various Mixtures of these; Sugar; Chicory.
Coloured Confectionery.	Wheat and Potato Flours, East India Arrow-root, Hydrated Sulphate of Lime.
Cayenne - - -	Ground Rice, Mustard Husks, Deal Sawdust, Salt.
Custard and Egg Powders.	Wheat, Potato, and Rice Flour, and mixtures of these.
Curry Powder -	Potato-Flour, Ground Rice.
Ginger - - -	Wheat, Sago, and Potato Flours; Ground Rice; Mustard Husks.
Gin - - - -	Water, Sugar.
Isinglass - - -	Gelatine.
Lard - - -	Potato Flour, Water.
Milk - - -	Water.
Mustard - - -	Wheat Flour, Turmeric.
Marmalade - -	Pulp of Apples or Turnip.
Oatmeal - - -	Barley Flour, and the Integuments of Barley, called Rubble.
Porter and Stout -	Water.
Pepper - - -	Wheat and Pea Flours, Ground Rice, Ground Mustard Seeds, Linseed Meal, P. D. or Pepper Dust.
Spices - - -	Wheat, Sago, and Potato Flours; East India Arrow-root; Ground Rice; Mustard Husks; two Vegetable Substances, one like Linseed Meal, Powdered Clove Stalks.
Sugar - - -	Potato Flour, Tapioca Starch.
Tea - - - -	Exhausted Tea Leaves; Leaves other than those of Tea, foreign and native; amongst the latter those of Sycamore, Horse Chesnut, and Plum; Lie Tea; Paddy Husk.
Tobacco - - -	Water, Sugar, Treacle, and Salts.
Vinegar - - -	Water.

The principal articles used with the view of imparting *colour* and for concealing other adulterations are, in the case of

Anchovies - -	Bole Armenian, Venetian red.
Bottled Fruits and Vegetables.	Certain Salts of Copper, usually the Acetate.
Coffee - - -	Burnt Sugar or Black Jack.
Chicory - - -	Ferruginous Earths, as Venetian Red and Reddle, and Burnt Sugar or Black Jack.
Cocoa - - -	Venetian Red, Red Ochre, and other ferruginous earths.
Custard Powders -	Chromate of Lead or Chrome Yellow, Turmeric.
Cayenne - - -	Venetian Red, Oxide of Lead or Red Lead, Bisulphuret of Mercury or Vermilion, Turmeric.
Curry Powder - -	Red Lead, Venetian Red.

Coloured Confectionery.	Cochineal, Lake, Red Lead, Vermilion, Indian Red; Gamboge, Lemon, Orange and Deep Chrome Yellows; Indigo, Ferrocyanide of Iron or Prussian Blue, Antwerp Blue, Artificial Ultramarine; Carbonate of Copper or Verditer, Emerald Green or Arsenite of Copper; the three Brunswick Greens, which consist of a mixture of Chrome Yellow and Prussian Blue in different proportions; Brown ferruginous Earths, as Umber, Sienna, and Vandyke Brown; Carbonate of Lead or White Lead.
Ginger - - -	Turmeric Powder.
Milk - - -	Annatto.
Mustard - - -	Turmeric Powder.
Porter and Stout -	Sugar and Treacle.
Pickles - - -	Salts of Copper, commonly the Acetate.
Potted Meats and Fish.	Bole Armenian, Venetian Red.
Preserves - -	Salts of Copper, including the Acetate.
Sauces - - -	Red Ferruginous Earths, as Bole Armenian, Venetian Red; Treacle.
Snuff - - -	Chromate and Bichromate of Potash, Chrome Yellow, Red Lead, Umber, Red and Yellow Ochre.
Tea - - - -	Indigo, Prussian Blue, Turmeric, Chinese Yellow, Black Lead, China Clay or Kaolin, Soapstone or French Chalk.
Tobacco - - -	Sugar, Treacle.
Vinegar - - -	Burnt Sugar.

The chief substances employed for the third purpose, viz., to impart *smell, flavour, pungency,* and *other properties,* are, in the case of

Bread - - -	Alum, Hards, and Stuff.
Butter - - -	Salt.
Flour - - -	Alum.
Ginger - - -	Cayenne Pepper.
Gin - - - -	Cayenne Pepper, Cassia or Cinnamon, Gin Flavourings of different kinds.
Lard - - -	Carbonate of Soda, Caustic Lime, Salt.
Porter - - -	Salt.
Snuff - - -	The Chromates of Potash, Carbonate of Ammonia, Lime, Silica or Powdered Glass, Salt, Orris-root.
Tea - - - -	Catechu, Gum, Sulphate of Iron, Le Veno Beno, Chinese Botanical Powder.
Tobacco - - -	Sugar, Treacle.
Vinegar - - -	Sulphuric Acid.

The above lists include, without exception, those substances only which actual and original analyses, as recorded in this work, have shown on the clearest evidence to be really employed. This list would have been trebled, had all those articles been enumerated which, according to the authority of other observers, either have been or are employed for the purpose of adulteration. It was thought advisable, however, not to include these, because, in most cases, the authors of the works in question do not speak from their own observation or investigations, but have handed down and adopted various statements made on the authority of previous writers. In this way much error has crept into the subject, and thus it has happened that works treating of Adulteration abound in statements respecting the substances employed which are not verified on personal research. It should be remembered, also, that the above lists refer only to those articles of food and drink of which Reports are given in this work, and do not include any of the various preparations employed in Medicine: had these been added, the lists would have been much extended. The many important facts connected with the adulteration of Drugs and Pharmaceutical

Preparations are reserved for another occasion. Further, there is no doubt but that more extended observation and investigation will show that many other substances, in addition to those contained in these lists, are sometimes employed.

The whole of the adulterations, to whichever of the three classes they belong, discovered by ourselves in the course of our investigations, are exhibited in the following table: —

Classified List of the various Substances ascertained by Ourselves to be employed for the different Purposes of Adulteration: viz. for Bulk and Weight, for Colour, and for Smell, Taste, and other Properties.

	For Bulk and Weight.	For Colour.	For Taste, Smell, and other Properties.
Arrow-Root -	Sago, Potato, and Tapioca Starches, and various mixtures and combinations of these with the inferior arrow-roots.		
Anchovies - -	Dutch, French, and Sicilian Fish.	Bole Armenian, Venetian Red.	
Bread - - -	Mashed Potatoes - -	- - - - -	Alum, Hards and Stuff.
Butter - - -	Water.		
Bottled Fruits and Vegetables.	- - - - -	Certain Salts of Copper, usually the Acetate.	Salt.
Cinnamon - -	Cassia, and most of the articles mentioned under Spices.		
Coloured Confectionery.	East India Arrow-root, Wheat and Potato Flour, Hydrated Sulphate of Lime.	Cochineal, Lake, Indigo, Prussian Blue, Antwerp Blue, Artificial Ultramarine, Carbonate of Copper or Verditer, Carbonate of Lead or White Lead, Red Lead, Vermilion; Chrome Yellow or Chromates of Lead, Lemon, Orange, and deep; Gamboge; the three Brunswick Greens, Emerald Green or Arsenite of Copper, Indian Red; brown ferruginous earths, chiefly Umber, Sienna, and Vandyke Brown, and various combinations of the above pigments.	
Coffee - - -	Chicory, Roasted Wheat, Rye and Potato Flours, Roasted Beans, Mangel-wurzel, Acorns.	Burnt Sugar, or Black Jack.	
Chicory - -	Roasted Wheat and Rye Flours, Burnt Beans and Acorns, Burnt Sugar, Sawdust, Mahogany Sawdust, Carrot, Mangel-wurzel.	Ferruginous earths, as Venetian Red and Umber, Burnt Sugar and Black Jack.	
Cocoa and Chocolate.	Maranta, East India, and Tacca or Tahiti Arrow-roots; Tous les Mois; the Flours of Wheat, Indian Corn, Sago, Potato, and Tapioca, and various Mixtures of these; Sugar, Chicory.	Venetian Red, Red Ochre, and other ferruginous earths.	
Cayenne Pepper -	Ground Rice, Mustard Husk, Deal Sawdust, Salt.	Red Lead, Vermilion or Bisulphuret of Mercury, Venetian Red, Turmeric.	
Custard and Egg Powders	Wheat, Potato, and Rice Flours	Chrome Yellow or Chromate of Lead, Turmeric.	
Curry Powder -	Ground Rice, Potato-farina, Salt.	Red Lead - - -	Salt.
Flour - - -	- - - - - -	- - - - - -	Alum.
Ginger - - -	Wheat, Sago, and Potato Flours, Ground Rice, Mustard Husks.	Turmeric Powder.	
Gin - - -	Water, Sugar - - -	- - - - - -	Cayenne, Cassia or Cinnamon, Sugar, and flavouring of different kinds. For fining, Alum, Salt of Tartar.

	For Bulk and Weight.	For Colour.	For Taste, Smell, and other Properties.
ISINGLASS - -	Gelatine.		
LARD - - -	Potato-flour, Water - -	- - - - - -	Salt, Carbonate of Soda, Caustic Lime.
MUSTARD - -	Wheat-flour, Turmeric -	Turmeric.	
MILK - - -	Water - - - - -	Annatto.	
MARMALADE - -	Pulp of Apple or Turnip.		
OATMEAL - -	Barley-flour, and the integuments of Barley called Rubble.		
PORTER AND STOUT	Water - - - - -	Sugar, Treacle - -	Sugar, Treacle, Salt.
PICKLES - - -	- - - - - -	Salts of Copper, usually the Acetate of Copper.	
POTTED MEATS AND FISH.	Flour, probably Wheat-flour boiled.	Bole Armenian, and sometimes Venetian Red.	
PRESERVES - -	Salts of Copper, including the Acetate.		
PEPPER - - -	Wheat and Pea Flour, Ground Rice, Ground Mustard Seeds, Linseed Meal, P. D., or Pepper Dust.		
SNUFF - - -	- - - - -	The Chromates of Potash, Chromate of Lead, ferruginous earths, chiefly Umbers, Red and Yellow Ochre, Red Lead, or Oxide of Lead.	The Chromates of Potash, Carbonate of Ammonia, Lime, Powdered Glass or Silex, Powdered Orris-root.
SUGAR - - -	Wheat-flour in two cases only, Potato-flour, and Tapioca-starch.		
SPICES:			
CLOVES - -	Powdered Clove-stalks in one case.		
CINNAMON - -	Cassia, Wheat-flour, Sago-meal, and mixtures of these; East India Arrow-root, Potato-flour.		
PIMENTO - -	Mustard Husk in one instance.		
MIXED SPICE -	Wheat, Sago, and Potato Flours, Ground Rice, Two Vegetable Substances, one of which resembled Linseed.		
SAUCES, as the Essences of Anchovies, Lobsters, and Shrimps, and Tomato Sauce.	- - - - -	Red ferruginous earths, as Bole Armenian and Venetian Red.	
TEA - - -	Exhausted Tea Leaves; Leaves, other than those of Tea, British and Foreign, as, amongst the former, those of Sycamore, Horse-chesnut, and Plum; Lie Tea, Paddy Husk, Sand, Starch.	Plumbago or Black Lead, Gum, Indigo, Prussian Blue, Turmeric, Chinese Yellow, China Clay, Soapstone or French Chalk.	Sulphate of Iron, Catechu, Gum, Le Veno Beno, Chinese Botanical Powder.
TOBACCO - -	Water, Sugar, Treacle, and Salts	Sugar, Treacle - -	Oil.
VINEGAR - -	Water - - - -	Burnt Sugar - -	Sulphuric Acid.

This Table, as already remarked, does not embrace nearly all the substances employed in the adulteration of the solids and fluids consumed as articles of food. It contains only those which have actually been discovered by ourselves in the several articles subjected to analysis. As soon, therefore, as the remaining Reports have been published, as those on Rum, Brandy, Spirits of Wine, Wine British and Foreign, Cheese, Honey, and Liquorice, this list will doubtless have to be much extended.

With the above Table three other lists may be given — the first, of articles ascertained to be used by others; the second, of articles stated to be employed by different writers, but of the use of which no positive proof is given, although it is highly probable that most of them either have been or are occasionally employed; and the third list, of articles the use of which appears to be but little probable, although stated to be sometimes had recourse to for the purpose of adulteration.

List of Articles ascertained by Others to be used for the Purpose of Adulteration.

	For Bulk and Weight.	For Colour.	For Taste, Smell, and other Properties.
Bread - - -	Sulphate of Copper.		
Coloured Sugar Confectionery.	Sap-green.		
Flour - - -	Mineral White or Hydrated Sulphate of Lime.		
Gin - - -	- - - - -	- - - -	Grains of Paradise, Sulphuric Acid, Various Gin Flavourings, containing Coriander Seeds, Angelica Root, Calamus Root, Almond Cake, Orris Root, Cardamom Seeds, Orange Peel, Grey and White Salts.
Lard - - -	Mutton Suet - - -	Alum, Potash.	
Milk and Cream -	Flour or Starch, Treacle.		
Porter and Ale -	- - - - -	- - - -	Cocculus Indicus, Grains of Paradise, Capsicum, Ginger, Quassia, Wormwood, Calamus Root, Caraway and Coriander Seeds, Ginger, Orange Powder, Liquorice, Honey, Sulphate of Iron, Sulphuric Acid, Cream of Tartar, Alum, Carbonate of Potash, Oyster Shells, Hartshorn Shavings, Fabia amara or Nux Vomica, Beans.
Snuff - - -	Quassia, Gentian and Colombo Root, Peat, Moss, Earthy Matter, Rhubarb Leaves, Leaves of Trees, Fustic Wood.		
Tea - - -	The Leaves of Beech, Plane, Bastard Plane, Elm, Poplar, Willow, Fancy Oak, Hawthorn, Sloe.	Rose Pink, Dutch Pink, Vegetable Red and Yellow Dyes. Chrome Yellow, Venetian Red, Carbonate of Copper, Arsenite of Copper, Chromate and Bichromate of Potash, Carbonates of Lime and Magnesia.	
Tobacco - -	Rhubarb, Potato, Coltsfoot, Dock, and other British Leaves, Sawdust, Malt Comings, Earthy Matter, Sand.	- - - -	Nitrate of Soda.

List of Articles stated by Others to be employed for the different Purposes of Adulteration, but of the Use of which no Positive Evidence has been adduced, although it is extremely probable that many of them have been, or are occasionally, had recourse to.

	For Bulk and Weight.	For Colour.	For Taste, Smell, and other Properties.
Arrow-root - -	Ground rice.		
Anchovies - -	Sprats.		
Bread - - -	Barley, Oat, Rye, Indian Corn, Bean and Pea Flours, Potato-starch, Pipe Clay, Plaster of Paris, Bonedust.		
Coloured Confectionery.	White Potter's Clay, Pipe Clay, or Cornish Clay, Chalk, Plaster of Paris, Sand.	Cobalt, Smalt, Ultramarine.	
Coffee - - -	Roasted Peas, Coffee Grounds, Parsnip.	Madder Root.	
Chicory - - -	Torrefied Ground Rice, Roasted Biscuit, Oak Bark Tan, Exhausted Tan, called Croats.	Baked Horse's Liver, Burnt Blood, Litmus, Naples Yellow.	
Cocoa and Chocolate.	Cocoa Shells, Old Sea Biscuits, Coarse branny Flour, Animal Fats, as Tallow, Lard, Treacle, Sulphate of Lime, Chalk.	Red Lead, Vermilion, Red and Yellow Ochre.	

	For Bulk and Weight.	For Colour.	For Taste, Smell, and other Properties.
FLOUR - - -	Rye, Indian Corn, Rice, Bean and Pea Flours, Potato-starch, Chalk, Bone Earth, Plaster of Paris, Powdered Flints.		
GIN - - -	- - - - - -	- - - -	Acetate of Lead.
LITMUS - - -	- - - - - -	- - - -	Common Arsenic and Peroxide of Mercury.
MUSTARD - -	Pea-flour, Linseed-meal, Radish Seeds.		
MILK - - -	Sheep's Brains, Chalk.		
PEPPER - - -	Ground Oil Cake, Clay.		
RASPBERRY JELLY -	Currant Jelly - - -	- - - -	Orris-root.
SUGAR - - -	Sand, Plaster of Paris.		
SAUCES - - -	Chalk, Plaster of Paris -	Red Lead.	
TOBACCO - -	The leaves of Cabbage, Seaweed, Roasted Chicory-root, Bran, Oakum.	Liquorice, Beet-root Dregs, Catechu, Fuller's Earth.	Sal Ammoniac, Carbonate of Ammonia, Nitrate of Ammonia, Salt, Alkalies, as Potash and Soda, Catechu or Terra Japonica, Opium.
VINEGAR -	- - - - - -	- - - -	Acetic, Pyroligneous, Hydrochloric, Nitric, and Tartaric Acids; Cayenne, Long Pepper, Mustard Seeds, Salt.

LIST OF ARTICLES STATED TO BE USED, BUT NOT LIKELY TO BE EMPLOYED, FOR THE PURPOSE OF ADULTERATION.

	For Bulk and Weight.	For Colour.
ANCHOVIES - - -	Plaster of Paris.	
BUTTER - - -	Lard.	
COFFEE - - -	Madder-root - - - - -	Madder-root,
CHICORY - - -	Brick-dust - - - - -	Brick-dust.
CAYENNE - - -	Brick-dust - - - - -	Brick-dust.
GIN - - - -	Oil of Turpentine, Oil of Almonds.	
MILK - - -	Milk of Almonds, Gum, Gum Tragacanth.	
PORTER AND ALE - -	Opium.	
VINEGAR - - -	Oxalic Acid.	

The following enumeration of the conclusions arrived at in the cases of the different articles of consumption submitted to analysis are given in order to convey some idea of the character and extent of the work, and to enable the reader, with the least possible trouble and loss of time, to become acquainted with the principal facts and conclusions contained in the body of the work.

COFFEE, AND ITS ADULTERATIONS.

The conclusions resulting from the Microscopical Examination of the first series of samples of Ground Coffee subjected to analysis were as follows: —

1st. That the *Thirty-four* coffees, *with three exceptions, were adulterated.*
2nd. That *chicory* was present in *Thirty-one* instances.
3rd. *Roasted corn* in *Twelve.*
4th. *Beans and potato-flour* each in *One* case.
5th. That in *Sixteen* cases the adulteration consisted of *chicory* only.
6th. That in the remaining *Fifteen* samples the adulteration consisted of *chicory,* and either *roasted corn, beans,* or *potato-flour.*
7th. That in many instances the quantity of coffee present was very small, and in others, not less than one fifth, fourth, third, half, and so on, of the whole article.

From a second series of samples examined at the same time the conclusions were,

1st. That *Eighteen out of the Twenty-samples were adulterated with chicory.*
2nd. That *Four of the samples contained roasted corn in addition to chicory.*

Second Report on Coffee.

The conclusions resulting from this series of examinations were, —

1st. That out of the *Forty-two* samples of coffee submitted to analysis *Eleven were unadulterated.*
2nd. That *the remaining Thirty-one samples were all adulterated with chicory,* which was met with in every proportion, in many cases constituting the chief part of the article.
3rd. That in *Two cases only was any other adulteration than that with chicory observed,* one consisting of a *vegetable substance* resembling *horsechesnut,* and the other of some *amorphous substance,* probably used for colouring.

Third Report on Coffee.

ON CANISTER COFFEE.

The conclusions arrived at, were, —

1st. That the whole of the *Twenty-nine* packages, bottles, and canisters of Coffee, submitted to analysis, with *a single exception, were adulterated.*
2nd. That in *Twenty-eight* of the samples, the adulteration consisted of *chicory;* this root, in many instances, constituting the *chief part* of the article.
3rd. That *Five* of the coffees contained *roasted wheat-farina,* and substances bearing a close resemblance to *mangel-wurzel* and *acorn.*

Fourth Report on Coffee.

The conclusions deduced from the examination of another series of analyses of samples of Coffee, made at a later period, were, —

1st. That out of the *Twenty samples* of *coffee* submitted to examination, *Nineteen* were adulterated with *chicory.*
2nd. That several of the samples, on incineration, left a coloured residue, from the *presence of red oxide of iron,* derived from some red ferruginous earth, as Venetian Red, employed in the adulteration of the Chicory contained in the Coffee.

Fifth Report on Coffee.

The conclusions deduced from the examination of the Thirty-four samples of Coffee purchased shortly after the recent regulation authorising the sale of mixed chicory and coffee in labelled packages were, —

1st. That out of the *Thirty-four* samples, ALL PURCHASED AS COFFEE, only *Three* were genuine, while no less than *Thirty-one* contained various proportions of *chicory.*
2nd. That in *Six* of the samples *chicory* was present in the proportion of about *one-third* of the article.
3rd. That in *Twenty-two* of the samples *chicory* formed about *one-half* of the article.
4th. That *Three* of the samples consisted almost entirely of *chicory.*
5th. That *Thirteen* of the samples were not labelled "Mixture of Chicory and Coffee," and yet *Ten* of these were adulterated with *chicory.*
6th. That the remaining *Twenty-one* samples, notwithstanding that COFFEE WAS DISTINCTLY ASKED FOR in each instance, were labelled "Mixture of Chicory and Coffee."

Sixth Report on Coffee.

The results obtained by the examination of Thirty-four samples of ground Coffee purchased a few days subsequently at the same establishments from which the previous thirty-four samples were procured, were as follows: —

1st. That of the *Thirty-four* samples, ALL PURCHASED AS COFFEE, *Nine* were genuine, while no less than *Twenty-five* contained various proportions of *chicory.*

2nd. That in *Eight* of the samples *chicory* was present in the proportion of about *one-third* of the article.

3rd. That in *Fourteen* of the samples *chicory* formed about *one-half* of the article.

4th. That *Three* of the samples consisted almost entirely of *chicory.*

5th. That *Two* of the samples were not labelled "Mixture of Chicory and Coffee," and yet were adulterated with *chicory*, the parties—the adulteration being brought home to them—being liable in each case to a fine of one hundred pounds.

6th. That of the *Twenty-five* samples containing chicory, notwithstanding that COFFEE WAS DISTINCTLY ASKED FOR in each case, *Twenty-three* were labelled "Mixture of Chicory and Coffee."

Contrasting these two Tables of Analyses, it appears, therefore, as consequences of our previous Report, that greater caution is now observed in the sale of mixed chicory and coffee without a label, an offence punishable by a fine of one hundred pounds; also, that a larger proportion of dealers sell the genuine article when asked for it; but that the "mixture" is still palmed off as extensively as ever upon the public as coffee.

The results of the examination of the *Ten* additional samples purchased as coffee, given in the present Report, were as follow: —

Two were sold as coffee, being labelled "Mixture of Chicory and Coffee;"
One was sold as a "Mixture of Chicory and Coffee," which it really was; and —
Seven were *genuine.*

SUGAR, AND ITS ADULTERATIONS.

From the examination of Thirty-six samples of Brown Sugar the conclusions arrived at were, —

1st. That fragments of *cane*, frequently so minute as to be visible only with the microscope, *were detected in all the sugars except one*, that being a very white sugar, and evidently purified by filtration, so as to cause it to approach in character refined or lump-sugar.

2nd. That *the disgusting insects, acari, were present* in *Thirty-five out of the thirty-six sugars*, and in *Nineteen* cases in very considerable numbers.

3rd. That *sporules* and *filaments* of fungi were present in at least *Ten* cases.

4th. That *grape-sugar was detected in the whole Thirty-six sugars*, often in very considerable amount.

5th. That *the whole of the sugars contained a variable proportion* of *vegetable albumen.*

6th. That a greater or less number of *pieces of woody fibre were noticed in nearly all the sugars.*

7th. That *stony particles or grit were observed in at least Eleven instances.*

8th. That a variable quantity of *starch* or *flour was contained in each sample of sugar*, either in the form of free granules, or aggregations of granules and cells.

9th. That in *Four* of the sugars the amount of *flour was so considerable, that it had evidently been employed for the purpose of adulteration.*

The results obtained from the examination of Fifteen samples of Lump Sugar, were,—

1st. That *in none of the sugars were fragments of cane present;* these having been separated by the filtration through charcoal to which sugar in process of refinement is subjected.

2nd. That in *no case were acari observed.*

3rd. That in *Three* of the sugars only were *traces of grape-sugar* to be detected.

4th. That *in none of the sugars were sporules of fungi to be seen.*

5th. That a *variable although a very small quantity of flour was present in the whole Fifteen sugars.*

6th. That *animal matter was observed in Ten cases.*

7th. That *sawdust-like fragments of woody-fibre were present in Twelve cases,* being very abundant in at least *Seven* of the sugars.

Second Report.

From the examination of a second series of Brown Sugars, purchased more recently at different shops, the conclusions were,—

1st. That the *sugar insect,* or *acarus, was present in the whole of the sugars,* the majority of the samples containing them in great numbers.

2nd. That *sporules of fungi were likewise present in all the sugars.*

3rd. That *Two* out of the *Thirty-six* sugars *were adulterated with flour,* one with *tapioca,* and the other with *potato-flour.*

Arrow-root, and its Adulterations.

The conclusions were,—

1st. That out of the *Fifty* samples of Arrow-root submitted to analysis *Twenty-two were adulterated.*

2nd. That in *Sixteen* cases the adulteration consisted in the addition of a single article, much cheaper in price, and very inferior in quality, to genuine arrow-root; this in *Ten* instances being *potato-flour;* in *Five, sago-meal;* and in *One* case *tapioca-starch.*

3rd. That in *Five* cases it consisted in the employment of two different articles, *potato-flour* and *sago-meal.*

4th. That in *Two* instances *Three* different starches were employed in the adulteration, viz., *potato-flour, sago-meal,* and *tapioca-starch* or *fecula.*

5th. That *Ten* of the arrow-roots contained scarcely a particle of genuine Maranta or West India arrow-root, for which they were sold. *One* consisted entirely of *sago-meal; Two* of *potato-flour* and *sago-meal; Two* of *potato-flour, sago-meal,* and *tapioca starch; One* of *tapioca-starch;* and *Four were composed entirely of potato arrow-root or starch.*

Second Report.

From the examination of a second series of samples of Arrow-root, the conclusions were,—

1st. That no less than *Eighteen,* or one-half the samples, *were either adulterated,* or else some *inferior starch, as potato-flour,* was substituted for the genuine arrow-root.

2nd. That *Five* of the samples consisted almost entirely of *potato-starch.*

3rd. That the remaining *Thirteen* samples consisted of mixtures in various proportions of *potato-starch* and *sago-powder,* (these in some cases forming the chief part of the article,) with occasionally other starches, as *tapioca, canna,* and *curcuma starches.*

Pepper, and its Adulterations.

From the examination of Forty-three samples of black and white pepper the conclusions were,—

1st. That *more than half of the peppers purchased previous to the recent convictions were adulterated.*

2nd. That *a much less, although still a considerable proportion of the samples procured subsequent to those convictions were likewise adulterated.*

3rd. That the adulteration practised consisted in the addition of *wheat-flour* in *Four cases,* of *pea-flour* in *One, ground rice* in *Two,* of *powdered mustard-seeds* in *Four,* of *linseed-meal* in *Three,* and of *P. D.* or *pepper-dust,* in *Two* instances.

Mustard, and its Adulterations.

The conclusions resulting from the examination of the various samples of this article were, —

1st. That *genuine mustard,* whatever be the price paid for it, *is scarcely ever to be obtained.*

2nd. That *the whole of the Forty-two samples* submitted to examination *were adulterated.*

3rd. That *the adulteration* practised, *in every case, was the same in kind, varying only in degree, and consisted in the admixture of genuine mustard with immense quantities of wheaten flour, highly coloured with turmeric.*

4th. That the practice of making inferior qualities of mustard, such as "seconds" and "fine" mustard, is open to much objection, since it gives the unscrupulous grocer the greatest scope for imposition.

Chicory, and its Adulterations.

The conclusions deduced from the examination of Thirty-four samples of Chicory were, —

1st. That *Fourteen were adulterated.*

2nd. That in *Nine* the adulteration consisted of *roasted corn.*

3rd. That *scorched beans* were present in *Four* of the samples.

4th. That in *One* case *ground acorn* was detected.

Second Report on Chicory.

From the examination of a second series of samples of Chicory, Twenty-three in number, the conclusions were, —

1st. That *Eleven* or *one-half* of the samples *were adulterated.*

2nd. That *Four* were adulterated with *roasted wheat.*

3rd. That *ground acorns* were present in *an equal number* of cases.

4th. That *Two* of the samples contained *sawdust,* and *One mahogany sawdust.*

5th. That *mangel-wurzel* was detected in *One* of the chicories.

6th. That in *One* instance *roasted carrot* was present.

Third Report on Chicory.

The results of the microscopical examination of samples of Chicory both as purchased and as obtained from manufacturers were, —

1st. That out of the *Eighteen* samples of chicory procured from manufactories, *Five* were adulterated with *roasted wheat-flour.*

2nd. That *several* of the samples yielded *a coloured ash.*

3rd. That out of the *Sixteen* samples of chicory purchased at the establishments of different grocers in the metropolis, *One* only was adulterated with *roasted farina.*

4th. That the *ashes* of several of the samples were *highly coloured,* indicating the presence of some red ferruginous earth, as *reddle and Venetian red.*

Bread, and its Adulterations.

The conclusions were, —

1st. That the whole of the *Twenty-four* samples of Bread examined *were adulterated with alum.*

2nd. That in *no one of the samples was potato, or any other farinaceous matter other than wheat-flour, detected; nor did any of the breads contain either carbonate or sulphate of lime.*

Second Report on Bread.

From the analyses of a second series of Bread made more recently, the conclusions were, —

1st. That the whole of the *Twenty-five* samples examined, including three sold by the *League Bread Company,* contained *alum.*

2nd. That in *none* of the samples was *potato* detected.

Flour, and its Adulterations.

From the examination of eight samples of Flour the important fact was ascertained, —

That four of the flours used by the bakers in whose bread alum had been detected, and who had questioned the accuracy of the analyses, also *contained alum.*

Cocoa, and its Adulterations.

The conclusions arrived at from the analysis of samples of Cocoa were: —

1st. That *Eight* of the Fifty-six samples were *genuine.*

2nd. That *sugar* was present in *Forty-three* samples, the amount forming from 5 to in some cases as much as nearly 50 per cent. of the article.

3rd. That *starch* was detected in *Forty-six* of the samples, the quantity present varying from 5 to nearly 50 per cent., and consisting either of *wheat, potato-flour, sago-meal,* &c., or mixtures of these in various proportions.

Second Report on Cocoa.

The conclusions to be deduced from the examination of the analyses of the above Fifty-six different samples of Cocoa were as follows: —

1st. That out of the *Ten* samples of *flaked cocoa* which were incinerated *Six* contained *earthy colouring matter.*

2nd. That *One* of the two samples of *granulated cocoa* yielded *a coloured ash.*

3rd. That *Two* of the three *Bromas* contained *earthy colouring matter.*

4th. That out of fourteen samples of *soluble cocoa, earthy colouring matter* was discovered in *Thirteen.*

5th. That *Five* of the fourteen *homœopathic cocoas* contained *coloured earth.*

6th. That the two *roll cocoas* were free from earthy colouring matter.

7th. That earthy colouring matter was present in *Seven* of the nine samples of *rock cocoa* examined.

8th. That the *ash* in *One* of the two *cocoa pastes* incinerated was *coloured.*

9th. That of the twelve samples of *chocolate* in *powder* and in *cake* examined, *earthy colouring matter* was present in *Four.*

10th. That out of sixty-eight samples of cocoa and chocolate submitted to examination, *Twenty-nine* were free from admixture with earthy colouring matter, while the remaining *Thirty-nine* samples all contained *coloured earthy substances,* in greater or less amount.

It appears further, —

That the preparations contained in the packages labelled with the names of

Handford & Davies, Strickland, Henry Sparrow, W. Headland, Nicol & Co., J. Epps, J. Relfe, Gatti & Bolla, Capper & Gray, and Peek Brothers & Co., *were entirely free from earthy colouring matter.*

That the packages bearing the names of J. Leath, Hawthorne & Co., and Cadbury Brothers, *contained earthy colouring matter.*

That of the samples of three different preparations of cocoa, labelled with the names of Graham & Hedley, *coloured earthy matter was found in One.*

That *both* of the samples bearing the names of Tyler & Essex *contained coloured earthy matter.*

That *earthy colouring matter* was present *in the Three packages* labelled J. W. Stratton & Co.

That the *Two* preparations of cocoa to which the name of Baron Dupuytren was affixed, *were largely adulterated with red earthy matter.*

That the *Two* samples labelled Steane, Davis, & Co., *furnished coloured ashes.*

That of the *Three* packages to which the names of Barry & Co. were affixed, *One* yielded a *coloured ash.*

That the ashes of *the whole* of the Seven preparations of cocoa contained in the packages to which the names of J. S. Fry & Sons were attached, *were coloured to a greater or less extent.*

That *Two* of the six preparations of cocoa, labelled Taylor Brothers, *contained earthy colouring matter.*

That the *Four* preparations purchased of the manufacturer, G. B. White, *were highly coloured.*

Lastly, that *the samples of cocoa, Four in number, manufactured by D. Dunn, and submitted to examination, were ascertained to be entirely free from any admixture with coloured earthy matter.*

Oatmeal, and its Adulterations.

The conclusions resulting from the examination of this article were, —

That *Sixteen,* or *more than one half* of the thirty samples submitted to examination, were adulterated with large proportions of *Barley Meal,* while others contained the refuse husk termed *Rubble.*

Tea, and its Adulterations.

The more important conclusions arrived at from the analyses of the different samples of black and green Tea, both as imported and as purchased of dealers in this country, were as follow: —

The chief points ascertained with regard to *Black Tea* were, —

1st. That the principal black teas — namely, the Congous and Souchongs, arrive in this country, for the most part, in a genuine state.

2nd. That certain descriptions of black tea, as Scented Orange Pekoe and Caper, are invariably adulterated, the adulteration in general consisting in the glazing of the leaves with plumbago or black lead; the Caper likewise being subject to admixture with other substances, as paddy-husk, Lie tea, and leaves other than those of tea.

3rd. That several varieties of a spurious Caper, or black Gunpowder, are prepared, which consist of tea-dust, and sometimes the dust of other leaves, and sand, made up into little masses with gum, and faced or glazed with plumbago, Prussian blue, and turmeric-powder: in some cases these imitations are sold separately, but most frequently they are used to mix with and adulterate the better qualities of Caper — viz. those which are made of tea faced with plumbago only.

With respect to *Green Tea* the principal conclusions were, —

1st. That these teas, with the exception of a few of British growth and manufacture, from Assam, are invariably adulterated — that is to say, are glazed with colouring matters of different kinds.

2nd. That the colouring matters used are in general Prussian blue, turmeric-powder, and China clay, other ingredients being sometimes but not frequently employed.

3rd. That of these colouring matters, Prussian blue, or ferro-cyanide of iron, possesses properties calculated to affect health injuriously.

4th. That in this country there is really no such thing as a green tea — that is, a tea which possesses a natural green hue.

5th. That green teas, and more especially the Gunpowders, in addition to being faced and glazed, are more subject to adulteration in other ways than black teas, as by admixture with leaves not those of tea, with paddy-husk, and particularly with Lie tea.

6th. That Lie tea is prepared so as to resemble green tea and is extensively used by the Chinese themselves to adulterate gunpowder tea; it is also sent over to this country in vast quantities, and is employed for the same purpose by our own tea-dealers and grocers.

The above are the more important conclusions as to the condition of black and green teas as imported, but these articles undergo further deterioration in our own country. Thus we have adduced evidence to show, —

1st. That exhausted tea-leaves are frequently made up with gum, &c., and re-sold to the public as genuine black tea, and, when artificially coloured and glazed, even as green tea.

2nd. That the substances employed in the colouring are in many cases very much more objectionable and injurious than those used by the Chinese, being often highly poisonous.

3rd. That it is no uncommon thing for tea, both black and green, to be fabricated from leaves not those of tea, and possessing no properties in common with the leaves of that plant.

4th. That black Lie tea is often coloured and extensively employed by our own dealers and grocers for the adulteration of green tea.

Milk, and its Adulterations.

The conclusions deduced from an examination of Twenty-six samples of Milk purchased of different milkmen and dairy-keepers resident in London were, —

1st. That *Twelve* were genuine.

2nd. That of these *Two* showed a deficiency of cream.

3rd. That *Eleven* were adulterated.

4th. That this adulteration consisted, in all cases, of *water*, the per-centages of which varied from 10 to 50 per cent., or one-half of the article.

5th. That in no case was *chalk*, *size*, *gum*, *sheep's brains*, or any of the other substances occasionally used for the adulteration of milk, detected.

Isinglass, and its Adulterations.

The conclusions were, —

1st. That out of the *twenty-eight* samples of Isinglass submitted to examination, *Ten*, or more than one-third, consisted entirely of *gelatine*.

2nd. That the price of the genuine isinglass varied from 8*d.* to 1*s.* 4*d.* per ounce; while that of the gelatine ranged between 10*d.* and 1*s.* 4*d.* per ounce.

Vinegar, and its Adulterations.

The conclusions resulting from the examination of Thirty-three samples of Vinegar purchased of grocers, oilmen, and publicans, were, —

1st. That the amount of *acetic acid*, the most important constituent of vinegar, varied greatly in different samples; the highest per-centage being 5·10, and the lowest 2·29, or less than half the first amount.

2nd. That since the standard No. 24. vinegars submitted to analysis range, for the most part, considerably over 4 per cent., vinegar to be deemed good ought to contain certainly *not less* than 4 per cent. of real acid.

3rd. Judged by this standard, out of twenty-three samples of vinegar purchased of dealers in London, *Seven* reached this strength and contained from 4 per cent. upwards of acetic acid; the per-centage of *Seven* of the vinegars ranged between 3 and 4; while in the remaining *Nine* the amount of acid varied from 2 to 3 per cent., it being in *Two instances* as low as 2·40 and 2·29.

4th. That *Twelve* samples out of the thirty-three analysed contained no free sulphuric acid, a fact affording convincing proof that the use of this acid, so objectionable in many respects, is not necessary for the preservation of well-made vinegar.

5th. That in *Eight* samples the quantity of sulphuric acid present did not exceed the amount formerly permitted to be added.

6th. That in the remaining cases the amount exceeded this, and in some instances was three or four times as great.

7th. Since the manufacturers prepare and sell vinegar of different qualities, some being very weak, and since, as is well known, they commonly add sulphuric acid, it is clear that the blame of the present unsatisfactory condition of the article lies mainly with them, although no doubt in some cases the retailer takes his part in the work of adulteration and deterioration by the addition of *sulphuric acid, burnt sugar, water, sour beer, and cider*.

Second Report on Vinegar.

The conclusions resulting from the examination of the second series of samples of the Vinegars of the principal manufacturers, twenty-eight in number, were as follows:—

1st. That *Seven* of the samples were entirely free from *sulphuric acid* or *oil of vitriol*.

2nd. That *Twenty-one* were adulterated with that powerful and corrosive mineral acid, the amount of which was variable, and often very considerable; from ·63, the lowest, to 6·02, the highest quantity, in 1000 grains.

3rd. That *Two* of the samples contained it in very small quantity only.

4th. That in *Three* samples it was present in considerable amount.

5th. That *Nine* contained it in very considerable amount.

6th. That in *Seven* samples it was present in immense quantity.

7th. That the *acetic acid* also varied very considerably in amount in different samples, the highest proportion being, in 1000 grains by measure, 56·66 grains, or 5·66 per cent., and the lowest, 27·63, or only 2·76 per cent.

8th. That in *Eight* samples, the acetic acid was present in amount over 5 per cent., which is above the standard strength.

9th. That in *Twelve* samples the quantity exceeded 4 per cent.

10th. That in *Seven* it was over 3 per cent.

11th. That in *One* the quantity of *acetic acid* present was so exceedingly small as to be *under* 3 per cent.,—that is, but little more than half the proper strength.

Pickles, and their Adulterations.

The conclusions deduced from the examination of the samples of Pickles were,—

1st. That the *vinegar* used for pickling is of *a very weak description,* the percentages of *acetic acid* ranging between 1·48 and 2·91, whilst *vinegar of good quality ought to contain from four to five per cent. of pure acetic acid.*

2nd. That *Nineteen* out of the twenty *vinegars* submitted to analysis, poor as they were, yet *owed a portion of their acidity to sulphuric acid,* the amount of which varied, in the different samples, from ·38 to 2·52 in the 1000 grains; *the largest quantity of this acid being detected in the vinegars in which the red cabbages were pickled.*

3rd. That, *in the whole of the Sixteen different pickles analysed for copper,* THAT POISONOUS METAL *was discovered in various amounts: Two of the samples contained a small quantity; Eight, rather much; One, a considerable quantity; Three, a very considerable quantity; in One, copper was present in highly deleterious, and in Two, in poisonous amounts.*

4th. That *the pickles which contained the largest quantity of copper were those which consisted entirely of green vegetables, as gerkins and beans.*

Ginger, and its Adulterations.

The conclusions were, —

1st. That out of *Twenty-one* samples of ginger submitted to examination, no less than *Fifteen,* being more than two-thirds of the whole, were found to be *adulterated.*

2nd. That the substances detected were various in character, including *sago-meal, potato-flour, wheat-flour, ground rice, Cayenne pepper, mustard-husks,* and *turmeric-powder,* — these occurring in various quantities, but in the majority of cases constituting the principal part of the article.

Cinnamon, and its Adulterations.

The conclusions deduced from the examination of Thirty-one samples of Cinnamon were, —

1st. That of the *whole* cinnamons, *Seven* were *genuine* and *Five* consisted of nothing but *cassia.*

2nd. That while the prices per ounce for the *whole* cassias varied between sixpence and one shilling, one being charged sixpence; three, eightpence; and one, a shilling; those for the cinnamon also varied between sixpence and one shilling; one being charged sixpence; three, eightpence; and three, one shilling.

3rd. That out of the *Nineteen* samples of *ground* cinnamon, *Three* consisted entirely of *cassia.*

4th. That *Ten* of the samples, or more than one-half, were *adulterated,* the articles most frequently employed being either *baked wheat-flour* or *sago-meal,* separately or in combination; but *East India arrow-root* and *potato-flour* were likewise detected, each in one instance.

5th. That of the above adulterated samples, *Three* consisted of *cassia,* adulterated; and *Seven* of *cinnamon* adulterated.

6th. That *Six* only of the *Nineteen* samples were *genuine.*

7th. That the prices given per ounce for the powdered *cassia,* substituted for cinnamon, were sixpence and eightpence, one being sixpence, and two eightpence.

8th. That the prices paid for the genuine powdered cinnamon were sixpence, eightpence, and one shilling per ounce; two being sixpence, three eightpence, and one a shilling.

9th. That the prices charged for the adulterated articles, whether cassia or cinnamon, were fourpence, sixpence, and eightpence per ounce—viz., one at fourpence, three at sixpence, and six at eightpence.

Nutmegs, and their Adulterations.

The conclusions arrived at from the examination of Eighteen samples of Nutmegs were, —

1st. That nutmegs as they reach the consumer are not in general deprived of their essential oil; a result contrary to the opinion commonly entertained on this point.
2nd. That, as met with in the English markets, they are seldom limed.

Mace, and its Adulterations.

The conclusion was, —

That the whole of the *Twelve* samples of Mace examined were genuine.

Cloves, and their Adulterations.

The conclusions deduced from the examination of Twenty-nine samples of Cloves were, —

1st. That whole cloves, as ordinarily met with, are not deprived of any portion of their essential oil.
2nd. That the whole of the powdered cloves were free from adulteration. *One* of the samples contained, however, a proportion of *ground clove-stalks.*

Pimemto, and its Adulterations.

The conclusions were, —

That of the *Twenty-one* samples of ground Allspice submitted to examination, *one only was adulterated;* a result probably mainly attributable to the great cheapness of this spice.

Mixed Spice, and its Adulterations.

The conclusions were, —

That of the *Twenty-six* samples of Mixed Spice subjected to microscopic examination, no less than *Sixteen,* or considerably more than one-half, *were adulterated;* and hence it is seen that of all the spices mixed spice is the most liable to adulteration.

Preserved Provisions.

The conclusions were, as regards the Preserved Vegetables, —

1st. That of the three vegetables examined and enclosed in tin canisters, the *carrots* were in a perfectly fresh and sound state; the *turnips* were apparently sound, but when dressed and brought to table were seen to be very much discoloured; the *green peas* were not in a satisfactory state of preservation, being altered in colour, having but little flavour, and evincing signs of incipient decomposition.
2nd. That the vegetable, *rhubarb,* contained in a bottle, and preserved according to the method devised by Mr. Sadlington, was in good condition.
3rd. That the several vegetables preserved under the process of M. Masson — viz., *cabbage, Brussels-sprouts, carrots, potatoes,* and *julienne,* were all sound and fresh, and in admirable condition in all respects.
4th. That the *potatoes* prepared under the patent of Mr. Edwards were likewise in a perfectly satisfactory state.
5th. That the *fruits* put up after the method of Mr. Sadlington were, with one exception, in a good state of preservation.

6th. That the *apples* prepared according to the patent of M. Masson, when soaked, as directed, in warm water, possessed the flavour unimpaired of the recent fruit.

With respect to the Preserved Animal Substances, the conclusions were,—

7th. That *Borden's Patent Meat Biscuit* was in a perfectly sound state, and that there is much reason to regard it as a valuable article of diet in the provisioning of ships, garrisons, &c.

8th. That the *extract of beef*, manufactured under the patent of Mr. Roberton, was free from the slightest taint, and possessed all the odour and flavour, to a remarkable extent, of beef recently roasted.

9th. That the *soups* were, with one exception, in which the article appeared to be in a state of incipient decomposition, of excellent quality, and in sound condition.

10th. That the preservation of the *milk* examined was not entirely successful.

11th. That the three canisters of *fish* were all found to be in excellent condition, the fish being as fresh as on the day they were enclosed in the cases.

12th. That the cases of *boiled and roasted beef* were in good preservation.

13th. That the samples of *pemmican* exhibited no symptoms of change or decomposition.

It appears that out of the *Thirty-four* samples of preserved provisions of all kinds submitted to examination, the condition of preservation of *Twenty-nine* was most satisfactory, the state of *Five* only out of the number being unsatisfactory, three of these being vegetables; and hence we deduce the further conclusion, that the several processes adopted for the preservation of vegetable and animal substances are, at least so far as regards home and domestic use, productive of satisfactory results. From the few cases, however, which have turned out unfavourably, it is evident that the greatest care is requisite in conducting the several steps of the different processes adopted.

Poisonous Cayenne Pepper.

The conclusions deduced were,—

1st. That out of the *Twenty-eight* samples of Cayenne Pepper subjected to analysis, *Twenty-four were adulterated.*

2nd. That out of the above number, *Four* only *were genuine.*

3rd. That out of the *Twenty-four* adulterated samples, *Twenty-two* contained *mineral colouring matters.*

4th. That red lead, often in large and poisonous quantities, was present in *Thirteen* samples.

5th. That *Venetian red, red ochre,* or some other analogous ferruginous earths, were contained in *Seven* samples.

6th. That cinnabar, vermilion, or sulphuret of mercury, was detected in *One* sample.

7th. That *Six* of the samples consisted of a mixture of *ground rice, turmeric,* and *cayenne,* coloured with either *red lead* or a *red ferruginous earth.*

8th. That *Six* samples contained large quantities of *salt,* sometimes alone, but more frequently combined with *rice* and a *red ferruginous earth* or with *red lead.*

9th. That *One* of the samples was adulterated with a large quantity of the *husk of white mustard-seed.*

10th. That *Two* contained *rice* only, coloured with *red lead* or a *ferruginous earth.*

Curry Powder.

The conclusions arrived at from the examination of Twenty-six samples of Curry Powder were,—

1st. That *Seven* only were *genuine.*

2nd. That *Nineteen,* or nearly four-fifths, were *adulterated.*

3rd. That *ground rice,* usually in very large quantities, was present in *Nine* samples.

4th. That *potato-farina* was detected in *One* sample.

5th. That *salt* was present in *Eight* of the samples.

6th. That the highly poisonous metallic oxide, RED LEAD, was detected in no less than *Eight* of the samples.

7th. That in *Seven* of the samples, the adulteration consisted of *ground rice* only.

8th. That in *One* sample the adulteration consisted of *ground rice* and *salt.*

9th. That in *One* sample the adulteration consisted of *ground rice* and RED LEAD.

10th. That in *Three* samples, the admixture consisted of *salt* only.

11th. That in *Three* samples, the adulteration consisted of *salt* and RED LEAD.

12th. That in *Three* samples, the adulteration consisted of RED LEAD only.

13th. That in *One* sample, the adulteration consisted of RED LEAD, *potato-farina,* and *salt.*

Poisonous Bottled Fruits and Vegetables.

The conclusions were,—

1st. That of the *Thirty-three* samples of Preserved Fruits and Vegetables *Seven were free from contamination with copper.*

2nd. That *Twenty-seven* samples *were more or less impregnated with that metal.*

3rd. That *traces of copper were discovered* in *Three* of the samples.

4th. That in *Seven* of the samples *copper was present in small amount only.*

5th. That *Eight* samples contained it *in considerable amount.*

6th. That in *Six* samples the metal *was present in very considerable amount.*

7th. That *Four* of the samples contained this poisonous impregnation *in very large quantities.*

8th. That the samples of *limes contained copper,* the one in *small amount* only, the other in *amount more considerable.*

9th. That *gooseberries* as commonly preserved contain *a considerable amount of copper, and some samples even a very large quantity.*

10th. That *rhubarb* usually contains an amount of copper *more considerable, some samples being contaminated with it to a very large extent.*

11th. That *greengages* in general contain *a still greater quantity of copper,* the metal being frequently present *in highly dangerous amounts.*

12th. That in *olives* this *poisonous impregnation is in the largest amount,* although its effect in heightening the colour of the fruit is less marked than in the other cases.

13th. That the preserved *red fruits,* as currants, raspberries, and cherries, are *not as a rule contaminated with copper.*

Anchovies, their Substitutions and Adulterations.

The conclusions resulting from the examination of Twenty-eight samples of Anchovies were,—

1st. That *Seven* of the samples consisted entirely of Dutch fish.

2nd. That *Two* of the samples consisted of a mixture of Dutch fish and anchovies.

3rd. That the brine in *Twenty-three* of the samples was charged with either *bole Armenian* or *Venetian red,* the quantity varying considerably in amount, but in most cases the brine was charged with these earthy powders to such an extent that they might be obtained and collected from the bottom of the bottles almost by tea-spoonfuls.

Potted Meats and Fish, and their Adulterations.

The results obtained from the examination of these articles were, —

1st. That the samples of *Potted Tongue* and *Ham* were entirely free from adulteration.

2nd. That *Four* out of the *Five* samples of *Potted Beef* were artificially coloured by means of the red earth, *bole Armenian.*

3rd. That the *whole* of the samples of *Potted Bloaters* examined were highly coloured with the before-named earthy substance.

4th. That *One* of the samples of *Bloater Paste* was adulterated in addition with a large proportion of *starch* or *flour,* probably wheat-flour boiled.

5th. That the *entire* of the samples of *Anchovy Paste* analysed were still more highly, and even vividly, coloured with very large quantities of *bole Armenian.*

6th. That *Two* of the *Anchovy Pastes* were in addition adulterated with *flour;* one with a large per-centage of *wheat-flour.*

7th. That of the *Twenty-eight* samples of *Potted Meats* and *Fish* subjected to analysis, no less than *Twenty-three* were more or less impregnated with the red earthy material, *bole Armenian.*

Sauces, and their Adulterations.

From the examination of Thirty-three samples of Sauces the conclusions were, —

1st. That *treacle* and much *salt* formed the bases of the *Five* samples of India Soy examined, if they did not even entirely consist of these two ingredients.

2nd. That in Lazenby's Harvey's Fish Sauce much *oxalate of lime,* and numerous minute chips of *charred deal,* were detected, the presence of these last affording some countenance to the inference that they had been used for the purpose of imparting colour to the sauce.

3rd. That of the *Seven* samples of Tomato Sauce analysed, *Six* were artificially coloured, *One* probably with *cochineal,* and the rest by the addition of considerable quantities of the ferruginous pigment *bole Armenian.*

4th. That the samples of Essence of Lobsters examined were almost saturated with very large quantities of *bole Armenian.*

5th. That the samples of Essence of Shrimps were saturated to an equal extent with *bole Armenian.*

6th. That the *whole* of the samples of Essence of Anchovies analysed were adulterated with immense quantities of the ferruginous oxide *bole Armenian.*

7th. That *Three* of the samples of *Essence of Anchovy* contained but a small quantity of *muscular fibre.*

8th. That *Two* of the samples contained a proportion of *flour* — one being a sample of essence of shrimps, and the other of essence of lobster.

9th. That out of the *Eighteen* red sauces submitted to examination, no less than *Sixteen* contained *bole Armenian,* and this usually in immense quantities, far exceeding what was detected in any of the potted meats and fish.

10th. That lead, for which separate analyses were made in each case, *was not detected in a single instance.*

11th. That *traces only of* copper *were discovered in some Three or Four samples.*

Preserves and Jams.

The conclusions obtained from the examination of the different kinds of Preserves and Jams were,—

1st. That the *Raspberry Jam* analysed contained a very considerable quantity of COPPER.
2nd. That the *Four* samples of *Gooseberry Jam* examined all contained COPPER.
3rd. That copper, sometimes in large amount, was detected in *Twelve* of the *Fourteen* samples of *Orange Marmalade* analysed.
4th. That *Three* of the *Marmalades* were adulterated with large quantities of *a vegetable substance,* most probably either *turnip* or *apple.*
5th. That the *Nine* samples of *Greengage Jam* were all more or less impregnated with COPPER, it being present in considerable amount in *Five* of the samples.
6th. That the *Greengages* contained in *Three* different boxes of *Crystallised Fruits* all owed their deep green colour to the presence of COPPER.
7th. That the *Limes* and *Greengages* present in a little glass jar of fruit preserved in jelly, also owed their brilliant colour to a salt of COPPER.
8th. That COPPER was present in the three samples of *Candied Citron Peel* subjected to analysis.
9th. That COPPER was detected in no less than *Thirty-three* of the *Thirty-five* samples of different preserves analysed: *Three* contained *traces* only; in *Eleven* the metal was present *in small quantity;* and in *Nineteen* either in *considerable,* or even *very large amount.*

Lard, and its Adulterations.

The conclusions in this case were,—

1st. That Lard is not unfrequently *extensively adulterated,* the ingredients employed being *water* and *potato-flour,* as well as certain saline substances, as *salt, potash-alum, carbonates of potash* and *soda,* and *caustic lime,* these being intended either to cause the lard to hold water, or to improve its consistence and colour.
2nd. That the description of lard most liable to adulteration is *keg-lard,* and, of this, particularly that which is manufactured in England, Irish keg-lard being but rarely adulterated.
3rd. That of upwards of *one hundred* samples of lard submitted to examination, and procured chiefly from retail dealers, *seven* only were found to be adulterated.

Butter, and its Adulterations.

It appeared from the examination of the various samples of Butter,—

1st. That all the *salt butters* examined contained variable and usually very large quantities of *water,* the amount ranging, with one exception, from 8·48 to 28·60.
2nd. That the *fresh butters* likewise contained variable and often considerable quantities of *water,* but in most cases very much less than in the salt butters, the quantities ranging from 4·18 to 15·43.
3rd. That the quantity of *salt* contained in the *salt butters* varied from 1·53 to 8·24, showing that no fixed rule is acted upon in salting butter.
4th. That in the *fresh butters* the salt varied from 0·30 to 2·91.
5th. That the per-centages of butter contained in the samples ranged from 67·72 to 96·93; that is, some of the samples contained 20, 30, and in one case even nearly 35 per cent. of water and salt.

Tobacco, and its Adulterations.

The results obtained from the numerous analyses, chemical and microscopical, instituted of the various descriptions of Tobacco were to the following effect:—

1st. That the *Tobacco-leaf* itself presents certain peculiarities of structure, by which it may be readily distinguished from the leaves of all other plants said to be employed in the adulteration of tobacco, especially in the form and structure of the hairs, and of the mid-ribs and veins. These peculiarities are so decisive as to enable the observer, by means of the microscope, at once to distinguish tobacco in all the forms of cut and roll tobacco, and even when the leaf is still more minutely divided, as in some kinds of snuffs.

2nd. That the majority of leaves not tobacco which have been detected from time to time in adulterated tobacco also present certain peculiarities in their organisation, by which they may be all distinguished, not only from tobacco, but from each other.

3rd. That while the structure of the tobacco-leaf is constant, its composition varies very greatly, particularly as regards the quantity of gum and sugar which it contains, and the amount of ash furnished on incineration: thus we find that in the six samples of unmanufactured *leaf tobacco*, the amount of hygrometric moisture varied from 10·8 to 13·4 per cent.; the extract from 40·8 to 60·0 per cent.; the sugar from mere traces to 3·6 per cent.; the gum from 7·4 to 10·1 per cent.; and the ash from 10·6 to 22·6 per cent., it being composed chiefly of chlorides, sulphates, carbonates, and phosphates, combined with much lime. In the eight samples of *leaf-stalk*, the analyses of which are now given, the hygrometric moisture varied from 11·60 to 18·16 per cent.; the extract from 21·04 to 39·85 per cent.; the sugar from traces to 4·91 per cent.; and the ash from 20·00 to 28·24, these ashes being remarkable for the large amount of soluble salts which they contained. These differences are evidently so considerable and so varied, as to render it manifest, that by imitating its chemical composition, tobacco may be adulterated to a considerable extent without the possibility of our being able to declare with certainty that it is so adulterated.

4th. That in the *Unmanufactured Tobaccos*, including stalk,

The hygrometric moisture varied from 11·25 to 22·96 per cent.
The extract, from 23·20 to 51·20.
The soluble ash, from 3·00 to 11·44.
The insoluble ash, from 9·60 to 17·80.
The total ash, from 13·60 to 27·90.
The sugar, from traces, to 4·91.

5th. That in the *Manufactured Tobaccos*,

The hygrometric moisture varied from 9·80 to 65·76.
The extract, from 29·32 to 62·20.
The soluble ash, from 3·24 to 7·60.
The insoluble ash, from 9·20 to 16·24.
The total ash, from 14·68 to 20·80.
The sugar, from traces, to 3·82.

6th. That in the *Bird's Eye Tobaccos* the soluble ash was very high, in consequence of the large quantity of mid-ribs which these tobaccos contain.

7th. That the extract from the *Negroheads and Twists* was in some cases unusually high, as was also the quantity of glucose: these large extracts were probably, in part, due to the oil employed in the manufacture of these kinds of tobacco, but principally to the use of some saccharine solution.

8th. That not one of the *Forty Samples* of manufactured cut tobacco was adulterated with any foreign leaf, or with any insoluble or organic extraneous substance of any description other than with sugar or some other saccharine matter, which there is good reason to believe was present in several instances. The more common adulterations of tobacco consist in the addition of water, sugar, and salts. The presence of these in amount sufficient to constitute adulteration can only be declared with certainty, however, when they are in considerable excess, or by a comparison of the unmanufactured and manufactured leaf.

Cigars and Cheroots, and their Adulterations.

The conclusions arrived at from the examination of the Fifty-eight samples of Cigars were, —

1st. That cigars and cheroots are but little subject to adulteration, the cheap penny cigars, even, consisting, in the majority of cases, entirely of tobacco, although no doubt of tobacco of very inferior quality. Cigars are, however, now and then met with, especially on race-courses, at fairs, &c., made up of Hay and Brown Paper.

2nd. That notwithstanding the generally received opinions, *Opium* was not detected in any of the twelve samples of Manilla cheroots analysed.

Snuff, and its Adulterations.

From the examination of Forty-three samples of Snuff of different kinds the conclusions were,—

1st. That *chloride of sodium or salt* is added in large and very variable quantities to all descriptions of snuff, the proportion ranging from 1·0 to as much as 12·8 per cent. Where the amount of chloride is less than 1·0 per cent., it is probable that it is derived from the tobacco itself, as well as the water used to moisten it.

2nd. That the *alkaline and earthy carbonates*, chiefly the *carbonates of potash and lime*, are likewise added to snuff, sometimes in considerable quantity, but usually to a less extent than chloride of sodium. One of the samples yielded 3·9.

3rd. It would appear also that in some cases the *alkaline and earthy phosphates* are in excess in snuff, as much as 7·0 per cent. of the former having been detected in *One* of the samples and 4·8 per cent. of the latter in another.

4th. That the *alkaline sulphates* are likewise somewhat in excess, amounting in *One* sample to 5·4 per cent. ; in this case the addition may have been intentional.

5th. That *oxide of iron* derived from different descriptions of coloured ferruginous earths, as *red ochre, yellow ochre,* and some of the brown earths, as *umber*, was present in upwards of *Two-thirds* of the samples, amounting in *One* case to no less than 5·0 per cent. While all the Scotch snuffs contained iron, the oxide of that metal was not present in any of the samples of Welsh and Irish snuffs submitted to analysis. *The presence of the above-named ferruginous earths constitute so many adulterations.*

6th. That *chromate of lead* was detected in *Nine* of the samples, amounting in *One* instance to 4·6 per cent. It occurred in *Five* out of the *Nine* samples of Scotch snuff examined, in *One* of the *Four* samples of Welsh, and in *One* of the *Three* samples of Irish snuff submitted to analysis. *The presence of this metallic compound in snuff constitutes an adulteration.*

7th. That *oxide of lead,* probably in the form of *red lead,* was discovered in *Three* cases, as much as 3 per cent. being found in *One* of the samples of Hardham's 37. *The presence of this metallic oxide is also an adulteration and an infraction of the Tobacco Act.*

8th. That *bichromate of potash* was present in *Three* of the samples; in *Two* cases it was found in the Scotch snuff, amounting in *One* sample to 6·2 per cent. *The presence of this salt likewise constitutes an adulteration.*

9th. That many of the samples contained a considerable quantity of *silica,* amounting in *One* instance to no less than 8·4 per cent. *In some of the samples the addition was no doubt intentional. Genuine tobacco rarely contains more than 3·4 per cent.,* and usually much less. In most of the siliceous residues of the ashes, *shiny particles* were observed, which under the microscope presented all the appearances of POWDERED GLASS.

10th. That *powdered orris-root* was detected in *Two* of the samples. *The presence of this in snuff is likewise an adulteration.*

11th. That the *total weight of ash* furnished by the incineration of the greater number of the snuffs examined, although many of them were very moist, much exceeded that of genuine tobacco after being dried. While the *ashes* of samples *of the latter have been found to vary in weight from* 10·6 *to* 22·6, those of the snuffs which were not dried, and many of which contained *large percentages of water,* were in no case under 18·26 per cent., while in one instance it amounted to 35·54 per cent. Had the snuffs been dried before analysis, as was the tobacco, the difference in the weight of the ashes would have been much more evident. The average proportion of water in the moist snuffs is about 25 per cent.

Looking then at the whole of the above results, it is evident *that snuff is subject to a very large amount of adulteration, and that of a kind which is not only detrimental to the revenue but highly injurious to health.*

POISONOUS COLOURED SUGAR CONFECTIONERY.

From the examination of upwards of one hundred samples of Coloured Sugar Confectionery, the following important conclusions and particulars were arrived at: —

The principal colours employed are yellows, reds, including pink and scarlet, browns, purples, blues, and greens.

Of the yellows it appeared—

That *Seven* were coloured with LEMON CHROME or the pale variety of CHROMATE OF LEAD.

That *Five* were coloured with ORANGE CHROME or the deep variety of CHROMATE OF LEAD.

That *Forty-seven* were coloured with the bright or canary-coloured variety of CHROMATE OF LEAD.

That *Eleven* of the samples were coloured with GAMBOGE.

While the colour of the majority of the above samples was confined to the surface, in many cases it was diffused equally throughout the whole mass of the sugar used.

Of the reds —

That *Sixty-one* of the samples were coloured with *organic pink* colouring matters, consisting in most cases of *Coccus Cacti,* or *cochineal.*

That in *Twelve* of the samples, the colouring matter was RED LEAD, RED OXIDE OF LEAD, or MINIUM.

That in *Six* cases, the colouring ingredient consisted of VERMILION, CINNABAR, or BISULPHURET OF MERCURY.

Of the browns —

That *Eight* were coloured with *brown ferruginous earths,* either *Vandyke brown, umber,* or *sienna.*

Of the purples —

That two samples were coloured with a mixture of *Antwerp blue,* which consists principally of Prussian blue, and an organic red pigment, most probably *cochineal.*

Of the blues —

That one was coloured with *indigo.*

That *Eleven* were coloured with *Prussian blue,* or *ferrocyanide of iron.*

That *Eleven* were coloured with *Antwerp blue,* which is a modification of *Prussian blue.*

That in *Fifteen* samples the colouring matter consisted of German or artificial ultramarine, which is a sulphuret of sodium and aluminium.

Of the greens —

That *Five* samples were coloured with the *pale variety* of Brunswick green.

That *Four* were coloured with *middle* Brunswick green.

That *One* was coloured with the *deep variety* of Brunswick green.

These greens consist of a mixture, in different proportions, of the chromates of lead and *Prussian blue.*

That one sample was coloured with verditer or carbonate of copper.

That *Nine* were coloured with Scheele's green, emerald green, or arsenite of copper.

The above colours were variously combined in different cases; as many as three, four, five, six, and even seven colours occurring in the same parcel of confectionery, including three and even four poisons.

That in *Four* of the samples, the colours used were painted on with white lead, or carbonate of lead. This was the case in all the cake ornaments.

It further appears from the above Analyses —

That *Thirteen* of the samples were adulterated with *hydrated sulphate of lime,* the quantity varying from 4·3 to 43·66 per cent.

That *Twenty-one* of the samples were adulterated with different kinds of *Flour,* in quantities varying from 1·66 to 25·56 per cent. In *Seventeen* samples the farina consisted of *wheat-flour;* in *Three,* of *potato-flour;* and in *One,* of *East India arrow-root.*

Porter and Stout, and their Adulterations.

The following are the conclusions arrived at from the analyses instituted of samples of London Stout and Porter obtained from the taps of the several London porter-brewers, and from publicans: —

That the samples of Stout either obtained from agents, or purchased at the taps of several of the principal London porter-brewers, were considerably stronger than those procured from publicans: the alcohol, of specific gravity ·796, temperature 60° Fahr., contained in the former samples, ranged from 7·15 per cent. the highest, to 4·53 the lowest; whereas that of the stouts procured from publicans varied, with one exception, from 4·87 per cent. to 3·25 per cent.

That the same difference of strength also characterised the various samples of Porter procured from the two different sources; the amount of alcohol in the porters obtained from the taps varying from 4·51 per cent. to 2·42 per cent.; whereas those purchased of publicans ranged from 3·97 per cent. to 1·81 per cent.

That in nearly all the stouts and porters *salt* was present, often in considerable amount.

That in some of the samples *cane-sugar* and *treacle* were likewise present.

There is reason to believe that the variation of strength would have been still more considerable had the samples been procured direct from the several breweries, instead of, as in most cases, from the brewers' taps.

This diminution of strength in the beer purchased of publicans is only to be satisfactorily explained by the addition in many cases of water, this addition being no doubt sometimes practised by the publicans and other retailers of malt liquors.

The addition of water constitutes the principal, but not the only, adulteration to which these beverages are subjected.

Thus the addition of water reduces the strength, flavour, and colour, to such an extent as to necessitate in some cases the further adulteration of the beer, and this is usually effected by means of a very coarse description of brown sugar, containing much treacle, and known as *Foots*, and salt.

Since the use of cane-sugar is permitted in the brewery, we did not attempt to ascertain which of the samples subjected to analysis contained that substance, because, had we found it in any of the samples, we should still have been unable to have declared whether the brewers or the publicans were the parties who made use of it. We believe, however, that the brewers do not often employ sugar, since it is alleged that beer made with any considerable proportion of cane-sugar does not keep so well as that prepared from malt only. Moreover, the price of sugar forms an obstacle to its use in breweries.

It appears, from the analyses, that salt is almost constantly present in porter. This addition we know is made in the first instance by the brewers themselves; but there is also no doubt that a further quantity of it is frequently used by the publican to assist in bringing up the flavour of beer which has been reduced in strength by the addition of water. The quantity of salt contained in porter is often sufficiently large to communicate a perceptibly saline taste to the mouth. The salt is used by the brewers in the following manner:—It is first mixed up in a tub with flour, usually wheat-flour, and the mixture is cast by handfuls over the surface of the wort in the cooling vat. It is said to assist in the preservation and fining of the wort, and it is alleged that these are the only purposes for which it is employed by the brewer.

The three usual and principal adulterations of porter consist, then, of water, by which its strength is reduced and its bulk increased, and sugar and salt, whereby its colour and flavour are in a measure restored. But there is good reason for believing, from evidence given before a recent Committee of the House of Commons on Public Houses, of which Mr. Villiers was the chairman, that other adulterations are practised, and that sulphuric acid, or oil of vitriol, salt of steel, or sulphate of iron, and cocculus indicus, are likewise not unfrequently used, and this both by the publican and the brewer.

Not only is the fact of the addition of water proved by the present analyses, but evidence of another character has been supplied by different parties to the Committee above referred to, showing the same fact. In particular, it has been proved that a publican could not afford to sell porter at the price which he pays for it, in the state in which it is supplied to him by the brewers, and realise a profit upon it, unless he had recourse to adulteration.

Gin, and its Adulterations.

The following important conclusions respecting the adulteration of Gin were established from the numerous analyses made of that article:—

1st. That the *strength* of the various samples ranged from 15,645 grs. to 34,160 per imperial gallon; the per-centages ranging from 22·35 to 48·80 per cent.

It thus appears, that some of the spirits contained only half as much alcohol as was present in some of the other samples, and therefore that their commercial value was reduced to the enormous extent of more than one half; thus, supposing sample 2. to be worth 12*s.* per gallon, sample 35. would be worth less than 6*s.* per gallon. This variation in the strength of the spirits is doubtless principally attributable to dilution with water.

2nd. That the quantity of sugar ranged from 3 oz. 4 dr. 23 gr. to 13 oz. 4 dr. 13 gr. per gallon.

3rd. That *Two* of the samples contained *Oil of Cinnamon,* or probably of *Cassia.*

4th. That *Seven* of the samples contained CAYENNE PEPPER, some of them in very large quantity, so that the syrupy extract left on evaporation possessed a burning and fiery taste.

5th. That in no case was *Sulphuric Acid* detected; its absence being sufficiently shown by all the samples being neutral to test-paper.

6th. That most of the samples contained combined sulphates, derived from the water and alum employed in their adulteration and clarification. In some few cases, possibly, the combined sulphates may be derived from white vitriol, white copperas, or sulphate of zinc, which we have the authority of a gin distiller for stating is commonly used, when gin has been diluted with water for the purpose of causing it to "bead," as it is technically termed. Here, again, then, we have obtained evidence of a second adulteration calculated to prove injurious to health.

A few remarks may next be bestowed upon the parties who practise and are guilty of the adulterations described. Abundant evidence is afforded in the pages of this work to show that the manufacturers, roasters, and grinders of articles of consumption, including drugs, are the chief offenders. Thus, the adulterations of roasted Chicory-powder, many of those of roasted Coffee and Cocoa, are the work, in most cases, of chicory and coffee roasters and grinders; the woody fibre or saw-dust of different kinds, as well as many of the other adulterations detected in Spices and in various Drugs in powder, are mostly added by the spice and drug grinders; while the copper in Pickles and bottled Fruits, the bole Armenian and Venetian red in potted Meats and Fish, are all added by the different manufacturers and preparers of these articles. These and many other adulterations practised are of a kind which it would be almost impossible for the retail tradesman to practise, special machinery being required for the purpose in some cases. Nevertheless, the latter does his part in the way of adulteration, although to a much less extent. This distinction is important, because it points to the direction in which the chief efforts for the suppression of the different kinds of adulteration discovered should be directed.

We will now turn to the consideration of the subject of Adulteration in some of the other aspects or bearings in which it presents itself to our notice, viz., the *pecuniary* and *fiscal*, the *sanitary* and the *moral aspects.*

The pecuniary considerations involved in the question of the adulteration of the solids and fluids consumed are of very great importance; they affect the buyer, the seller, and the revenue.

The interest of the buyer or consumer, in the pecuniary bearing of this question, is very great. All articles of consumption are divisible into two classes — those which pay a duty to the state, and those which are free of duty: on both these classes the consumer is a great loser, through the practice of adulteration now so disgracefully prevalent. We complain, and not without some reason, of the largeness of our taxes; but there is much cause to believe that the losses of the consumer, arising out of adulteration, amount to more than the sum of his taxes. This is certainly the case as regards the humbler classes, the labourer, and the artizan; and this practice, therefore, presses with peculiar hardship upon them. The price of an article being comparatively less an object to the rich than the poor, the former usually go to the best shops, where, by paying high prices, they are generally, but not always, tolerably sure of procuring a good and genuine article; but to the great mass of the public the cost is a primary consideration, and in too many cases they buy their articles where they profess to be cheapest, with but little thought as to their quality or purity, and without perceiving that these apparently cheap articles, in consequence of adulteration, are often the dearest in the end. The poor man, then, unlike the rich, can scarcely help himself in the matter. So much for the pecuniary interest of the consumer in the question of the adulteration of food. We will now bestow a few reflections upon that of the seller.

It is clear that the sellers of adulterated articles of consumption, be they manufacturers or retail dealers, are in a position to enhance their profits by the practice of adulteration, and are enabled to undersell, and too often to ruin, their more scrupulous and honest competitors. The question of the adulteration of food is, therefore, one which vitally affects the interests of the more honest and respectable portion of the trading community, who depend upon the manufacture and sale of articles of consumption, and it behoves them strenuously to exert themselves to put an end to the system of adulteration which is so calculated to undermine the very foundation of trade, viz., faith in commercial integrity.

The pecuniary interests of the State in this question will be best appreciated by an examination of the following Table, which contains a list of articles, nearly all of which we have adduced evidence to show are subject to great and varied adulteration; also the duties charged, the quantities consumed, and the revenue derived from them for the year 1853:—

List of Articles subject to Adulteration, the Duty charged, the Quantities consumed, and the Revenue derived for the Year 1853.

Articles.	Duty.	Quantity on which Duty was paid.	Revenue derived.		
			£	s.	d.
Arrow-root	$4\frac{1}{2}d.$ per cwt.	16,757 cwts.	384	0	0
Brandy	15*s.* per proof gallon	1,870,567 gal.	1,402,925	5	0
British Spirits:					
England	7*s.* 10*d.* per proof gallon.	10,350,307 gal.	4,053,870	2	10
Scotland	4*s.* 8*d.* ” ” Now 5*s.* 8*d.* ” ”	6,534,648 gal.	1,524,751	4	0
Ireland	3*s.* 4*d.* per proof gallon. Now 4*s.* ” ”	8,136,362 gal.	1,356,060	6	8

Articles.	Duty.	Quantity on which Duty was paid.	Revenue derived. £ s. d.
Butter - -	5s. per cwt., foreign. British Posses. 2s. 6d. cwt.	397,911 cwt.	131,756 0 0
Coffee - - -	3d. per lb. - - -	37,091,814 lbs.	462,747 13 6
Chicory:			
Roasted or ground	4d. per lb. - - -	765 lbs.	14 0 0
Raw or kiln-dried -	4s. per cwt. - -	1,750 cwt.	512 0 0
Cigars, foreign - -	9s. per lb. and 5 per cent.		
Cocoa Paste or Chocolate.	1d. per lb. - - -	15,128 lbs.	226 0 0
Cheese - -	2s. 6d. per cwt. foreign, and 1s. 6d. British.	383,622 cwt.	59,488 0 0
Flour or meal of all kinds.	4½d. per cwt. - -	4,662,948 cwt.	532,692 0 0
Ginger, raw -	Foreign 10s. per cwt. - Colonial 5s. per cwt. -	17,577 cwt.	4,602 0 0
Isinglass - - -	5s. per cwt. - -	554 cwt.	138 0 0
Pepper - - -	6d. per lb. and 5 per cent.	3,461,333 lbs.	86,533 6 6
Snuff, foreign - -	6s. per lb. and 5 per cent.		
Sugar - -	British Colonial 10s. per cwt., and varying rates according to quality. Foreign, 12s. per cwt., and ditto, ditto.	7,523,187 cwt.	4,104,376 0 0
Molasses - - -	3s. 9d. and 4s. 6d. per cwt.	846,722 cwt.	172,816 0 0
Spices, viz.,—			
Cloves - -	2d. per lb. - - -	228,837 lbs.	109,137 0 0
Cassia - - -	1d. per lb. - - -	136,363 lbs.	
Cinnamon - -	2d. per lb. - - -	37,694 lbs.	
Pimento - -	5s. per cwt. - - -	3,746 cwt.	
Nutmegs - -	1s. per lb. - - -	208,198 lbs.	
Mace - - -	1s. per lb. - - -	23,558 lbs.	
Rum - - -	8s. 2d. per proof gallon.	3,233,059 gal.	1,320,165 15 2
Tea - - - -	1s. 10d. per lb. - -	58,860,127 lbs.	5,686,194 0 0
Tobacco - - -	3s. and 5 per cent. per lb.	- - -	4,751,780 0 0 including cigars and snuffs.
Wine - -	5s. 6d. per gallon foreign, and 5 per cent. 2s. 9d. Cape and Colonial, and 5 per cent.	7,197,572 gal.	2,036,083 0 0
Vinegar - - -	3d. per gallon foreign. Now 4½d.	74,773 gal.	87 0 0

It is not possible to estimate with any degree of accuracy the loss to the State arising out of Adulteration, but it is very evident from the above Table, as well as from the revelations contained in this work, that that loss must be great indeed, and must amount annually to many hundreds of thousands of pounds. The cost of the Customs and Excise, to which bodies are entrusted the collection of the Revenue, and the prevention of the adulteration of exciseable articles, amounted, in 1843, to no less a sum than 4,031,633*l.* 16*s.* 7½*d.* Of this sum 1,886,250*l.* 0*s.* 1*d.* should be deducted for charges connected with the various taxes: this leaves a balance of 2,145,383*l.* 16*s.* 6½*d.*; *viz.* for the Customs 1,302,720*l.* 12*s.* 3*d.*, and for the Excise 842,663*l.* 4*s.* 3½*d.*; a great part of which expense is incurred for the protection of the Revenue against adulteration. How one of these bodies performs its duties will hereafter appear.

It must be recollected that in the foregoing Table the latest duties only are given; and since many of these have recently been greatly reduced, there is no doubt but that the loss from adulteration was formerly much greater than at present.

Now, we think it would not be difficult to show that the machinery in operation for the purpose of checking adulteration, viz., the Excise, is as clumsy and inefficient as it is expensive. We make this remark, not out of any hostile feeling towards the Excise, but, as we conceive, as a matter of truth and right.

We have said that the Excise is inefficient. In proof of this statement, we have only to refer to the pages of this work, demonstrating as they do, beyond the possibility of a doubt, the fact, that adulteration is scandalously and disgracefully prevalent in nearly every duty-paying article: take, for example, coffee, chicory, spirits, tobacco, spices, snuff, and other leading and prime exciseable articles.

And why is the Excise thus inefficient? and why has it not accomplished the purposes for which it was instituted? There are several reasons One of them is a want of sufficient vigour and activity in enforcing the powers with which they are entrusted. Compared with the extent of the prevalence of adulteration how seldom do they institute prosecutions? Another reason is, that they do not sufficiently employ the resources of science for the discovery of adulteration. They rely too much upon the information of excise inspectors, and too little upon science, upon the resources of chemistry, more particularly of organic chemistry, and especially upon a knowledge of vegetable structure as revealed to the competent observer by means of the microscope. Hence it is, that we, employing these resources, have so often succeeded in bringing to light adulterations, of the very existence and nature of which the excise authorities themselves had been wholly ignorant.

We have said that the machinery of the Excise is not only inefficient but that it is clumsy: let us see what is the nature of the machinery in question. Excise inspectors or officers are appointed to watch over the operations of all the manufactories of the kingdom in which articles of consumption that pay duty are prepared, and to see that prohibited substances are not employed. In some cases the exciseman almost lives upon the premises, staying there the whole day, and when he leaves at night he locks up certain parts of the manufactory, and takes the key with him, thereby stopping to some extent in many cases the productiveness of the manufactory. That this is an inquisitorial and a very arbitrary proceeding few will deny; but another evil springing out of the residence of excisemen upon the premises of a manufacturer is, that after a time in too many cases intimate relations come to be established between the exciseman and the manufacturer, and he is frequently brought to connive at practices contrary to his duty. The records of excise proceedings afford many instances of excisemen having been bribed by manufacturers.

In other instances the exciseman does not reside upon the premises, but pays daily or occasional visits to the manufactory, and thus in his absence many opportunities are afforded for adulteration; while retail dealers are but seldom troubled with the visits of the excise officers at all, so that full opportunities are afforded to them for the practice of adulteration, of which, as the records contained in this work show, they are not slow to avail themselves. Moreover, the efforts of the exciseman are usually directed to the discovery of the adulterating ingredients in the mass, in the raw state, if we may so term it, and not in the manufactured and adulterated article.

In some cases this method of proceeding is no doubt productive of useful results, but in too many instances it fails; moreover, it must be remembered that it is one which is enormously costly. While it might be advisable to retain in some cases the services of excise inspectors or officers, the number employed might doubtless be much reduced, and thus a great saving would be effected, and the work at the same time less objectionably and much more efficiently and scientifically performed.

We reserve for the present the details by which these very desirable results might be secured, and will now confine ourselves to the remark that the methods at present adopted by the Excise for detecting adulterations are unworthy of the scientific character of the times in which we live. We believe, however, that the importance of a more full application of science to the question of adulteration has begun to be considered by the Excise authorities, and that some studentships have been instituted for the instruction of young men in those sciences, the knowledge of which is absolutely necessary to qualify them for the duties of excise examiners.

We have now shown that the State is deeply concerned in a pecuniary respect in the question of the adulteration of exciseable articles of consumption.

The next point for consideration is the sanitary aspect of the subject. Sufficient evidence will be found in the present work to show that this is not an unimportant branch of the question. The following more or less injurious, deleterious, or poisonous substances have been detected in the several articles already reported upon: thus in—

COFFEE - - -	Chicory, Roasted Corn and Beans, Carrots, Acorn, &c., injurious indirectly by depriving the consumer of so much Coffee, with the valuable properties of which the substituted articles have nothing in common.
COCOA - - -	Inferior Starches, Coarse Sugar, and Ferruginous Earths, as Venetian Red and Ochre.
CAYENNE PEPPER AND CURRY POWDER.	Red Lead, Vermilion or Bisulphuret of Mercury, and Venetian Red.
COLOURED CONFECTIONERY.	Red Lead, Vermilion, Gamboge, Chrome Yellow or Chromate of Lead, Prussian Blue, Verditer or Carbonate of Copper, Emerald Green or Arsenite of Copper, the three Brunswick Greens, various Oxides of Iron, White Lead or Carbonate of Lead.
CUSTARD POWDERS -	Chrome Yellow.
GIN - - - -	Cayenne.
PICKLES, PRESERVES, AND BOTTLE FRUITS AND VEGETABLES.	Certain Salts of Copper, chiefly the Acetate.
POTTED MEATS AND FISH, ANCHOVIES AND SAUCES.	Iron Earths, as Venetian Red and Bole Armenian.

Porter and Stout	- Cocculus Indicus and Sulphate of Iron.
Snuff - -	- Bichromate of Potash, Chrome Yellow, Red Lead, Ferruginous Earths, as Umber, Red and Yellow Ochre.
Tea - - -	- Indigo, Prussian Blue, Chinese Yellow, Black Lead, Catechu, Sulphate of Iron, Foreign Leaves, Sand, &c.
Vinegar - -	- Sulphuric Acid, Pyroligneous Acid.

The above list includes not only many articles which are more or less injurious and deleterious, but likewise some of the deadliest and most virulent of known poisons, as the following:—the chromates of potash and lead, carbonate of lead, red oxide of lead, bisulphuret of mercury or vermilion, the three Brunswick greens, which are composed of Prussian blue and chrome yellow, the carbonate, acetate, and arsenite of copper.

Some might be supposed to allege that the quantities used are too inconsiderable to be productive of injury to health; this is assuredly not so, however, as is proved by actual observation and experience. Some of the articles above named, as the several preparations of lead, copper, mercury, and arsenic, are what are called cumulative,—that is, they collect and accumulate in the system,—so that, no matter how small the quantity of them introduced at one time or in a single dose, the system, or particular parts of it, are at length brought under their influence, and certain diseases are induced, characteristic of poisoning by lead, copper, mercury, or arsenic.

Of this fact very striking evidence is afforded in the cases of lead-poisoning reported in the article on Snuff and its Adulterations, and which were occasioned by the use of snuff adulterated with lead.

But the quantity of these poisonous substances taken at one time is often by no means inconsiderable, but sufficient in some instances indeed to be at once productive of serious, and occasionally even fatal, effects. Scarcely a year passes by but several cases are recorded of poisoning by articles of coloured confectionery; the particulars of a few of such cases will be found in the Report on Poisonous coloured Sugar Confectionery.

No doubt, in many cases, the effects produced by the daily introduction, in minute quantities, of certain powerful or poisonous substances are slow and insidious, and their action not easily traced out; but yet, that the ultimate effects of these on the system are very great, cannot for a moment be doubted. Thus, it is impossible to conceive but that the introduction of Picrotoxine into the stomach, through the beer consumed, or of copper through the pickles and bottled fruits used; or of cayenne through the gin and rum drank, must be productive of injurious consequences. The effects of alcohol, when taken in large quantities or for a long period, are in themselves sufficiently injurious; but, by the addition of cayenne to this, it forms a combination the action of which no human stomach can long resist. These examples are cited merely as illustrations: their number might be greatly increased.

But sufficient has now been advanced to show that the subject of the Adulteration of the Solids and Fluids consumed as articles of food is one intimately associated with the Public Health. Were we to extend our inquiries to Drugs and Pharmaceutical Preparations, the immense importance of the question would become still more strikingly manifest. Nearly all the most useful and important articles of the Materia Medica are grossly and systematically adulterated, often to an enormous extent, so that it is impossible to estimate the strength of the different remedies administered, or the extent and character of the effects produced. The greatest confusion and uncertainty are thus introduced into the practice of medicine, and, no doubt, many valuable lives annually sacrificed. For confirmation of this statement, see the Reports of the Analytical Sanitary Commission contained in "THE LANCET" for 1853 and 1854, on the Adulteration of Jalap, Scammony, Opium, &c.

The third and last aspect in which adulteration has to be considered is the Moral.

It is impossible for a man to be guilty of adulteration, and yet be an honest and a moral man, although doubtless there are many adulterators who flatter themselves with the belief that they are so; it is, however, but an attempt at self-deception, as they themselves could scarcely fail to admit, were they fully and deliberately to consider the subject of adulteration in all its bearings.

Can it be said that the man, be he a manufacturer, or a roaster and grinder of chicory and coffee, or be he a retail tradesman, who adulterates the goods which he sells, and mixes with them roasted corn or beans, Venetian red, or red lead, &c., is guilty of a less offence than the man who appropriates that which is not his own? Really and morally, the former is the greatest offender, notwithstanding that the law, through defect, appears to make a distinction in his favour, although it regards both as guilty. Thus, while the adulterator, when the offence is brought home to him, which, through supineness, is very rarely the case, is punished by a mere pecuniary fine, the thief, if he steal only the value of a penny piece, is committed to prison, and has often to expiate his offence on the wheel of the tread-mill. Although such is the present defective state of the law in this respect, it surely cannot long be permitted to remain in this condition.

But adulteration makes not only those who practise it dishonest, but other very serious evils ensue. Thus, it begets the greatest mistrust on the part of the buyer, who loses confidence in those with whom he deals, and in this way sometimes the honest trader comes to be looked upon with the same suspicion as the adulterating merchant, manufacturer, or tradesman. Another consequence is, that the status of that portion of the trading community which sells articles of consumption is lowered, and is looked upon with misgiving in all its transactions. Lastly, the character of the whole nation suffers in consequence of the prevalence of adulteration. The character of this country has certainly suffered, to some extent, in consequence of the disclosures contained in the Reports embodied in this work. In proof of this statement, we have only to refer to those foreign journals, principally German and French, in which the Reports of the Analytical Sanitary Commission are noticed, and nearly all the Reports were thus noticed from time to time as they appeared. These notices were not unfrequently accompanied with remarks anything but flattering to our integrity. One notice, we remember, alluding particularly to our being a nation of shopkeepers, observed that we appeared to have strong claims for being regarded as a nation of rogues.

The moral effects of adulteration are, then : — That it makes men dishonest, distrustful of each other in their dealings, and that it lowers the commercial character of the nation.

Thus we have shown that there is not a single individual whose interests are not deeply concerned in the subject of adulteration. The interests of bodies and associations of men, who have the provisioning of large numbers, are of course still greater. Thus the subject of adulteration vitally affects our hospitals and other charitable institutions, workhouses, barracks, depôts, shipping, lunatic asylums, public schools, and similar institutions. These are usually supplied by contract with the different articles of consumption, as tea, sugar, coffee, cocoa, arrow-root, oatmeal, spices, &c. Now, as we have shown in some of the Reports contained in this work, the articles supplied under these contracts are more subject to adulteration than any others.

It is to be regretted that the heads of the different institutions above alluded to, especially Boards of Guardians, do not adopt some means by which the quality and condition of the several articles of consumption supplied to them may be ascertained. It is true that by adulteration those Boards are often enabled to accept contracts *under market price;* and as paupers only have to be fed, they seldom trouble themselves much about the purity of the articles supplied. We could cite instances in which this practice has been adopted; for one case the reader is referred to the Report on Arrow-root. A memorable instance of the ill effects resulting from adulteration is afforded by the Tooting case. It will be remembered that some four or five years since a great many deaths occurred in Drouitt's establishment for pauper children at Tooting, and an inquiry, over which Mr. Wakley the coroner presided, was instituted, as to the cause of death. It came out, on the investigation, that the oatmeal, which formed so considerable a portion of the diet of the children, was largely adulterated with barley-meal, which differs from oatmeal in its being less nutritious, and in its aperient properties; diarrhœa and wasting were prominent symptoms in the cases of the unfortunate children.

It cannot be doubted but that much benefit has resulted to the public from the Reports on Food and its Adulterations embodied in this work. Of the correctness of this statement much convincing evidence could be adduced. We will not dwell, however, upon this part of the subject, but will simply remark, that much of the good which has been effected has been due to the manner in which the several Reports as they appeared were taken up by the Press, the chief facts contained in them being thus at once extensively communicated to the public.

Before concluding this Introduction, we would advert to the circumstances under which the Analytical Sanitary Commission took its origin.

In 1850, the author of this work first came to reside in London. Many months had not elapsed before he perceived that there was something very wrong in the state of most of the articles of consumption commonly sold, and he was particularly struck with the condition of the ground coffee as ordinarily met with. This led him to make some examinations, principally microscopical, of different samples of this article. The results of these examinations were embodied in a paper which was communicated to the Botanical Society of London. The subject attracted considerable attention, and notices of the paper read were promptly inserted in nearly all the daily and weekly newspapers, including the "Times." The author next turned his attention to Sugar, and prepared a paper, which he likewise intended to submit to the above-named society; he also resolved in his own mind to follow up the subject of the Adulteration of Food, perceiving its important nature. In the meantime, after the publication of the paper on Coffee, and before the reading of that on Sugar, Mr. Wakley communicated with the author, stated his conviction that the exposure of adulteration would fail to produce any beneficial effects, unless it was accompanied by the publication of the names and addresses of all parties of whom the articles examined were purchased, and this whether they were found to be genuine or adulterated; and he asked, whether it was possible that the inquiries could be so conducted as to admit of the publication of the names and addresses of the manufacturers and tradesmen of whom the articles were procured, and whether the writer was prepared to undertake a series of investigations on the subject of adulteration. After a little consideration, the reply was in the affirmative. On this, Mr. Wakley determined, after having given due warning and notice, to publish the names and addresses of all parties which the author might furnish to him, and Mr. Wakley further devised the Title under which these Reports have from time to time appeared.

For a period of nearly four years, the Reports in question have now been published with considerable regularity, and during that time the names and addresses of hundreds of manufacturers and tradesmen have been made known, and much good in a variety of ways has resulted. The consumer, the revenue, and the honest trader have all been greatly benefited.

It is quite impossible to speak in too high terms of the great moral courage evinced by Mr. Wakley in his determination to publish in all cases the results of the investigations, and to give to the world the names and addresses of all persons concerned. The responsibility incurred was immense; and had the confidence reposed not been justified, and had not the greatest thought and caution been exercised, most disastrous would have been the consequences. Great, therefore, is the debt of the public to Mr. Wakley in this matter. The author fully believes that there is not another editor to be found who would have ventured upon so bold and so unprecedented a step. Lastly, the author desires it should be known, that in conducting these inquiries he possessed the greatest possible freedom of action; that Mr. Wakley never interfered with him in the slightest manner; that no suggestions were at any time made as to the neighbourhoods in which the purchases should be made; and that in no single instance since the inquiries began did Mr. Wakley suggest that any one name should be either added to, or omitted from, the lists that were published. Thus friends and foes were in all instances similarly treated. In fact, nothing could be more strictly impartial and disinterested than the conduct of Mr. Wakley throughout in reference to the publication of these Reports.

One feature which distinguishes the Reports contained in this work from all other articles treating on the same subject is their strictly *bonâ fide* character, the conclusions and facts contained in them being all deduced from actual observation and experiment. The statements of writers so often handed down from author to author were in no cases accepted, unless confirmed by personal research.

Another feature which characterises these investigations is, that in them, for the first time, the powers of the microscope were regularly and systematically applied to the elucidation of the subject of adulteration, and this with an amount of success not originally hoped for, and which is truly surprising.

The earliest and most successful application of the microscope was to the adulteration of coffee. Contrary to what many would have anticipated, and contrary to the opinions and statements of three of the most eminent chemists of the day, as cited in the House of Commons by a late Chancellor of the Exchequer, who affirmed that neither by chemistry nor by any other means could the admixture of chicory with coffee be detected, the author succeeded in discovering, in the most certain and demonstrative manner, the presence of chicory and a variety of other vegetable substances in adulterated ground coffee.

We may be pardoned also for alluding to the many points of scientific interest which have been elucidated by our researches. The component elements and ultimate structure of a vast variety of vegetable substances are illustrated in the following pages, in such a manner as to constitute no unimportant contribution to vegetable anatomy and physiology.

We will now consider the means by which adulteration may be checked, to a very great extent, if not entirely prevented. These means should be so devised as to embrace the whole question of adulteration, and should not be confined to those articles upon which a duty is levied, but should embrace all articles of food and drink, as well as drugs and pharmaceutical preparations.

The means to be employed are twofold,—the first includes those measures which are requisite for the *discovery* of adulteration, and the second embraces all those means necessary for *prevention.*

For the discovery of adulteration, it is requisite—

That there should be a Central Board or Commission, upon which there should be a sufficient number of scientific analysts, microscopical and chemical. Under the direction of this Board, purchases of articles should be made from time to time, analyses of them instituted, and Reports published.

That examining inspectors should be appointed at all the more considerable import and export towns, to prohibit either the importation or exportation of adulterated articles of consumption of all kinds, including drugs.

That these inspectors should be empowered to make purchases in the different towns to which they are appointed, and that they should forward all articles which are suspected to be adulterated to the Central Board for examination.

That district examining inspectors should be appointed, having their residence in all the large inland towns; that the duty of these should be to keep a close watch upon all suspected articles, to make purchases of samples, and to forward them to the Central Board.

For the prevention of adulteration, the following are the measures which appear requisite: —

That adulteration, when brought home to the party practising it, should be punishable both by fine and imprisonment.

That the seller of any adulterated article should be punishable by the infliction of fines, and this, in most cases, under the summary jurisdiction of a magistrate.

That the actual adulterator should be punishable by fine or imprisonment, or by both.

That a system of publication of the names and addresses of all persons whose goods have been analysed should be adopted, and this whether the articles on examination have proved to be genuine or adulterated.

Further, it might be well, for the still more effectual discovery and prevention of adulteration, to invite the public to forward under seal to the Central Board samples of articles of consumption in their possession suspected to be adulterated.

The above is merely a short sketch or outline of the measures required for the discovery and prevention of adulteration.

It should be recollected that at the present time there is a most extensive and costly machinery at work for the prevention of the adulteration of all exciseable articles, the Excise, but this object it has hitherto failed to accomplish; so that nearly all that would be requisite for carrying out these suggestions would be to re-model the detective and analytical or scientific department of the Excise, and to enlarge the sphere of its operation. Thus no objection exists against the scheme here propounded on the score of expense. There is no question but that while a considerable saving of expense would ensue to the consumer, the revenue would likewise be benefited, and the public health protected; and all this would be accomplished at a less cost to the state than is now entailed by the machinery referred to, which so completely fails to effect the principal purpose for which it was instituted, viz., the prevention of the adulteration of all duty-paying articles. We lately had an opportunity of offering suggestions for the most part similar to the above, in evidence given before a recent Committee of the House of Commons on Public-houses.

Another, and perhaps a more simple method of dealing with the question of adulteration in the first instance, would be to establish a Commission or Board in connection with the General Board of Health. Such a Commission, actively carried out, although it might not wholly suppress adulteration, would certainly do so to a considerable extent, and through it all those adulterations which are detrimental to health might be speedily and effectually prevented. It would also possess certain other advantages; the machinery would be simple, inexpensive, and it would not interfere with any existing arrangements.

We have now to acknowledge the great assistance which we have derived at different times from our friend Dr. Letheby, to whom we have been in the habit of referring frequently on doubtful points. The chemical portions of the later Reports contained in this volume, commencing with that on Vinegar and its Adulterations, have all been revised by Dr. Letheby. Our best thanks are, therefore, due, and most cheerfully accorded, to that gentleman for the kind and ready aid which he has at all times afforded us.

We have to express our acknowledgements to Mr. Joseph Hume, and Mr. A. W. Fonblanque, of the Board of Trade, for certain statistical information most kindly and readily afforded.

Lastly, we are indebted to Mr. J. C. Kent, of Upton-upon-Severn, for much similar information.

Although this work abounds with facts relating to Adulteration, it yet does not afford by any means a complete exposure of the subject. Numerous adulterations, with many of which we are already acquainted, remain to be described; these will be treated of in the Reports of the Analytical Sanitary Commission on Food and its Adulterations, which yet remain to be published. In the meantime, it is hoped that the publication of these Reports in their present form will hasten the adoption of those preventive measures which are so urgently required. The public are now fully alive to the importance of the subject; the medical profession is equally so; meetings are being held, as at Birmingham and Wolverhampton, to urge upon the Legislature the necessity of adopting some steps to counteract the pernicious effects of adulteration; the President of the General Board of Health has proclaimed his intention of dealing with the subject; lastly, the Select Committee on Public Houses have embodied in their Report to the House of Commons, a distinct recommendation to the effect that the whole question of Food, Drink, and Drugs, from its great importance, demanded that an early Parliamentary inquiry should take place. This recommendation was thus expressed:—"The matter of adulteration and dilution is, however, sufficiently important to form the subject of a distinct inquiry; and your Committee are of opinion that, as early as may be convenient, an inquiry should take place into the whole question of the adulteration of food, drink, and medicines. The suppression of adulteration is of the utmost importance, not to the consumer only, but in checking the dishonest competition so recklessly carried on, to the ruin of fair trade." We have thus, then, good reason to hope that the days are drawing to a close when practices so disgraceful and so dishonest as those revealed in this work will no longer be tolerated.

The Glass and other Chemical Apparatus and Instruments required for the Detection of Adulteration may be procured of the parties mentioned below.

The chemical glass apparatus required for conducting the inquiries and investigations contained in this work, may be procured of either Mr. J. Griffin, 10. Finsbury-square; Messrs. Jackson & Townson, 89. Bishopsgate-street Within; Mr. Button, Holborn Bars; and Mr. G. Simpson, 1. Kennington-road.

The chemical instruments, and other apparatus necessary, may all be obtained of Messrs. Horne, Thornwaite, & Co., Newgate-street. In particular, they have undertaken to supply a very excellent microscope well adapted for the detection of adulteration, for 6*l.* 6*s.* This instrument will be furnished with two object-glasses, one magnifying 100 diameters, and the other 350 diameters.

A somewhat similar microscope, on terms equally reasonable, may be obtained of Mr. Pellischer, Optician, of New Bond-street.

CONTENTS.

LIST OF ENGRAVINGS.

FOOD

AND

ITS ADULTERATIONS.

INTRODUCTORY REMARKS.

Uncontaminated air and pure water are now universally regarded as necessary to the maintenance of a healthy existence, and to obtain them we have appointed "Boards of Health" and "Commissions of Sewers." That unadulterated Food, the bone and muscle of the body, is not less requisite, will be readily allowed; and it will appear, on reflection, as somewhat remarkable, that the interests of the public in these important particulars should not hitherto have been watched over and protected by any authorised body or commission.

That the various articles of consumption differ greatly in quality, and are subject to numerous adulterations, must be evident to all, from the slightest consideration and examination of the subject; and if any general proof were required to establish the truth of this position, it would be found in the low and unremunerative prices at which very many commodities, to be genuine, are now commonly sold. That, therefore, there is much relating to our food and drink requiring exposure and remedy cannot be doubted.

We propose, then, for the public benefit, to institute an extensive, and somewhat rigorous, series of investigations into the present condition of the various articles of diet supplied to the inhabitants of this great metropolis and its vicinity, and it is probable that hereafter the inquiries will be extended to some of our distant cities and towns.

One especial feature of these inquiries will be, that they are all based upon actually observation and experiment: the microscope and test-tube throughout these investigations will be our constant companions. We shall borrow but little from the writings of others, preferring to labour and think for ourselves, and to work out our own conclusions in an independent manner.

A second feature will consist in the introduction of faithful engravings, illustrating all the more important particulars relating to the structure of each article as determined by the microscope.

A third and highly important feature will be the *publication* of the *names* and *addresses* of the parties from whom the different articles, the analyses of which will be detailed, were purchased: the advantages of such a course of proceeding require little explanation.

Experience has shown, that any merely general exposure of the nature of the adulterations practised on the public through their food is not sufficient to deter from a repetition of them, and that the only way in which it can be hoped that such fraudulent practices can be stayed, and the public protected, is by such proceedings as will entail personal discredit and probable loss.

Now, although we are fully and firmly determined to protect the interests of the public, we, at the same time, do not desire to inflict injury on any one, as a proof of which we shall refrain from giving any names of adulterators for the space of three months from this date, and shall at present, in connexion with the analyses, merely indicate the street or place in which each vitiated commodity subjected to examination was purchased.

Notwithstanding that we should be perfectly justified in at once making known the name of the tradesman or merchant who is dishonest enough to adulterate the article which he vends, and although to such a proceeding he could raise no sufficient objection, nor hope for the sympathy of the public, yet, desiring to avoid all appearance of harshness, we shall refrain, as we have stated, from doing so at present, but give him the benefit of this distinct warning.

That the public at large will be greatly benefited by these inquiries is obvious, and that such of our colonists as import any article of food into this country and the revenue itself will be largely the gainers, might be very easily and satisfactorily proved.

The honest tradesman or merchant will also be benefited; he has nothing to fear, but, on the contrary, much to gain, for while he will be able to secure fair prices for a genuine commodity, his name, also, will be made known to the public, and he will be upheld in his true light and character, as an upright and honourable tradesman.

Who, then, need fear the disclosures it will be our duty to make? Fradulent dealers,—whether they be wholesale merchants, knavish manufacturers, or adulterating retailers,—they alone will have cause to fear, but none whatever rightfully or legally to complain of the consequences of their own unprincipled proceedings.

The urchin who filches a bun, a penny-piece, or the value of one, breaks the law, and is liable to punishment, even imprisonment,—is it to be supposed, therefore, that the cunning and systematic adulterator of our food and drink, who robs us, not only of our money, but sometimes even of our health and strength, is less guilty? that he is to be allowed to violate the law with impunity in his daily dealings, and not only to go unpunished, but to carry about with him, as at present he commonly does, in his intercourse with his fellows, the undeserved reputation of an honest man? That the law, while it rigorously punishes the trivial offender, should allow the greater criminal to go at large unscathed, is an insult to common sense.

But the question is not merely one of honesty and dishonesty, of profit and loss, it is also eminently sanitary, one of health, and even, in some cases, of life itself—of which many proofs might be readily adduced.

Thus the physician, having carefully planned the diet of his patient, too often finds his well-grounded hopes frustrated through the nefarious practice of adulteration.

In one case he orders arrow-root and isinglass,—the first is very commonly adulterated with potato, or some other inferior farina, whilst for the second is substituted some ill-prepared form of gelatine. In another case he prescribes strong coffee or tea, it may be to counteract the effect of some narcotic poison,—the one is adulterated with a large quantity of chicory, and the other consists of exhausted tea-leaves re-dried.

Similar and even more striking examples affecting strength, health, and sometimes life, might be multiplied to almost any extent; but these few observations are sufficient to show the vast interests involved in the consideration of the subject of the adulteration of the food and drink consumed by the public.

In treating the several subjects which will come under our notice, we do not intend to confine ourselves to any very strict order of arrangement, but shall probably, from time to time, turn aside from our regular course to take into consideration such subjects as may happen to be possessed of peculiar or temporary public or professional interest.

COFFEE, AND ITS ADULTERATIONS.

That the adulteration of coffee prevails to a great extent may be inferred, not merely from the variations frequently to be observed in the outward characters of different samples of this article, but also from several considerations of a general nature. Thus—

1st. While the consumption of all other articles, during the past few years, has progressively increased with the increase of the population, coffee, during that period, has remained comparatively stationary, although, as is well known, the use of an article, under the name of coffee, is now much greater than formerly, especially amongst the members of the different temperance and total abstinence societies.

2nd. It has been ascertained that a much larger quantity of a substance called coffee is annually sold than passes through the custom-houses.

3rd. Chicory is cultivated in large quantities in various parts of this country; and it has been even rumoured that a *minister of the Crown* is himself a large grower of this plant; now, as little chicory is *retailed* to the public under its own name, the inference is, that it is employed, and annually consumed, in the adulteration of coffee.

But it is very far from necessary that in making out our case we should rely upon general statements and arguments; scientific evidence of the most conclusive character has been obtained, by which the nature of the adulterations of coffee, and the extent to which they prevail, may be ascertained.

Now, the chief articles, although many others are occasionally employed, with which coffee is adulterated are, chicory, different kinds of corn, as wheat, rye, and barley, potato, and beans. It is necessary that these substances, like the coffee-berry itself, should be roasted—that is, that they should be partially charred, and so far reduced to the condition of charcoal, or carbon.

In vegetable charcoal, as is well known, the component parts of the several tissues may yet be distinguished, without any great difficulty, by means of the microscope. The less completely carbonised structures of the coffee-berry, chicory-root, and other organic substances employed in the adulteration of coffee, may likewise be detected, with still greater facility, by the same means. This fact, as will presently be seen, has been fully proved by the results obtained.

The vegetable productions with which coffee is adulterated differ very considerably from each other; hence it might be concluded that each would present well-marked structural differences; and this is really the case: the structure of the coffee-berry is very different from that of the chicory-root, and both differ as much from corn, beans, or potato, as these do from each other.

We will now describe sufficient of the structure of each of these substances as will be necessary to enable us to detect the adulteration of coffee with any one or more of the above substances.

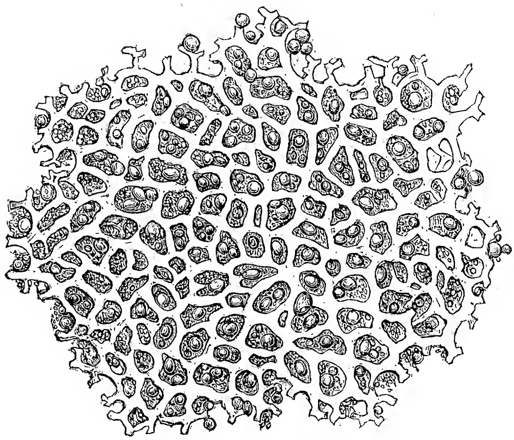
Structure of the Coffee-Berry.—Two parts are to be discriminated in the coffee-berry—the substance of the berry, and the testa, or investment by which it is surrounded.

The *berry*, previous to roasting, and even after it has been soaked for a long time in water, is hard and tough, in which respect it differs from all those substances which enter into the adulteration of coffee, and which become softened by immersion in cold water; the hardness is even retained subsequently to the charring, and is so great, that by this character alone the fragments of the ground and roasted coffee-berry may be readily distinguished from those of chicory.

It consists of an assemblage of vesicles or cells of an *angular* form, which adhere so firmly together that they break up into pieces rather than separate into distinct and perfect cells. The cavities of the cells include, in the form of little drops, a considerable quantity of aromatic volatile oil, on the presence of which the fragrance and many of the active principles of the berry mainly depend. *Fig.* 1.

The *testa*, or investing membrane, presents a structure very distinct from that of the substance of the berry itself, and when once seen it cannot be confounded with any other tissue which has yet been observed entering into the adulteration of coffee: it is made up principally of elongated and adherent cells, forming a

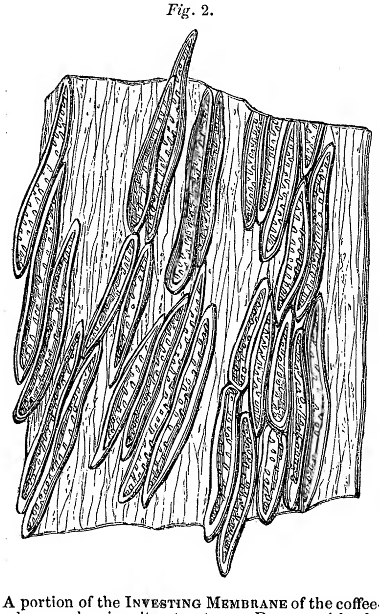
Fig. 1.



Section of UNROASTED COFFEE-BERRY, showing the size and form of the cells, as well as the drops of oil contained within their cavities. Drawn with the Camera Lucida, and magnified 140 diameters.

single layer, and having oblique markings upon their surfaces; these cells rest upon another thin membrane which presents an indistinct fibrous structure. Between the berry and its covering some essential oil is generally present. *Fig.* 2.

Fig. 2.



A portion of the INVESTING MEMBRANE of the coffee-berry, showing its structure. Drawn with the Camera Lucida, and magnified 140 diameters.

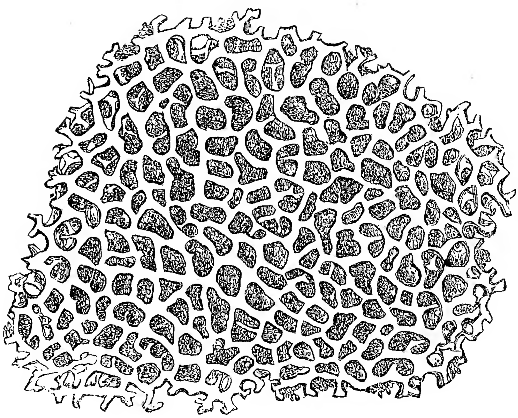
The quantity of this membrane present in a broken and divided state in any sample affords, therefore, some clue to the amount of coffee contained in it.

It has been proposed to deprive the berry of this membrane, and a patent has actually been taken out for this purpose—a process of somewhat doubtful utility, because the removal of this tissue cannot be effected without the loss of the greater part of the essential oil lying between it and the berry, and usually adherent to the former. In the act of roasting, however, more or less of this membrane becomes separated from the berry, when it is termed by the roasters "flights."

In the groove which runs along each berry, a few small vessels, each formed of a single and continuous spiral thread, are usually to be met with; it is impossible, however, to confound these with the ducts hereafter to be described, and which occur in certain other vegetable tissues.

Now the roasting of the berry does not alter its structure; the tissues are indeed partially charred, but they still preserve their chief characteristics. The essential oil, however, is no longer visible in the cells in the form of minute drops or spherules. This has, in part, been dissipated by the heat employed in the process of roasting, and in part is more generally diffused throughout the cavities of the cells; that it is not entirely dissipated and destroyed is evident

Fig. 3.



A fragment of Roasted Coffee. Drawn with the Camera Lucida, and magnified 140 diameters.

from the fact, that in ground roasted coffee, diffused in a little water, the oil may be readily detected in considerable quantity in a partially fused state, in little masses of irregular size and form. *Fig.* 3.

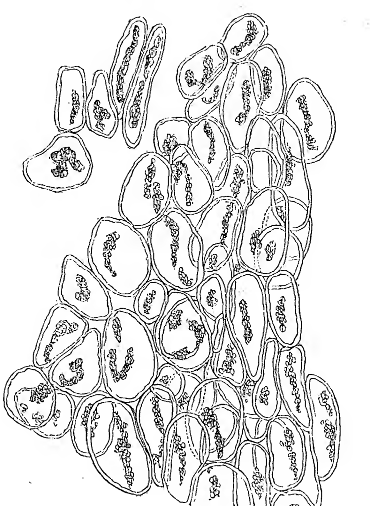
Structure of Chicory Root.—Chicory is the root of the *Cichorium Intybus*, a plant belonging to the natural order *Cichoraceæ*, which includes the Dandelion; and, as might be supposed, from the very dissimilar characters of roots and seeds, it differs very greatly in structure from the coffee-berry.

In it also two parts require to be discriminated, cells and vessels. The chief bulk of the root is made up of little utricles or cells, which are generally of an *elongated* form, but sometimes *rounded*, and which, unlike the cells of the coffee-berry, separate from each other with great readiness, and present appearances which, when once observed, cannot be mistaken. *Fig.* 4.

The cells do not, like those of coffee, contain globules of essential oil, a fact of much importance.

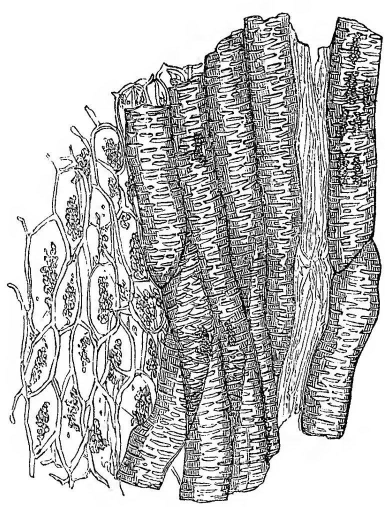
Running through the centre of the root, in a longitudinal direction, are bundles of vessels varying greatly in size, but all of the dotted or interrupted spiral kind. Now there is nothing analogous to these beautiful structures in the coffee-berry, or in the majority of the substances ordinarily employed in the adulteration of that article. *Fig.* 5.

Fig. 4.



Fragment of Roasted Chicory-root, taken from a sample of adulterated coffee, showing the cells of which it is principally constituted. Drawn with the Camera Lucida, and magnified 140 diameters.

Fig. 5.



Fragment of Roasted Chicory-root, taken from a sample of adulterated coffee, showing the dotted or interrupted spiral vessels, which pass in bundles through the central parts of the root. Drawn with the Camera Lucida, and magnified 140 diameters.

Chicory, owing to the absence of essential oil, unlike coffee, readily imbibes water, and when immersed in that fluid it quickly becomes soft, in which respect also it differs from the roasted coffee-berry.

Structure of the Farina of the Gramineæ.—Each grain of the different species of corn, deprived of its investing tunics, or husks, consists of a network of cells, the substance of which has been denominated cellulose, and in each of which a variable number of starch granules is included.

Now these starch granules differ in character in different plants, and this frequently, even in species belonging to the same natural family, so that by their means it is often easy to name the particular species to which any given granule belongs. In the majority of the corn tribe, the granules are flattened and rounded discs, of moderate size, obscurely marked with concentric lines or rings; the starch granules of many species also possess other perfectly distinctive markings, and characters, of which, in this place, it is not necessary to give a detailed description, as in a future report the starch of wheat, rye, oats, &c. will be fully described and accurately represented.

Structure of the Farina of the Leguminosæ. — The different species of beans and peas, deprived of the seed-covering, possess a structure analogous to the grain of corn decorticated, that is, each pea or bean consists of a reticulation of cells, the cavities of which are occupied with numerous starch granules.

The cells differ, however, from those of the seeds of the Gramineæ in their stronger and stouter character, and particularly in the thickness of their parieties.

The granules in the pea, bean, and many other species of this tribe, are large, oval, sometimes reniform, and the central cavity is usually of an elongated shape, presenting the appearance of a furrow under the microscope. These also will be figured and further described at a future stage.

Structure of the Farina of the Potato.—Pure potato flour is seldom used in the adulteration of coffee, it being too expensive, and otherwise not well adapted for the purpose; it is usually the whole potato which is employed, and which is probably first boiled, and then roasted.

The general structure of the potato resembles, to some extent, that of the corn, pea, and bean, already cursorily described. In the unboiled state, the cells form a coherent reticulation, but after boiling, they readily separate from each other, and thus show that each is really a distinct and independent structure.

These cells after boiling present a somewhat fibrous appearance, and are, of course, much larger than the starch granules, many of which are contained in each cell.

The granules themselves, as seen in pure potato flour, are large, ovate, and beautifully marked with concentric rings; but in the boiled potato, they lose much of their form and beauty, and become, for the most part, misshapen and collapsed.

Coffee Colourer.—But the list of articles employed in the adulteration of coffee does not terminate with those above enumerated; at least one other remains to be noticed.

The uninitiated in the mysteries of coffee imagine that the deep-brown colour of the beverage made from that substance is peculiar to coffee, and that the richness and depth of the colour indicate the strength and purity of the article.

Now this brown colour is not peculiar to, or indicative of, coffee; it results from the burning, or partial charring, of the berry; and most other roasted vegetable substances, as chicory, corn, &c., yield, on infusion or decoction, a similar colour.

When cold water is poured upon coffee, the liquid acquires colour only very slowly and gradually; the colouration is never very deep, even after prolonged maceration, and the transparency of the water is scarcely at all affected: when boiling water even is employed, the infusion, although somewhat deeper, still remains clear and transparent.

When, however, cold water is poured upon ground chicory-root, the liquid becomes almost immediately of a deep brown, and in a very short time the depth of colour is so great, and the loss of transparency such, that the fluid is rendered opaque: with water at the temperature of 212° Fah., the results are of course much more marked.

The very different effects of the action of water on ground coffee and chicory, afford, then, one useful and practical means of discriminating between genuine coffee and that adulterated with chicory.

The natural colour thus produced does not, however, satisfy the trade, and a material is very extensively employed to heighten the tint, and thus to hide the nature of the adulterations practised: this is called "the coffee-colourer."

This substance is sold in tin canisters; its use is generally attended with secrecy, but it is sometimes vended openly, not as a coffee-colourer, but as a "coffee-refiner"—a phraseology indicative simply of a refinement of deception.

The specimens of this article which we have examined have consisted of burnt sugar, the great colouring properties of which are well known.

The rapid colouration of water, although calculated to excite suspicion, does not afford, therefore, certain proof of adulteration by chicory, as it may be occasioned likewise by the coffee-colourer just noticed.

We have been informed that sugar is sometimes added to the coffee-berries while undergoing the process of roasting, and being thus burned, becomes converted into a coffee-colourer. The coffee-colourer is much used by the retail dealer, but principally by the owners of coffee-shops, who employ it to cover and conceal the poverty and nauseous character of the filthy and abominable compound which many of them vend, at a penny and a penny-halfpenny per cup, under the much-abused name of coffee.

Extent to which Coffee is adulterated.—We will now proceed to ascertain, by the examination of different samples of coffee, the extent to which the adulteration of that article prevails. The results of the analyses exhibited in the next table are entirely distinct from those given in the table that succeeds it, and the analyses themselves were made several months previously.

RESULTS OF THE MICROSCOPICAL EXAMINATION OF THIRTY-FOUR DIFFERENT COFFEES OF ALL QUALITIES AND PRICES, AND SOLD UNDER THE FOLLOWING ATTRACTIVE TITLES:

Coffees of High Price.

1. *Finest Mocha Coffee.* No adulteration.
2. *Noted Old Mocha.* No adulteration.
3. *Finest Jamaica Coffee.* No adulteration.
4. *Rich Old Mocha.* Of chicory, a good deal.
5. *Best Old Mocha.* A little chicory.
6. *Fine Old Turkey Coffee.* Much chicory.
7. *Very Fine Mocha.* Much chicory.
8. *Genuine Old Mocha.* A little chicory.
9. *Finest Turkey Coffee.* Contains chicory.
10. *Celebrated Old Mocha.* A good deal of chicory.

Coffees of Medium Price.

11. *Costa Rica Coffee.* Nearly one half chicory.
12. *Fine Jamaica Coffee.* Contains a considerable quantity of roasted corn.
13. *Delicious Coffee.* Roasted beans and chicory, forming about one-third of the article.
14. *Plantation Coffee.* Of roasted corn, much, with some chicory, both together forming not less than a third of the sample.
15. *Finest Turkey Coffee.* Much chicory, and some roasted corn; very little coffee.
16. *Celebrated Jamaica.* Very little coffee, principally chicory.
17. *Finest Berbice Coffee.* About one-half coffee, much chicory, and some wheat.
18. *Splendid Turkey Coffee.* About one-half coffee, the rest chicory.
19. *Fine Plantation Coffee.* One-third coffee, the rest chicory, with a little roasted corn.
20. *Beautiful Jamaica Coffee.* Two-thirds coffee, the rest chicory, with a little corn.

21. *Finest Java Coffee.* Half coffee, much roasted corn, with a little chicory.
22. *Superior Plantation Coffee.* Three-fourths coffee, the remainder chicory.

Coffees of Low Price.

23. *Fine Mountain Coffee.* Four-fifths coffee, one-fifth chicory.
24. *Parisian Coffee.* Principally chicory and corn, very little coffee.
25. *Superb Coffee.* The principal part corn and chicory; very little coffee.
26. *Rich Drinking Coffee.* One-third coffee, the rest chicory, with some roasted corn.
27. *Very excellent Coffee.* One half coffee, the other mostly chicory.
28. *Delicious Family Coffee.* One-fourth coffee, three-fourths chicory.
29. *Fine Ceylon Coffee.* Very little coffee, a great deal of chicory, with some roasted corn.
30. *Fine Java Coffee.* Much chicory, and some roasted potato; very little coffee.
31. *Coffee as in France.* Principally chicory.
32. *Very excellent Coffee.* Principally chicory.
33. *Fine Plantation Ceylon.* Nearly all chicory; very little coffee.
34. *Delicious Drinking Coffee.* A large quantity of chicory and much roasted corn.

From an examination of this Table it appears—

1st. That of the thirty-four coffees, *thirty-one* were adulterated.
2nd. That chicory was present in *thirty-one* of the samples.
3rd. Roasted corn in *twelve.*
4th. Beans and potato flour, each in *one* sample.
5th. That in *sixteen* cases the adulteration consisted of chicory only.
6th. That in the remaining *fifteen* samples, the adulteration consisted of chicory, and either roasted corn, beans, or potatoes.
7th. That in many instances the quantity of coffee present was very small; while in others, it formed not more than one-fifth, fourth, third, half, and so on of the whole article.

From calculations which we have made, we are satisfied that the gross aggregate of the adulterations detected did not amount to less than one-third of the entire bulk of the quantity purchased. Now, on referring to the Revenue Returns, we find that the sum derived from the duty on coffee for 1849, was 709,632*l.* 3*s.* 11*d.*, an amount which we have no hesitation in saying might be increased, by vigilance in the detection of the adulteration of this important article, and by punishment of the fraud, when dectected, to very nearly 1,000,000*l.*

We observe that for 1850 the duty amounted to only 642,519*l.* 10*s.* 9*d.*, showing a falling off, in spite of increase of population, of upwards of 67,000*l.* as compared with 1849, and which deficiency is doubtless mainly due to increased adulteration.

The Adulteration of Coffee, considered Dietetically and Medicinally.—The coffee-berry is a seed, and, like seeds in general, it contains the active principles, in large proportion, of the plant from which it is procured, and especially the essential oils.

The beverages most extensively employed amongst mankind nearly all over the world are prepared from tea and coffee; to the use of these different nations have been directed by gradually acquired and long experience of the refreshing and beneficial properties possessed by these infusions.

Now the active principles of tea and coffee are "theine" and "caffeine,"—highly nitrogenised substances, possessed of extraordinary influence on the nervous system; and, by means of chemistry, the remarkable discovery has been made that these two bodies are identical. It is thus seen how correct has been the almost universal practice of mankind in making use of tea and coffee,—a practice not based on science in the first instance, but resulting solely from experience.

Chicory, on the contrary, is the root of a plant. Now roots in general, are remarkable rather for nutritious properties than for any active or medicinal qualities; and of this we find a very sufficient explanation, in the fact of their exclusion from light and heat, the great agents in the elaboration of all the more active organic principles.

The cells of chicory-root, unlike those of the coffee-berry, do not contain any essential oil, and the plant, moreover, is wholly destitute of the active principle of coffee,—viz., caffeine; it being described as somewhat resembling in its medicinal properties, taraxacum or dandelion, being slightly tonic, but chiefly aperient; these properties, however, are probably almost entirely destroyed by the roasting.

It is therefore obvious that *chicory root is no substitute for coffee*, since it so completely wants the peculiar fragrance, and the invaluable stimulant qualities, of that berry.

Of the inferiority of chicory the observer may easily convince himself by preparing hot infusions of chicory and coffee separately, and then carefully contrasting their more obvious properties: the one has little or no fragrance, a sweetish and mawkish taste, and is dark-coloured, thick, and glutinous; the perfume of the other is rich and exhilarating, the taste agreeable, and the liquid bright and transparent.

If, however, the employment of chicory be deemed desirable, either by itself or in combination with coffee, let it be sold openly and separately, under its own name, and at *chicory price;* but it is an unjustifiable imposition on the public to sell under the appellations Ceylon, Berbice, Costa Rica, and Mocha coffees, a mixture of which very frequently coffee constitutes the smallest portion.

The adulterations by means of roasted corn, beans, potato, and coffee-colourer, are altogether indefensible, since the only thing in common between these and coffee is the colour which they yield on infusion or decoction.

Some years since, roasted corn, principally rye, was largely sold, and employed to make a beverage, which, by a fiction, was dignified by the name of coffee; the chief argument, independent of price, urged in favour of it, was its supposed nutritive properties.

When it is recollected that the starch of roasted corn is nearly all reduced to the condition of charcoal, it will at once be perceived that its nutritive qualities cannot be very great, and that a single mouthful of wholesome bread contains more nourishment than a dozen cups of a beverage made from roasted corn.

Although "roasted corn" is now no longer sold openly, yet, as we have just seen, the grocer has not failed to avail himself of it for his own benefit, but to the great disadvantage of the public.

The adulteration of coffee by substances so cheap and, for the purpose to which they are applied, worthless as these, is a gross fraud, requiring emphatic condemnation, and, when ascertained to be practised, meriting exposure and punishment.

Hints to Coffee-Drinkers —It will not be an inappropriate conclusion to this communication, if we offer a few brief directions on the subject of the preparation of the beverage coffee.

Thus every person who desires to have good coffee should attend to the following points.

Except of tradesmen of unquestionable integrity, he should never buy ground coffee, but should procure the roasted berry: in choosing this, care should be taken to notice that it be not too dark, for if so it has been too much roasted, and some of its active properties have been injured or destroyed. It should be ground to rather a fine powder, as this, by setting free the essential oil contained in the cells, allows more readily of the action of water upon it. Immediately on being reduced to powder, it should be placed in a tin canister. Lastly, an *infusion*, and not a *decoction*, of the berry should be made, as during the process of boiling, the active principles, and especially the delicate aroma, are in part dissipated. By attending to these directions, not only will good coffee be obtained, but "a heavy blow and great discouragement" inflicted on the adulterators of coffee.

Above all, the coffee-drinker should never buy the coffee contained in canisters; for he may be assured that it is even more adulterated than other coffee, as it is necessary not only that the purchaser pay for the coffee, but also for the canister itself.

Analyses of various Coffees purchased at the Establishments of different Metropolitan Grocers, Tea and Coffee Merchants.

1*st Sample.*—Purchased on Ludgate-hill.
Adulterated—with much *chicory.*
2*nd Sample.*—Purchased on Ludgate-hill.
Adulterated—with *chicory*, which forms about one-fifth of the article.
3*rd Sample.*—Purchased near St. Paul's.
Adulterated—with *chicory.*
4*th Sample.*—Purchased near St. Paul's.
Adulterated—with *chicory.*
5*th Sample.*—Purchased in High Holborn.
Adulterated—with *chicory*, which forms about a third of the whole article.
6*th Sample.*—Purchased in High Holborn.
Adulterated—with very much *chicory*, which forms more than half the article, and causes it to cohere, or cake, into a solid mass.
7*th Sample.*—Purchased in New Oxford-street.
Adulterated—with *chicory.*
8*th Sample.*—Purchased in Oxford-street.
Adulterated—very much with *chicory.*
9*th Sample.*—Purchased in Tottenham-court-road.
Adulterated—with very much *chicory*, which probably forms more than half the article, and which causes it to clog, or cake.
10*th Sample.*—Purchased in Tottenham-court-road.
Adulterated—very much with *chicory*, which forms not less than half the article, and causes it to cake into a compact mass.
11*th Sample.*—Purchased in Tottenham-court-road.
Adulterated—with *chicory*, which constitutes more than a third of the entire article.
12*th Sample.*—Purchased in the Edgeware-road.
Adulterated—with much *chicory*, as well as roasted corn, the two together forming the greater part of the article.
13*th Sample.*—Purchased in the Edgeware-road.
Adulterated—with *chicory*, which forms not less than half the article.
14*th Sample.*—Purchased in the Edgeware-road.
Adulterated—with *chicory.*
15*th Sample.*—Purchased in Charlotte-street, Tottenham-court-road.
Adulterated—with much *chicory* and some *roasted corn*, both together forming the principal part of the article.
16*th Sample.*—Purchased in Broad-street, Bloomsbury.
Adulterated—with much *chicory.*
17*th Sample.*—Purchased in Crawford-street, Edgeware-road.
Adulterated—with *chicory* and *roasted corn.*
18*th Sample.*—Purchased in Great James-street, Lisson-grove.
Adulterated—with much *chicory.*
19*th Sample.*—Purchased in Church-street, Portman-market.
Adulterated—with a large quantity of *chicory* and some *roasted corn.*
20*th Sample.*—Purchased in Princess-street, Soho.
Adulterated—with much *chicory.*

We now approach the conclusion of this Report. In the Introduction, it was stated that the names of the adulterators of the food of the public would not be published by us until after the offenders had received the benefit of an ample warning. But it may be asked—What is to be done, in the meantime, with respect to those tradesmen who were found to carry on an honest trade, and manage their establishments, with integrity? It may be remarked, that such traders were called upon by accident; that they had no notice—no intimation that the goods they were selling were to be subjected to any unusual or any unprecedented scrutiny,—still it was ascertained, that in the ordinary course of their business they were acting with integrity towards their customers. Who shall allege, that, under such circumstances, they are not fairly entitled to the just distinction and reward which the publication of their names will inevitably confer? Such an act of justice will be universally admitted to be no more than their due. We feel, therefore, much satisfaction in announcing, that the two establishments where *unadulterated*, excellent coffee was purchased, at reasonable prices, were those of

MR. J. F. BETTS,
262. Oxford-street (corner of North Audley-street);

and

MESSRS. KNIGHT AND SON,
83. Gracechurch-street, City.

The coffee purchased at these addresses was of excellent quality and high flavour, no very marked difference existing to distinguish the one from the other. The price paid at the shop of Mr. Betts was 1*s.* 4*d.* per pound; at the shop of Messrs. Knight, 2*s.* per pound. In both instances the article was entirely free from adulteration.

Let us hope that there are hundreds of dealers in coffee, in this metropolis, who are equally entitled to respect and confidence with Mr. Betts and the Messrs. Knight. We have only deeply to regret, that it has so happened, that out of between twenty and thirty apparently reputable establishments, from only two was genuine ground coffee obtained. If it be true that the public health ought to be protected from the noxious influence of sophisticated food, it must assuredly be admitted, with equal truth and propriety, that the honest trader should be protected against his fraudulent competitor.

Adulterations of Coffee, how distinguished. — To sum up, then, briefly. The several adulterations of coffee described in the analyses may be distinguished by the following characters: —

The adulteration with *chicory*, by the size, form, and ready separation of the component cells of the root, as well as by the presence of an abundance of spiral vessels of the dotted form.

That with *roasted corn*, by the size, form, and other characters, of the starch granules, of which the grains are principally composed.

That with *beans*, also by the form, &c., of the constituent granules of starch.

That with *potato*, by the large size, rounded form, and ready separation of the cells of the cellulose, as well as by the fibrous markings on their surfaces.

Lastly, the adulteration with *burnt sugar*, by the flavour and by the tests proper to grape-sugar.

By attention to the above particulars, the principal adulterations to which coffee is liable may be detected with facility and certainty. Other means, however, for the discovery of certain of them, have been pointed out; these we shall now consider.

Thus, it has been stated, that if coffee containing chicory be shaken up with cold water in a wineglass, it will float, while the chicory will sink to the bottom, and this, on a repetition of the trial, we have found to be correct to a certain extent, but not entirely so: in many cases part of the coffee subsides with the chicory, and a portion of the latter rises to the surface with the coffee, and after the lapse of a few minutes, in general both coffee and chicory fall to the bottom, so that in this way we are not able to separate the two substances completely the one from the other, and therefore are unable to determine exactly the quantity of each ingredient of which any sample professing to be coffee is made up, although we can approximately estimate the proportion of each actually present. It is best not to shake the suspected coffee up with the water, but to place it gently upon the surface; it is also advisable to experiment with powdered chicory and coffee separately in the first instance. The reason why the coffee floats upon the liquid is to be found in the quantity of essential oil which it contains, which makes it lighter than the water, which it at the same time repels; on the other hand, it is the absence of this oil which occasions the sinking of the chicory. In repeating these experiments, it will be observed, that the water to which coffee alone has been added, becomes scarcely coloured for some time, while that with the chicory, in less than a minute, assumes a deep brown tint.

It is of importance to know, however, that this last test is almost equally applicable to roasted corn, &c., as to chicory.

It has been further stated, that the presence of roasted corn may be detected by the blue colour produced on the addition of a solution of iodine to the cold decoction. We have not found this to be correct in all cases, for on adding iodine to decoctions of five different coffees ascertained to be adulterated with roasted corn, the liquids did not become blue, but almost black, with a tinge of brown or olive. This appears to arise from the obscuration of the blue colour developed by the iodine, by the rich brown colouring matter of the chicory—a proportion of which almost always accompanies the adulteration with corn. This test, however, is still very useful, in some cases, although it does not often give rise to a colour which can be called blue. It should be known, also, that solution of iodine, added to a cold decoction of chicory root, deepens the colour very greatly, owing probably in part to the presence of a minute quantity of starch: the increase of colour is never, however, so considerable as when flour is present.

It is to be further observed that no exact idea can be formed in this way of the quantity of starch contained in the adulterated coffee, because the greater part being charred, gives no reaction with iodine.

With these explanations the above tests will be found very useful to those who have not a microscope at command; but that instrument affords the only ready and certain means of detecting the majority of the adulterations to which ground coffee and other vegetable powders are so subject.

In searching for roasted corn in coffee with the microscope, the fragments, before being submitted to the object glass, should be well broken up with the points of needles.

We have now considered all the more important adulterations to which, as appears from the preceding analyses, coffee is subjected: it has been stated, however, that the berry is sometimes imitated; but of this no positive evidence has fallen under our own observation. Some grocers make it a practice, in order to give their customers confidence, to grind the coffee while they wait for it. In such cases it is usual to keep a box of chicory nibs of about the size of coffee berries upon the counter; during the grinding a handful or so of the nibs is adroitly transferred to the mill usually without the least suspicion being excited. We shall hereafter have occasion to return more than once to the consideration of the adulteration of coffee.

SUGAR, ITS IMPURITIES AND ADULTERATIONS.

Two kinds of sugar have been particularly distinguished by chemists—viz., cane and grape sugar, or glucose: the first is obtained from the sugar-cane, the beetroot, the maple tree, and some other plants,—while the second is contained in greater or less quantities in most fruits, and particularly in grapes and figs. Honey, although usually described as consisting of grape-sugar, contains a large quantity of crystallisable sugar resembling cane-sugar, and is therefore probably a mixture of the two kinds.

These two sugars differ considerably in many of their properties. *Cane-sugar* consists of oxygen, hydrogen, and carbon, in definite proportions; it is crystallisable, the crystals are six-sided oblique prisms, and when pure, not prone to deliquesce, or alter when exposed to moisture or a moderate temperature.

Grape-sugar consists of the same elements, but contains a less proportion of carbon. Unlike cane-sugar, its manufacture can be effected by art, that is, by the action of the dilute mineral acids, particularly the sulphuric, on either starch or woody fibre; it has but little disposition to crystallise; and when it does so, the crystals assume no definite figure, but are arranged in acicular tufts; exposed to moisture, or a moderate temperature, it readily deliquesces.

Pure and *unadulterated* cane-sugar, therefore, should present a highly crystalline texture, should be of light colour, and free from clamminess or moisture.

These two sugars may be readily discriminated from each other by the action of certain tests, and grape-sugar particularly by the copper and potassa tests.

Now grape-sugar is frequently met with in the brown sugars of commerce, in considerable quantity, and is sometimes introduced for the purpose of adulteration.

This adulteration Dr. Ure, in the Supplement to his "Dictionary of Arts, Mines, and Manufactures," states, can always be detected by means of the well-known copper test; and at page 240. that chemist thus expresses himself on this point:—"With my regulated alkaline mixture I never fail in discovering an exceedingly small portion of starch sugar, even when mixed with Muscovado sugar; and thus an excellent method is afforded of detecting the frauds of the grocers."

The correctness of the above assertion we are not able to confirm, for the reasons about to be adduced.

When sulphate of copper and liquor potassæ are added in certain proportions to a solution of grape-sugar, and heat is applied, the red oxide of copper is immediately thrown down. In a solution of pure cane-sugar no such result ensues.

On employing this test in thirty-six solutions of different samples of cane-sugar, obtained from grocers, we find that the red oxide was thrown down in every case: now had we relied implicitly on the authority above alluded to, we should, without further investigation, have adopted the conclusion that the whole of the sugars so tested *were adulterated* with grape or starch sugar.

The uniformity of the result, however, excited suspicion, and we determined to investigate further.

The test was then applied to some sugars obtained direct from the hogshead, and with the same result; the red oxide was thrown down as before; this of course added strength to previous suspicion.

It was next tried in a solution of some sugar taken direct from the cane itself, and with a similar result. The cane from which the sugar was procured was not recent, but was a portion of a bamboo which had been sent over to this country.

Applied to solutions of twelve different lump sugars the test was more or less successful in three cases, and after the solutions had been boiled for a few minutes, and the sugar thus reduced to the state of a syrup, it became perfectly so in the whole twelve sugars.

Lastly, employed with very dilute solutions of treacle in water, a copious precipitate of the red oxide invariably subsided.

These experiments are of considerable importance, and show clearly—

1st. That cane and grape sugars are very constantly associated, and that they even, in some cases, co-exist in the cane itself.

2nd. That grape-sugar is very generally, and probably invariably, present in the colonial sugars as imported into this country.

3rd. That it is present in nearly all the brown sugars of commerce in very variable quantities.

4th. That some lump sugars even—which are in general to be regarded as nearly pure cane-sugar—contain traces of grape-sugar, and that by the action of a temperature but little exceeding 212° Fahr., they may be readily converted into the inferior sugar termed glucose or grape-sugar.

5th. That treacle is in great part constituted of grape-sugar, resulting, as will be shown hereafter, from the decomposition of the cane-sugar itself, which takes place to a very great extent during its manufacture.

The several results obtained with the copper test were all confirmed by the potassa test; thus solutions of cane-sugar, obtained either direct from the cane, the hogshead, or the grocer, were, when boiled with caustic potash, more or less darkened; the solution of the sugar taken directly from the cane was perfectly colourless until after boiling with the alkali, when it became deep brown.

It thus becomes evident that *the subsidence of even a large amount of the red oxide of copper from the application of the copper test to solutions of cane-sugar is not a sufficient proof of fraudulent adulteration with grape-sugar*, as it was deemed to be formerly.

Impurities of Cane-Sugar.

The impurities of cane-sugar may be divided into the organic and the inorganic.

The *organic* impurities consist of fragments of the sugar-cane, glucose or grape-sugar, vegetable albumen, blood, an animalcule peculiar to sugar, fungi, woody fibre, and starch granules.

The *inorganic* impurities are lime, lead, iron, and sand or particles of stone or grit.

Now, these several impurities are not contained in the crystals themselves, which are pure cane-sugar, but in the more fluid and uncrystallised part of the sugar, that is, in the molasses of sugars, which adheres to and coats the surface of the crystals.

On the Presence of Fragments of Sugar-Cane in Sugar, and on the Structure of the Cane.—The juice of the cane is expressed by means of powerful machinery, and during the operation innumerable fragments of the cane itself, many of them of extreme minuteness, become detached, and pass into the juice. As this in its manufacture into sugar does not undergo in general any process of filtration, and as but few of the fragments drain away with the treacle, the greater part of them are retained in the sugar, in all unfiltered samples of which they may be readily detected in great abundance by means of the microscope.

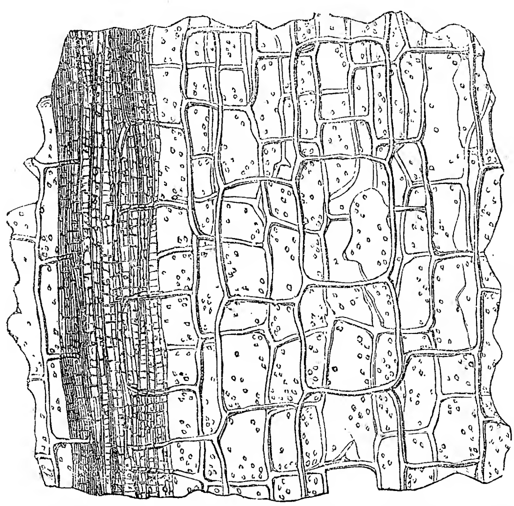
For the more ready and certain identification of these fragments, it is necessary to give a short outline of the structure of the sugar-cane itself.

The sugar-cane belongs to the class of Endogens and the family of the Grasses; it consists of nearly cylindrical rods or stems, which are divided into joints at irregular distances of some three or four inches, and its structure is made up of cellular tissue, woody fibre, vessels, and epidermis.

The parenchyma, or cellular tissue, forms the most considerable portion of the sugar-cane, and it is constituted of aggregations of infinite numbers of utricles or cells, in the cavities of which the juice is inclosed.

These cells are usually rather longer than broad, and in the central parts of the bamboo they are several times larger than in its outer and harder part; the membranes of which the walls of the cells are formed, are all finely dotted or punctated, a character by which the cells of the sugar-cane may be clearly distinguished from most other vegetable cells.

Fig. 6.



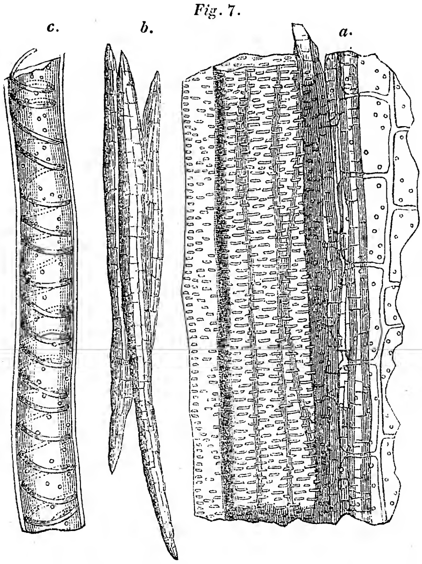
A fragment of SUGAR CANE, taken from near the centre of the stem, showing the size and character of the cells of which the parenchyma is formed, as well as, on the right, a bundle of woody fibre. Drawn with the Camera Lucida, and magnified 100 diameters.

The woody fibre traverses the cane in a longitudinal direction in distinct bundles, which give to transverse sections a dotted appearance. Each bundle is constituted of a number of greatly elongated cells, and sometimes incloses vessels; these are also usually more or less dotted, like the ordinary cells of the parenchyma, of which, indeed, they appear to be merely modifications. *Fig.* 6.

The vessels follow the same disposition as the woody fibre, in the centre of each bundle of which one or more is generally included. These vessels are of two kinds: the one is the interrupted spiral or dotted vessel, and the other the simple or continuous spiral vessel. The dotted vessels are sometimes cylindrical, but frequently polygonal, from the compression exerted upon them by the woody fibre, by which they are immediately surrounded, and the markings of the cells forming which they frequently exhibit on their surfaces; the spiral vessels are found chiefly in the outer and harder part of the stem; they are formed of a single thread, remarkable for its thickness and strength. *Fig.* 7.

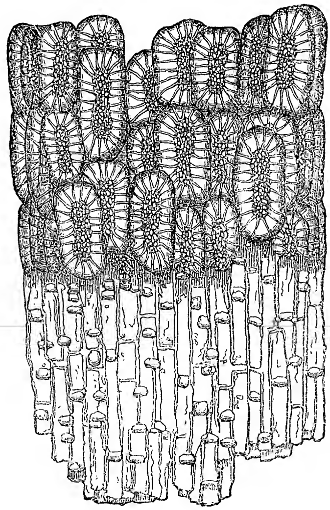
The epidermis or cuticle is known by the elongated, crenate cells, of which it is composed, and the presence of stomata. At the distal extremity of each internode of the cane, the ordinary epidermic cells are replaced or overlaid by a layer of cells, having totally different characters; they are usually little longer than broad, more or less rounded or oval in shape, with their edges marked with short and well-defined lines, disposed in a radiate manner: these cells resemble somewhat the cells found in the stones of fruit, and they form by their union a zone round the cane, polished, hard, and of about the third of an inch in depth. *Fig.* 8.

Fig. 7.



Fragments of the SUGAR CANE, exhibiting the structure of the two kinds of vessels which enter into its composition, as well as the cells of which the woody fibre is constituted. *a*, *Dotted vessel* embedded in woody fibre; *b*, cells of *woody fibre*; *c*, *spiral vessel*. Drawn with the Camera Lucida, and magnified 200 diameters.

Fig. 8.



A portion of the EPIDERMIS of the CANE, showing THE TWO KINDS OF CELLS of which it is composed — viz., those of which the general surface of the cane is formed, and those of which the polished zone described in the text is chiefly constituted. Drawn with the Camera Lucida, and magnified 200 diameters.

Fragments of sugar-cane are present in great quantity in Muscovado sugar, in the sugars of the shops in general, and in "bastards," a product of the manufacture of loaf-sugar.

They are not contained in loaf-sugar, crushed lump, sugar-candy, nor in certain of the East Indian sugars: in the preparation of all these sugars the cane-juice undergoes a process of filtration which effectually removes all solid and bulky impurities.

The presence of these fragments, in many cases, serves to distinguish satisfactorily cane-sugar from either beet, maple, or grape-sugar, a discrimination which otherwise it would be extremely difficult if not impossible to effect.

By the same means, also, cane-sugar may be detected when mixed with beet or starch sugar, a practice which, we believe, is common in France.

The saccharine juice of the beet-root is filtered, and therefore fragments of that plant are not present in the sugar made from it, as they would doubtless be, were this means of purification not adopted.

The presence of sugar-cane in sugar increases the bulk and weight of the article, lessens its sweetness, and thus deteriorates both its quality and value.

On the Admixture of Grape with Cane-sugar, or Glucose.—Purified cane-sugar, some of the more obvious properties of which have already been described, is the most perfect form of sugar known; it is cristallisable, possesses great sweetening properties, and is remarkably indisposed to undergo putrefactive or fermentative changes.

Grape-sugar, denominated more correctly glucose, on the contrary, is a low sugar, deficient in sweetening power, and very prone to fermentation.

It is therefore obvious that cane-sugar must be considered as deteriorated in quality, and consequently depreciated in value, by admixture with grape-sugar, the deterioration and depreciation being proportionate to the amount present.

Now, lump-sugar, well refined, is entirely free, as we have seen, from grape-sugar, and this, therefore, is one of the purest forms of sugar met with in commerce.

Sugar-candy is another of the purer forms, especially white sugar-candy.

Crushed lump, and even the inferior loaf sugars, are also comparatively pure cane-sugars.

Again, certain of the sugars of the East Indies are tolerably free from grape-sugar.

On the other hand, most of the brown sugars of the shops contain a good deal of grape-sugar.

Raw or Muscovado sugar, containing, as it always does, much treacle, is contaminated with a still larger proportion of grape-sugar.

But the treacle itself, and the sugar called "bastards," contain by far the largest proportion of grape-sugar, and are, indeed, to a considerable extent, constituted of it.

It is also well it should be distinctly understood that the inferiority of such cane-sugars as contain grape-sugar largely is not in general due alone to the presence of that substance, but also to certain other impurities which usually accompany it, as vegetable albumen, fragments of cane, &c.

On Vegetable Albumen in Cane-sugar.—Vegetables, like animals, contain principles, into the composition of which nitrogen largely enters: the chief of these is vegetable albumen.

Now, these principles, whether they occur in the dead plant or animal, are remarkably prone to undergo change and decomposition.

This decomposition reacts on the non-nitrogenised substance sugar, and induces in it a series of changes including fermentation.

The greater the amount of vegetable albumen, therefore, contained in any sample of sugar, the more liable will it be to undergo fermentative and putrefactive changes.

It is the presence of this vegetable albumen in the juice of the sugar-cane which constitutes one of the great difficulties of sugar-refining. Various salts and substances, sugar included, it is known will not readily crystallise in an albuminous fluid: the efforts of the refiner, therefore, are directed to the removal of this substance, no easy task; and the more completely this removal is effected, the purer, in general, will be the sugar obtained.

In loaf-sugar, sugar-candy, and certain East Indian sugars, although they contain some albumen, yet the amount comparatively is but small.

The brown sugars in general use, raw or Muscovado sugar, treacle, "bastards," all contain albumen largely, and therefore are liable to ferment; and, indeed, as usually met with in commerce, they are actually in a state of slow fermentation, as is shown by the fact, that a solution of them in warm water evolves a distinct and frequently strong odour, resembling that of sweet-wort.

It thus appears that those sugars which contain most grape-sugar ordinarily also are most contaminated with albumen.

Now, grape-sugar, as we have before said, is the form of sugar most liable to fermentation, and it is even necessary that cane-sugar, before it can ferment, should first be converted into grape-sugar; the presence of albumen, therefore, tends to convert cane into grape-sugar, and so augment the amount of the latter.

But there are other evils, still more serious, connected with the presence of albumen in sugar, and which will be presently noticed.

Blood in Sugar.—The employment of the blood of animals is confined to the manufacture of loaf-sugar, and its use, we believe, is now very frequently dispensed with, even in the preparation of this article.

The blood acts only through the albumen which it contains: now, we have just said, that one of the great difficulties of sugar-refining arose from the presence of vegetable albumen in the cane-juice; and here we have the apparent contradiction involved in the practice of putting albumen into the solution of sugar.

The advantages derived from the use of this substance, we presume, are considered to more than counterbalance the disadvantages attending it; and indeed it would appear that there is not the same difficulty in the removal of animal albumen as is experienced in the abstraction of vegetable albumen.

The mode of its operation is as follows: the fluid albumen is diffused throughout the whole of the sugar-solution to be clarified; on the application of heat, the albumen immediately solidifies, and forms meshes and films, which, being lighter than the water, ascend, and in their upward course carry with them the solid impurities contained in the solution, on the surface of which a scum is gradually formed, consisting of the impurities in question and the solidified albumen: this scum may be removed by skimming.

Now, as it is the albumen of the blood only which assists in clarifying the sugar-solution, and not the blood itself, it would be far better that albumen alone, as white of egg, should in all cases be employed.

Blood is a fluid compounded of fibrin, albumen, and a variety of salts and effete substances; its use, therefore, in the manufacture of lump sugar, is not merely disgusting, but is calculated to prove injurious to the health.

The sugar-refiner will tell us that the whole of the blood employed is removed by the processes of filtration adopted. This is not the case, however, as may in general be readily proved by dissolving a few knobs of lump-sugar in a large wineglass of warm water, and subjecting the sediment which usually falls to the bottom, to microscopic examination and chemical analysis: the first shows that the sedimentary matter consists of angular flocculi, taking the form of the interstices of the crystals; and the second, that it is composed of coagulated albumen.

The only considerable advantage derived from the use of blood, is its cheapness; but when not merely cleanliness but health is concerned, the question of economy ought not to be entertained for one moment.

On the Acarus sacchari, or Sugar Insect.—There is very commonly present, in the more impure kinds of sugar, a beetle-like animalcule, of the genus *Acarus*.

The discovery of the very general presence of this acarus rests, we believe, entirely with ourselves.

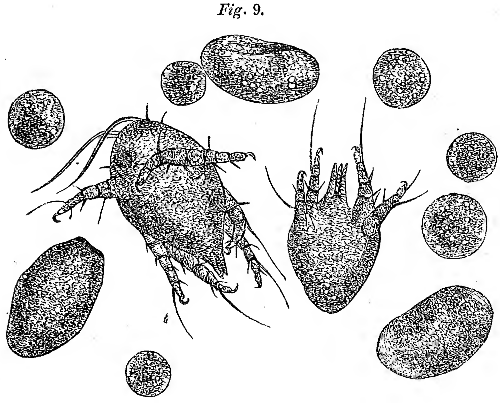
The sugar acarus approaches somewhat, in organisation and habits, the louse and the itch-insect itself, which are also included in the genus *Acarus*.

The sugar-mite is in size so considerable, that it is plainly visible to the unaided sight. When present in sugar, it may always be detected by the following proceeding:—two or three drachms or teaspoonfuls of sugar should be dissolved in a large wine-glass of tepid water, and the solution allowed to remain at rest for an hour or so; at the end of that time the animalcules will be found, some on the surface of the liquid, some adhering to the sides of the glass, and others at the bottom, mixed up with the copious and dark sediment, formed of fragments of cane, woody fibre, grit, dirt, and starch granules, which usually subsides on the solution of even a small quantity of sugar in water.

We will now proceed to give a description of the acarus in question, and observe, in the first place, that the whole of its development may be clearly traced out in almost every sample of brown sugar.

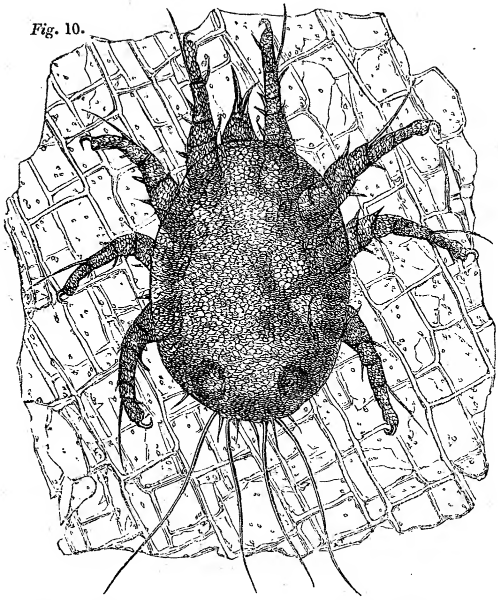
The *Acarus sacchari* is first visible as a rounded body, or egg; this gradually enlarges and becomes elongated and cylindrical until it is about twice as long as broad; after a time, from the sides, and one extremity of this ovum, the legs and proboscis begin to protrude. These stages of the development of the acarus are exhibited in the accompanying figure.

Fig. 9.



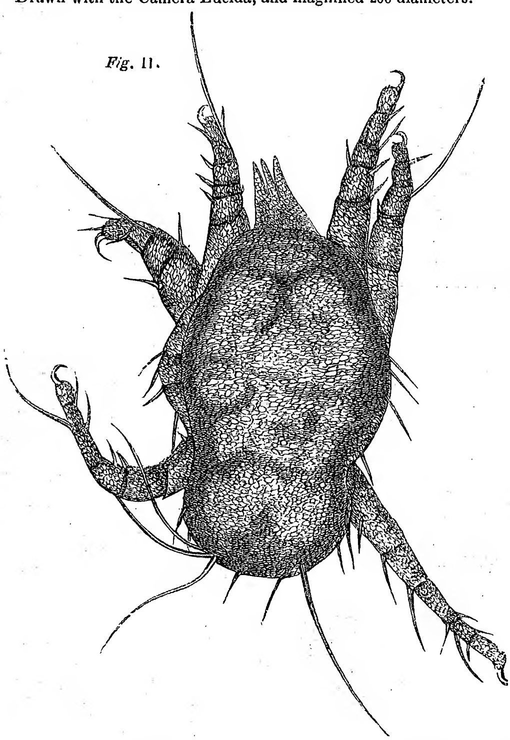
Ova and young of the ACARUS SACCHARI, or *sugar-insect*. Drawn with the Camera Lucida, and magnified 200 diameters.

Fig. 10.



A SUGAR-INSECT of medium size, representing its attitude and appearance when alive, and as seen crawling on a fragment of cane. Drawn with the Camera Lucida, and magnified 200 diameters.

Fig. 11.



This figure represents a SUGAR-INSECT, which has nearly attained its full development, and as it frequently appears when dead. Drawn with the Camera Lucida, and magnified 200 diameters.

The acarus thus far formed, goes on increasing in size until it attains its full growth, when it is visible to the naked eye as a mere speck.

In its perfect state, its structure is as follows:—The body is oval, or rather somewhat ovate, being broader behind than before; from its posterior part four long and stiff bristles proceed, two together on each side; and some eight or ten smaller ones are arranged nearly at equal distances around the circumference of the body; from its anterior part a proboscis of complex organization proceeds, and from its inferior surface eight legs, jointed and furnished with spines or hairs at each articulation; the spine which issues from the last joint but one of each leg is very long, and extends much beyond the termination of the leg itself; lastly, each leg is armed at its extremity with a formidable hook.

Many of the above particulars are faithfully exhibited in the engravings.

In most samples of sugar the acari may be seen of all sizes, that is, in all the stages of their growth and in every condition, some alive, others dead, some entire, and others broken into fragments, bodies here, legs there.

When the acarus is alive the legs are most commonly regularly disposed around the body, and the creature makes efforts to crawl; not unfrequently a number of acari may be seen attached to fragments of the cane; when dead the attitude and disposition of the several parts are changed; the proboscis falls on one side, and the legs are variously arranged.

The *Acarus sacchari* clings to life with great tenacity, for very warm water does not always kill it, and it may frequently be found in a living condition even after twenty-four hours' immersion.

We have said that the sugar-mite is very commonly present in the less pure sugars—we might have asserted that it is almost constantly so, the statement being based upon the examination of not less than *one hundred* different samples of sugar.

Thus the acari are usually present—

In nearly all the brown sugars as imported into this country.

In the ordinary brown sugars of the shops.

They are not contained

In lump sugar.

In sugar-candy.

In certain of the white sugars of the East Indies, in the manufacture of which filtration is had recourse to.

As a rule the number of acari present in any sample of sugar may be taken as a fair indication of the purity of that sugar; the purer the sugar, the freer it will be from the disgusting sugar-mite. The correctness of this statement we shall immediately proceed to make evident.

It has often happened to us to have to refute the foolish statement of ill-informed and unreflecting persons, that living productions are to be found in everything we eat and drink: this assertion, although unfortunately true of the water we are compelled to drink, and one or two other articles of consumption, as a general statement is completely at variance with the truth, and it may be safely affirmed that whenever living animal or vegetable productions are contained in our food or drink, they indicate conditions which render such food or drink wholly unfit for human consumption.

Every animal production, from the largest to the smallest, contains in its composition a certain proportion of nitrogen; and no animal can live for any length of time on food, as on sugar, for example, which does not contain a proportion of the same principle—viz., nitrogen.

Since, then, the sugar acari live and multiply in sugar, it is evident that they must find in it some substance to feed upon containing nitrogen, and thence capable of sustaining them.

This substance the acari obtain in the *vegetable albumen* of which we have already spoken, and in proportion to the amount of this, in any sample of sugar, will, in most cases, be the number of acari contained in it.

We now understand why the *Acarus sacchari* is not found in the purer sugars, as lump-sugar, sugar-candy, and certain sugars of the East Indies, and why it is almost always present in the brown sugars of commerce, and in raw or Muscovado sugar.

The acari are not usually present in treacle, although this contains a large quantity of vegetable albumen; the reason of this is, that they require atmospheric air, and are not adapted to live for any length of time in fluids.

Grocers' Itch.—It is well known that grocers are subject to an affection of the skin, denominated "grocers' itch," of which one of the symptoms is extreme irritation and itching.

To this disease all grocers are not equally liable, but those more particularly who are engaged in the "handling" of the sugars, as the warehousemen.

Now the *Acarus sacchari* actually belongs to the same genus as the *Acarus scabiei*, or itch-insect, than which, however, it is larger, and possessed of an organisation still more formidable and forbidding.

It thus becomes extremely probable that the disease in question does really arise from the sugar acarus—a point, however, which nothing short of microscopic observation can satisfactorily determine.

It may be contended that the eruption of grocers' itch does not resemble that which is ordinarily occasioned by animalculæ; and it has been very plausibly suggested by an eminent authority on the diseases of the skin, Mr. Erasmus Wilson, that the disorder may be occasioned by derangement of the digestive organs, resulting from the frequent tasting of the sugars.

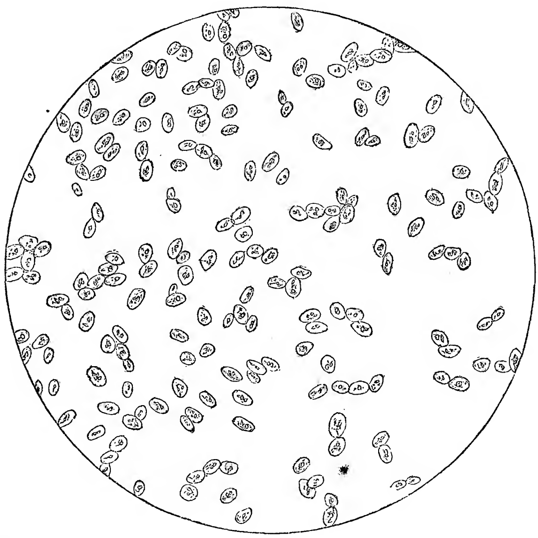
Grocers are not the only persons subject to an eruption of the skin, attended with excessive irritation, and arising from causes connected with their occupation. Bakers are also liable to a somewhat similar disease; and it is known that flour frequently swarms—is, in fact, "alive"—with a species of acarus, which we name "*Acarus farinæ*," and of which we shall have occasion to speak hereafter in detail.

On Sporules of Fungi in Sugar.—Innumerable sporules of fungi are very generally to be observed in the less pure kinds of sugar; they occur, indeed, most abundantly in those sugars which favour the development of the acari.

They are best seen by dissolving a small quantity of any brown sugar in water, and looking for them in the sediment which subsides, and which, to a great extent, is constituted of the sporules in question.

These sporules are exceedingly minute bodies, usually of an oval form, and either floating singly in the sugar-solution, or else adhering together, and thus forming little beaded threads. Under favourable circumstances the sporules become developed into perfect plants or fungi.

Fig. 12.



Sporules of the FUNGUS found in brown sugar. Drawn with the Camera Lucida, and magnified 420 diameters.

Now, fungi, like animals, contain nitrogen, and require nitrogenised food for their support: thus they feed, as do the sugar acari themselves, on the *vegetable albumen* contained in impure sugars.

The presence of fungi in sugar, then, is another evil resulting from its admixture with nitrogenised substances, and they are no doubt, in general, indicative of the fermentation of the sugar. Sporules of fungi are to be found in the brown sugars of commerce, with scarcely a single exception.

On Starch in Sugar.—In almost every sample of brown sugar, there may be noticed a variable quantity of starch granules. For the presence of these we were for some time at a loss to account, and did not know whether they were to be regarded or not as evidences of adulteration: the quantity was obviously too small to serve the purpose of direct adulteration; but it was thought that they might indicate the admixture of cane with starch-sugar, prepared from potato farina, and to which we shall have again to allude under the head of "The Adulterations of Sugar."

It became manifest, however, on further investigation, that in most cases their presence was accidental, as not only was the number of granules small, but they were unchanged, so that very generally they could be referred to the plant to which they belonged; thus, in samples of sugar obtained direct from the hogshead or bag, the starch granules discovered were those of Indian corn, arrow-root, sago, or tapioca; while in those samples procured from grocers, not only were these same kinds present, but also others, as those of wheat, corn, &c.

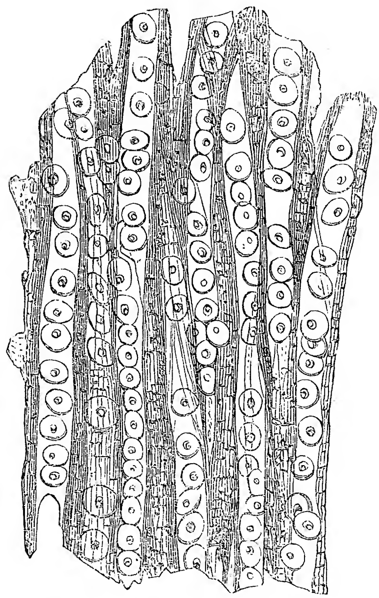
When it is remembered that the grains of starch form an almost impalpable powder, and that the slightest breath of wind is sufficient to diffuse them through the atmosphere, there is no difficulty in accounting for their presence in most *brown sugars.*

But starch granules are almost constantly met with in *lump sugars*, in which case the same explanation appears scarcely so satisfactory.

It some rare instances, however, as will be noticed shortly, the quantity of farina present in sugar is so great, that it must have been designedly introduced.

The ripe sugar-cane contains but little starch, and as the cane-juice is subjected to prolonged boiling, it is manifest that no portion of the starch found in sugar can in any case be derived from the cane itself.

Fig. 13.



A fragment of woody fibre of the FIR, showing its structure. Drawn with the Camera Lucida, and magnified 200 diameters.

Woody Fibre in Sugar.—The last organic substance which we have noticed frequently in sugar occurs in the form of minute and sawdust-like fragments of deal: as these present a very beautiful and curious structure, and as without some notice or explanation they might greatly puzzle the inexperienced observer, we give an engraving of a minute fragment of wood-fibre of the fir. The presence of these fragments in brown sugar is no doubt accidental, and in most cases they are derived from the hogshead, or other wooden material with which the sugar may have come in contact.

In lump-sugar, microscopic or sawdust-like fragments, not only of deal, but also of other woods, are almost constantly seen, and this frequently in great abundance. Of their presence in this description of sugar it is not easy to give a satisfactory explanation; their number in some cases would lead to the inference that they had been designedly introduced, possibly to facilitate crystallisation, by acting as nuclei.

We have next to notice the inorganic impurities of sugar.

On Lime in Sugar.—Lime has a remarkable affinity for organic matter, and it is this which has led to its general employment in the purification of cane-juice.

Now, as brown sugar does not undergo, in the course of its preparation, any process of filtration, a portion of the lime used may very commonly be detected in such sugar.

In the manufacture of lump-sugar, an additional quantity of lime, in the form of lime-water, is employed; and in this sugar, also, notwithstanding the careful filtration to which the sugar solution is subjected, that substance may sometimes be discovered.

On Lead in Sugar.—In some cases, traces of lead may be detected in refined or lump-sugar; this circumstance is explained by the use of leaden vessels.

On this subject we shall not at present offer any further observations, as we may probably, in a future Report, treat of the manufacture of sugar, and examine all the facts connected with the process employed by Dr. Scoffern for the refinement of sugar.

On Iron in Sugar.—It occasionally, although rarely, happens that iron may be detected in refined sugar; this, like the lead, is to be traced to the use of metallic utensils.

On fragments of Stone or Grit in Sugar.—Fragments or particles of stone or grit may almost constantly be detected in brown sugar.

There are three sources from which these might be derived—from the imperfectly washed cane itself; from the lime used in clarifying the cane-juice; and from exposure during the process of crystallisation.

Results of the Microscopical and Chemical Examination of Thirty-six Brown Sugars of different Qualities and Prices.

The quantity of each sugar submitted to examination did not in general exceed one drachm, yet the following were the results.

1*st Sample.*—Contained numerous fragments of *cane*, a great many *starch granules*, and two or three pieces of *starch*, made up of aggregations of granules; several pieces of *woody fibre;* TEN OR TWELVE ACARI; *grape-sugar; vegetable albumen; lime.*

2*nd Sample.*—Numerous fragments of *cane;* a great many *starch granules*, two or three pieces of *starch;* A CONSIDERABLE NUMBER OF ACARI; much *vegetable albumen; grape-sugar*, and *grit.*

3*rd Sample.*—Not many pieces of *cane;* a moderate quantity of *starch granules*, one or two masses of *starch;* A CONSIDERABLE NUMBER OF ACARI; a few filaments and sporules of *fungus;* much *vegetable albumen*, and *grape-sugar.*

4*th Sample.*—A few minute pieces of *cane* only; a considerable number of *starch granules;* A GREAT MANY ANIMALCULES, SOME ALIVE; a few oval *ova* of same; much *albumen*, and *grape-sugar.*

5*th Sample.*—Not much *cane;* rather a small number of *starch granules*, three or four pieces of *starch;* A FEW ACARI; *albumen; grape-sugar.*

6*th Sample.*—Much *cane;* a considerable number of *starch granules*, one or two pieces of *starch;* NOT MANY ACARI; numerous *sporules*, and a few filaments of *fungus;* several fragments of *woody fibre; albumen; grape-sugar.*

7*th Sample.*—A few pieces of *cane;* a great many *starch granules*, several masses of *starch;* FIVE OR SIX ACARI; numerous fragments of *woody fibre; albumen; grape-sugar; grit.*

8*th Sample.*—Not much *cane;* a great many *starch granules;* several pieces of *starch*, formed of large cells, like those of the potato; NUMEROUS ACARI, and oval *ova* of same; much *vegetable albumen* and *grape-sugar; grit.*

9*th Sample.*—A few pieces of *cane;* many *starch granules*, and several masses of *starch;* NUMEROUS ACARI; sporules of *fungi; woody fibre; albumen; grape-sugar; grit.*

10*th Sample.*—Much *cane;* a great many *starch granules*, and several masses of *starch;* NUMEROUS ACARI, some broken into pieces; a few bits of *woody fibre; albumen; grape sugar.*

11*th Sample.*—A few pieces of *cane;* not very many *starch granules;* one or two masses of *starch;* TWO OR THREE ACARI; several *ova* of same; sporules of *fungus; albumen; grape-sugar.*

12*th Sample.*—A great many pieces of *cane*, but few *starch granules;* two or three masses of *starch* and cells, filled with *granules*; A FEW ACARI, SOME ALIVE; *albumen; grape-sugar; grit.*

13*th Sample.*—Much *cane;* a considerable number of *starch granules;* A GREAT MANY ACARI, SOME ALIVE; much *albumen; grape-sugar; grit.*

14*th Sample.*—A few pieces of *cane;* a considerable number of *starch granules*, and numerous masses of *starch;* a few filaments of *fungus* terminating in globular extremities, beset with sporules, (this fungus we have seen several times in sugar;) fragments of *woody-fibre; grape-sugar.*

15*th Sample.*—But little *cane;* a great many *starch granules*, and two or three masses of *starch;* TEN OR TWELVE ACARI; several pieces of *woody fibre;* numerous sporules, and a few filaments of *fungus; albumen; grape-sugar; grit.*

16*th Sample.*—Very little *cane;* not many *starch granules;* NUMEROUS ACARI OF LARGE SIZE, MANY ALIVE; a great many *eggs* of same; much *albumen* and *grape-sugar.*

17*th Sample.*—Very few pieces of *cane;* a very considerable number of *starch granules;* one or two masses of *starch;* AN IMMENSE NUMBER OF ACARI, some entire, some broken into fragments; a great many circular and oval *ova* of same; fragments of *woody fibre; grape-sugar;* very much *albumen.*

18*th Sample.*—But few pieces of *cane; starch granules*, and several large masses of *starch;* A VAST NUMBER OF ACARI of all sizes and in all conditions; also a great many circular and oval *ova* of same; much *albumen; grape-sugar.*

19*th Sample*—A good deal of *cane;* A LARGE QUANTITY OF POTATO FLOUR; no *acari; grape-sugar.*

20*th Sample.*—Much *cane*; a very great many *starch granules*; NOT MANY ACARI; some *albumen*; *grape-sugar*.

21*st Sample.*— A moderate quantity of *cane*; *starch granules*; SEVERAL ENTIRE ACARI, as well as fragments; numerous *ova* of same; fragments of *woody fibre*; *albumen*; *grape-sugar*.

22*nd Sample.*—A great deal of *cane*; A VERY LARGE QUANTITY OF POTATO FLOUR; A FEW ACARI, SOME ALIVE; *albumen*; *grape-sugar*.

23*rd Sample.*— A moderate quantity of *cane*; very few *starch granules*; SEVERAL ACARI, SOME ALIVE; sporules, and filaments of *fungus* in tufts; *grape-sugar*; *albumen*.

24*th Sample.*— Numerous pieces of *cane*; A LARGE QUANTITY OF FLOUR; A FEW ACARI, and many *ova* of same; *grape-sugar*; *albumen*; much *grit*.

25*th Sample.*—Much *cane*; a few *starch granules*; one or two masses of *starch*; SEVERAL ACARI and *ova* of same; *albumen*; *grape-sugar*.

26*th Sample.*—Much *cane*; not a great many *starch granules*; a few *potato cells*; ACARI; fragments of *woody fibre*; *grape-sugar*; *albumen*.

27*th Sample.*— Much *cane*; a considerable number of *starch granules*; several cells filled with granules like *potato* cells; A FEW ACARI; numerous sporules of *fungus*; *woody-fibre*; *albumen*; *grape-sugar*; much *grit*.

28*th Sample.*— Not much *cane*; a very great number of *starch granules*; several masses of *starch* visible to the naked eye; NOT MANY ACARI; *grape-sugar*; *albumen*.

29*th Sample.*— A few pieces of *cane*; not many *starch granules*; A GREAT MANY ACARI, SOME ALIVE; numerous *ova* of same; two or three fragments of *woody fibre*; *grape-sugar*; *albumen*.

30*th Sample.*— Very little *cane*; a considerable number of *starch granules* and several masses of *starch*; A FEW ACARI; *grape-sugar*; *albumen*; *grit*.

31*st Sample.*—A few pieces of *cane*; not many *starch granules*; cells like those of *potato*, adhering so as to form little masses; AN IMMENSE NUMBER OF ACARI, MANY ALIVE, and numerous *ova*; sporules of *fungus*; *grape-sugar*; much *albumen*.

32*nd Sample.*— Much *cane*; not many *starch granules*; A VERY GREAT MANY ACARI; numerous *ova* of same; sporules and filaments of *fungi*; *grape-sugar*; *albumen*.

33*rd Sample.*— No *cane*; a great many *starch granules* and masses of *starch*; TWO OR THREE ACARI ONLY; no sporules of *fungus*, and no *grit*; a very little *grape-sugar*; *albumen*.

(This sugar presented a highly crystalline texture, and was nearly as white as lump-sugar; the absence of all solid impurities showed that it had been subjected to filtration.)

34*th Sample.*— A few pieces of *cane*; MUCH FLOUR; several cells like those of *potato*; A GREAT MANY ACARI, SOME ALIVE; *grape-sugar*, and much *albumen*; a little *grit*.

35*th Sample.*— But little *cane*; a great many *starch granules*; two or three masses of *starch*; several *potato cells* filled with *granules*; NUMEROUS ACARI, and many *ova*; *grape-sugar*; *albumen*.

36*th Sample.*— Much *cane*; a few *starch granules*; ONE OR TWO ACARI; a few minute fragments of *woody fibre*; *grape-sugar*; *albumen*.

An analysis of the above Table shows—

1st. That fragments of *cane*, frequently so minute as to be visible only with the microscope, were detected in all the sugars except one, that being a very white sugar, and evidently purified by filtration, so as to cause it to approach in character refined or lump-sugar.

2nd. That *the disgusting-looking Acari were present in Thirty-Three out of the Thirty-Six sugars*, and in nineteen cases in very considerable numbers.

3rd. That sporules and filaments of *fungus* were present in at least Ten cases. (From subsequent examinations we have ascertained that sporules of fungus are almost invariably present in brown sugars.)

4th. That *grape-sugar* was detected in the whole thirty-six sugars, often in very considerable amount.

5th. That the whole of the sugars contained a variable proportion of vegetable *albumen*.
6th. That a greater or less number of pieces of *woody fibre* were noticed in nearly all the sugars.
7th. That *stony particles* or *grit* were observed in at least eleven instances.
8th. That a variable quantity of *starch* or *flour* was contained in each sample of sugar submitted to examination, either in the form of free granules, or aggregations of granules and cells.
9th. That in *four* of the sugars the amount of flour was so considerable, that it had evidently been employed for the purpose of adulteration.

We will now proceed to relate the results obtained by the examination of samples of refined or lump sugar.

Results of the Microscopical and Chemical Examination of Fifteen Samples of Lump-Sugar of different Qualities and Prices.

The quantity of sugar submitted to examination in each case was about half-an-ounce.

37*th Sample.*—A considerable number of *starch granules;* flocculi of *animal matter;* a great many fragments of *woody fibre.*
38*th Sample.*—Much *starch*, partly in lumps, visible to the naked eye; flocculi of *animal matter;* a great many minute pieces of *woody fibre.*
39*th Sample.*—A few *starch granules;* flocculi of *animal matter;* many pieces of *woody fibre;* a little *grape-sugar.*
40*th Sample.*—A few *starch granules;* several masses of *starch* and *potato cells*, filled with *granules;* flocculi of *animal matter;* a great many chips or minute fragments of *wood.*
41*th Sample.*—A considerable number of *starch granules;* and several masses of *starch* visible to the naked eye; flocculi of *animal matter;* a few pieces of *woody fibre* only.
42*th Sample.*—A few *starch granules;* one or two pieces of *starch;* flocculi of *animal matter;* several fragments of *woody fibre.*
43*th Sample.*—Very few *starch granules;* a considerable number of fragments of *woody fibre;* traces of *grape-sugar.*
44*th Sample.*—A few *starch granules;* a dozen fragments or so of *woody fibre.*
45*th Sample.*—A few *starch granules;* two or three cells of *potato;* hundreds of fragments of *woody fibre*, forming at the bottom of the glass a sediment of *saw-dust.*
46*th Sample.*—A few *starch granules*, and one or two aggregations of *granules;* a very great many pieces of *woody fibre;* traces of *grape-sugar.*
47*th Sample.*—A few granules of *starch;* flocculi of *animal matter* abundant; two or three dozen fragments of *woody fibre.*
48*th Sample.*—A small number of *starch granules;* one or two aggregations of *granules;* a few microscopic fragments, or chips of *wood.*
49*th Sample.*—A considerable number of *starch granules;* several *potato cells;* flocculi of *animal matter;* a few fragments of *woody fibre.*
50*th Sample.*—A few *starch granules;* a little *animal matter;* a very few fragments of *woody fibre.*
51*th Sample.*—*Starch granules* rather numerous; several cells of *potato* filled with granules of *starch;* flocculi of *animal matter* abundant.

From an examination of this Table it appears—

1st. That in none of the sugars were fragments of *cane* present; these having been separated by the filtration through charcoal to which sugar in process of refinement is subjected.
2nd. That in no case were *acari* observed.
3rd. That in three of the sugars only were traces of *grape-sugar* to be detected.
4th. That in none of the sugars were sporules of *fungi* to be seen.
5th. That a variable, although small, quantity of *flour* was present in the whole *fifteen* sugars.
6th. That *animal matter* was observed in *ten* cases.

7th That *sawdust-like fragments of woody fibre* were present in twelve cases, being very abundant in at least *seven* of the sugars.

For the presence of even a small quantity of flour in lump-sugar it is not easy to account satisfactorily; and as all we could say on this point would be conjectural, we shall not at present offer any further observations upon it.

We are in the same position of uncertainty with respect to the fragments of woody fibre, but we have elsewhere suggested a possible use and explanation of their presence in sugar.

The animal matter so generally present is no doubt a portion of that used in the clarification of the sugar solution.

Contrasting, then, the condition of moist and lump sugar, as met with in commerce, it is evident that the impurities of the former are much greater, and of a more objectionable character, than those of the latter; that while in the one there are very commonly present the repulsive insects or acari, sporules and filaments of fungi, grape-sugar, albumen, grit, starch and woody fibre, the other is at least free from the majority of these impurities.

We will, in the next place, give the results furnished by the examination of several samples of brown sugar, the produce of various colonies and countries; we shall thus be in a position to judge of the state in which many of the sugars imported into this country arrive.

The samples submitted to examination but little exceeded one drachm.

Results of the Microscopical and Chemical Analyses of Samples of various Brown Sugars, the Produce of different Countries.

Madras.—Sugar dark, moist, staining the paper; somewhat crystalline, crystals small: contains fragments of cane; *several acari;* very few starch granules; grit; much grape-sugar and vegetable albumen.

Madras.—Contains a few pieces of cane; starch granules; much grit; *several acari* and ova; grape-sugar; albumen.

Mauritius.—Contains much cane; *ten or twelve acari*, of large size; several ova of same; a few starch granules; fragments of woody fibre; grit; much grape-sugar and albumen.

Mauritius.—Contains some cane; *several acari;* a few starch granules—those of arrow-root; grit; grape-sugar and albumen.

Calcutta.—Sugar not very dark, dry; earthy-looking; but few crystals apparent, and those very small; not much cane; a few starch granules; grit; *no acari* visible; grape-sugar; albumen.

Calcutta.—Sugar perfectly white, dry, and highly crystalline, resembling crushed lump; a few starch granules; *no acari*, fungus, cane, or grit; scarcely a trace of grape-sugar or albumen.

Bombay.—Sugar exceedingly dark-coloured, earthy, and damp: contains some cane; a great many starch granules; (sago?) *numerous acari;* much grape-sugar; albumen.

Cassipore, Calcutta.—Sugar pale straw-colour, dry and highly crystalline, large-grained; a very few pieces of cane; *one small acarus;* a few starch granules; scarcely a trace of albumen or grape-sugar; a little grit.

Cassipore, Calcutta.—Sugar pale straw-colour, not very dry, fine-grained, the crystals being very small: contains a few pieces of cane; starch granules; *several acari* of large size; much grit; a little grape-sugar and albumen.

Jamaica.—Sugar dark-brown, not very dry, but still not staining the paper, tolerably large-grained and crystalline: contains much cane; *several acari* and ova of same; a few starch granules; no grit.

Rio de Janiero.—Contains much cane; *several acari* and ova of same; a great many starch granules, like those of Indian corn; much grit; grape-sugar and vegetable albumen.

On an attentive consideration of the above *Eleven* analyses, it appears that only two of the sugars could be fairly regarded as pure, and in a condition fit for human consumption—the white, large-grained Calcutta sugar, resembling crushed lump; and the pale straw-coloured, large-grained, highly crystalline, Cassipore sugar. Of these samples, that from Calcutta was by far the best.

It would be a great advantage if the above-described sugars could be introduced in large quantity into this country, and sold at moderate prices.

The last analyses which we propose to give are those of samples of sugars procured from the establishments of various grocers.

Results of the Microscopical and Chemical Examination of numerous Brown Sugars, of all Qualities and Prices, purchased at the Establishments of various Grocers resident in the Metropolis.

The quantity of sugar submitted to analysis in each case was three drachms.

1*st Sample.*—Purchased in Gracechurch-street, City.

Sugar crystalline and light-coloured; contains a few fragments of cane; *numerous acari, some alive;* sporules of fungus; vegetable albumen; a small quantity of grape-sugar.

2*nd Sample.*—Purchased on Ludgate-hill.

Sugar coarsely crystalline, light-coloured, wetting and staining the paper in which it was folded considerably; contains *hundreds of acari,* numerous ova of same; much cane; sporules of fungus; two or three fragments of wood; a few starch granules; grit; vegetable albumen; grape-sugar.

3*rd Sample.*—Purchased in High-street, Whitechapel.

Sugar rather earthy, intermixed with a few minute and shining crystals; contains a little cane; *hundreds of acari;* sporules of fungus; much grit; vegetable albumen; grape-sugar.

4*th Sample.*—Purchased in Whitechapel-road.

Sugar fine-grained, rather light-coloured; contains numerous fragments of cane; *several acari,* and ova of same; sporules of fungus; a few pieces of woody fibre; albumen; grape-sugar.

5*th Sample.*—Purchased in Whitechapel-road.

Sugar scarcely crytalline, presenting an earthy appearance; contains fragments of cane; *hundreds of acari,* some alive, and many ova of same; sporules of fungus; albumen; grape-sugar; and much *tapioca starch,* with which the sample is adulterated.

6*th Sample.*—Purchased in Whitechapel-road.

Sugar coarsely crystalline, dark-coloured, and moist, wetting and staining the paper considerably; compounded evidently of two sugars of different colours and qualities, imperfectly mixed; contains *a few acari;* sporules of fungus; a few pieces of woody fibre; albumen; grape-sugar; it deposits, when dissolved, a copious sediment, which consists principally of the sporules of the fungus.

7*th Sample.*—Purchased in Whitechapel-road.

Sugar dark-coloured, not highly crystalline, crystals minute, paper stained; contains *a great many acari,* and ova of same; sporules of fungus; one or two pieces of woody fibre; grit; albumen; grape-sugar.

8*th Sample.*—Purchased in Whitechapel-road.

Sugar presenting rather an earthy appearance, but few crystals being visible, and these very small; contains numerous fragments of cane; *hundreds of acari;* a great many sporules of fungus; grit; albumen; grape-sugar.

9*th Sample.*—Purchased in High-street, Whitechapel.

Sugar coarsely crystalline; contains a great many pieces of cane; *numerous acari,* several ova of same; sporules of fungus; a few starch granules; grit; albumen; grape-sugar.

10*th Sample.*—Purchased in High-street, Whitechapel.

Sugar coarsely crystalline; contains *two or three acari,* and ova of same; much cane; grit; albumen; grape-sugar.

11*th Sample.*—Purchased in Aldgate.

Sugar earthy, scarcely at all crystalline, dark; contains much cane; *hundreds of acari;* a great many sporules of fungus; several pieces of woody fibre; starch granules; grit; albumen; grape-sugar.

12*th Sample.*—Purchased in Clare-market.

Sugar earthy, scarcely at all crystalline, dark; contains fragments of cane; *a considerable number of acari;* sporules of fungus; granules of starch; grit; grape-sugar; albumen.

13*th Sample.*—Purchased in Clare-market.
Sugar earthy, scarcely at all crystalline; contains fragments of cane; *hundreds of acari, some alive;* sporules of fungus; starch granules; albumen; grape-sugar; grit.

14*th Samples.*—Purchased in Blackmoor-street, Clare-market.
Sugar coarsely crystalline, evidently consisting of two different kinds intermixed; not much cane; *a few acari;* sporules of fungus; grape-sugar; albumen.

15*th Sample.*—Purchased in Drury Lane.
Sugar earthy, dark; contains pieces of cane; *a considerable number of acari;* ova of same; sporules of fungus; starch granules; grape-sugar; albumen.

16*th Sample.*—Purchased in Drury-lane.
Sugar earthy, light-coloured; contains much cane; sporules of fungus; grape-sugar; albumen; and *swarms with acari.*

17*th Sample.*—Purchased in Drury-lane.
Sugar earthy, dark-coloured, evidently consisting of two different sugars intermixed; contains fragments of cane; *a great many acari;* sporules of fungus; grit; albumen; grape-sugar.

18*th Sample.*—Purchased in Drury-lane.
Sugar earthy, dark-coloured, moist, staining the paper greatly; contains fragments of cane; sporules of fungus; grape-sugar; albumen; and *swarms with acari.*

19*th Sample.*—Purchased in Drury-lane.
Sugar earthy; contains fragments of cane; *an immense number of acari;* numerous ova of same; sporules of fungus; starch granules a few; woody fibre; grit; albumen; grape-sugar.

20*th Sample.*—Purchased in Drury-lane.
Sugar very earthy, dark; *adulterated with much potato flour,* containing *hundreds of acari;* sporules of fungus; fragments of cane; grape-sugar; albumen; grit.

21*st Sample.*—Purchased in Holborn.
Sugar rather earthy, light-coloured; contains fragments of cane; *hundreds of acari;* sporules of fungus; grit; grape-sugar; albumen.

22*nd Sample.*—Purchased in New Church-street, Edgeware-road.
Sugar earthy, dark; contains much cane; *hundreds of acari;* ova of same; sporules of fungus; a few starch granules; one or two pieces of woody fibre; grit; albumen; grape-sugar.

23*rd Sample.*—Purchased in Edgeware-road.
Sugar rather earthy, intermixed with a few small and shining crystals; *swarming with acari;* contains sporules of fungus; albumen; grape-sugar; but not much cane.

24*th Sample.*—Purchased in Edgeware-road.
Sugar coarse-grained, crystalline; contains fragments of cane; *a considerable number of acari;* sporules and thallus of fungus; grape-sugar; albumen.

25*th Sample.*—Purchased in Edgeware-road.
Sugarrather earthy, consisting of a mixture of two different kinds apparently, and containing fragments of cane; *hundreds of acari;* sporules of fungus; albumen; grape-sugar.

26*th Sample.*—Purchased in Edgeware-road.
Sugar light-coloured, rather crystalline, containing fragments of cane; a *considerable number of acari;* sporules of fungus; a few starch granules; albumen; grape-sugar.

27*th Sample.*—Purchased in Goodge-street, Tottenham-court-road.
Sugar light-coloured, crystalline, crystals small; paper a little stained; contains fragments of cane; a *considerable number of acari, some alive;* sporules and much thallus of fungus; a great many starch granules, those of West India arrow-root; grit; albumen; grape-sugar.

28*th Sample.*—Purchased in Broad-street, Bloomsbury.
Sugar somewhat crystalline, crystals small; *swarming with acari;* contains sporules of fungus; fragments of cane; a few starch granules; one or two pieces of woody-fibre; albumen; grape-sugar; grit.

29*th Sample.*—Purchased in High-street, Marylebone.

Sugar earthy, staining the paper slightly; contains *acari by hundreds;* cane; sporules of fungus, a great many; a few starch granules; albumen; grape-sugar; much grit.

30*th Sample.*—Purchased in Crawford-street, Edgeware-road.

Sugar earthy, consisting of two different kinds intermixed; *swarming with acari, some alive,* others dead and broken into fragments; contains cane; starch granules; one or two pieces of woody fibre; albumen; grape-sugar; sporules of fungus.

31*st Sample.*—Purchased in High-street, Marylebone.

Sugar evidently mixed, and made up of two different qualities; contains numerous fragments of cane; a *considerable number of acari;* sporules of fungus; a few starch granules; grape-sugar; albumen; grit.

32*nd Sample.*—Purchased in Tottenham-court-road.

Sugar crystalline; rather light-coloured; made up of two different colours and qualities; contains much cane; *hundreds of acari;* sporules of fungus; grape-sugar; albumen; a little grit.

33*rd Sample.*—Purchased in Tottenham-court-road.

Sugar presenting a very earthy appearance; contains a *considerable number of acari;* not much cane; sporules of fungus; numerous starch granules, altered by boiling; one or two pieces of woody fibre; grape-sugar; albumen.

34*th Sample.*—Purchased in Tottenham-court-road.

Sugar somewhat crystalline, staining and wetting the paper very much, contains a little cane, *acari by hundreds;* a great many sporules of fungus; one or two fragments of woody fibre; grape-sugar; albumen.

35*th Sample.*—Purchased in Tottenham-court-road.

Sugar somewhat crystalline; paper slightly stained; contains much cane; *several hundreds of acari;* a great many sporules of fungus; grape-sugar; albumen; grit.

36*th Sample.*—Purchased in Holborn.

Sugar earthy, dark; contains much cane; *swarms with acari* and numerous ova of same; a great many sporules of fungus; albumen; grape-sugar; grit.

From an examination of the above Table it appears—

1st. That the *Sugar insect* or *Acarus was present in the whole of the sugars,* the majority of samples containing them in great numbers.

2nd. That *sporules of fungus were likewise present in all the sugars.*

3rd. That *two* out of the *thirty-six sugars* were adulterated with flour, one with *tapioca starch,* and the other with *potato-flour:* the adulteration in the first case was no doubt effected prior to the importation of the sugar into this country, and in the other it was evidently the work of the retail grocer.

From the earthy appearance presented by many of the sugars examined, they were probably the produce of the East Indies.

The Adulterations of Sugar.

The character of the adulterations to which any article is liable, will of course vary with the article itself, and depend upon its nature and composition.

Thus the adulterations to which the brown sugars of commerce are subject, have relation to their composition, and a knowledge of the various processes adopted in the manufacture of sugar.

Substances entirely different from sugar in their nature are but seldom employed in the adulteration of that commodity, the grocers having recourse to proceedings more natural and more difficult of detection, but scarcely less dishonest, than the introduction of foreign matters possessed of wholly different properties.

The Mixing or "Handling" of Sugar consists in the mixing together, in various proportions, of sugars of different qualities and prices, none of which are very pure, and some highly impure: an article is thus prepared, presenting a tolerable appearance to the eye, but which is really one of very great impurity, and rarely what it professes to be, "real Jamaica," or "Demarara sugar," &c.

The impure sugars are dark-coloured; imperfectly crystallised, heavy, and clammy, readily caking into masses: examined with the microscope they are found to contain fragments of cane, woody fibre, grit, &c., and to abound with the acari and sporules of fungus.

The raw or Muscovado sugar of the West Indies is of this nature, as well as, indeed, to a less extent, nearly all the brown sugars imported into this country.

Now these inferior sugars are largely employed to mix with the whiter and drier sugars of the East Indies and the Mauritius, and are thus sold to the public.

The *large-grained* and white sugars are not well adapted for this process of mixing or " handling," as they will not conceal sufficiently the impure sugars with which they are mixed, and so hide the deception practised; they are not, therefore, purchased for this purpose, but in place of them, inferior and *small-grained* descriptions of sugar, termed " grocery sorts."

We have seen that nearly all the brown sugars imported into this country contain a large amount of impurity, but in general the sugar procured from the grocer does not alone contain this same amount, but it is increased, sometimes doubled and trebled, by the use of variable proportions of other sugars still more impure, in fact, the most impure that can be purchased, so that in the state in which it reaches the public it is very unfit for use.

The injurious tendencies of this system are not confined to the public, the purchasers of the impure article, but it extends even to the sugar-producer, who is not only not encouraged to send to market a pure and good article, but is compelled to produce an inferior one to meet the views of " the adulterating grocer." While for the bad article there are purchasers enough, for the good there is scarcely any sale or encouragement: the little that is sold is bought more for the purpose of being conspicuously displayed in the grocer's window, and so to tempt the passer-by, than for actual sale.

To show that these statements are not overdrawn, we will quote, first, a short extract from the " City Article " of *The Times* for January, the 11th instant:—

" The grocery sorts still attract attention, and realise high prices, but refining and graining classes have been rather neglected."

And second, a few paragraphs from the work of Dr. Scoffern, on the Manufacture of Sugar.

" If the West Indian sugar-growers were to be furnished at once with a never-failing means of producing a large-grained, and therefore an easily cured, sugar, to the exclusion of all other sorts, their produce would have to encounter a difficulty which the consumer would scarcely have imagined. Such large-grained sugars are very unfavourable to the perpetration of certain mysterious operations of legerdemain*, which grocers understand too well. They will not mix. A small-grained sugar may readily be incorporated with glucose, with pieces or bastards, and other less innocent bodies, without such incorporation being discoverable to the eye. A large-grained sugar, on the other hand, is a most refractory material for these little manipulations: its crystals, no matter how mingled with contaminating agents, never ceasing to manifest their native brilliancy, and thus proclaiming the fraud. It is most easy, then, to understand why the grocer, as a rule, does not encourage these large-grained sugars. He cannot '*handle*," them, and therefore brands them with a fault. He says they are deficient in saccharine matter — that they will not sweeten. True it is, that comparatively small portions of these large-grained sugars are sold, and sold at high prices, but merely as fancy articles, on the proceeds of which the grocer nets too little to make their sale an object of primary solicitude.

" Such is the source of one prejudice against dry and large-grained sugars — a prejudice originating amongst the grocers. There is also another, which originates amongst refiners, who are adverse to the general consumption of these beautiful colonial sugars, for the very obvious reason that the consumption of their own staple is thereby lessened."

On the Adulteration of Sugar with Flour. — But grocers do in some cases introduce foreign substances into sugar; thus we have seen that it is sometimes adulterated with flour. This is used, probably not so much because it is cheaper, but partly to improve the colour of very dark and bad sugar, and partly to

* Termed by grocers, " *handling*."

cause the absorption of the water of the treacle with which dark-coloured sugars are in general contaminated.

On the Adulteration of Cane with Potato Sugar.—Grape-sugar or glucose, as we have already stated, may be made from either starch or woody fibre by the action of dilute sulphuric acid.

Some years since this sugar used to be largely prepared in this country from potato-flour, and as it was sold much under the price of cane-sugar, it found a ready sale, grocers employing it for the purpose of adulteration.

The Excise authorities becoming acquainted with the fact of the extensive manufacture of potato-sugar, imposed a duty upon it, since which we believe it has ceased to be prepared.

On the Adulteration of Cane-Sugar with Gum or Dextrine.—We have been informed that British gum is not unfrequently used to adulterate sugar.

This substance is prepared usually from potato-flour by exposing it to a certain temperature in an oil-bath.

As the starch granules are usually not entirely destroyed by the temperature to which they have been exposed, but are only so far altered in their composition as to become partially soluble in water, their detection in sugar by means of the microscope would not be difficult.

We have not ourselves as yet met with a sample of sugar adulterated with "British gum."

On the Means of Detecting the Impurities and Adulterations of Sugar.

The impurities and adulterations of sugar may be detected by the appearance of the sugar, by the touch, by the effect of its contact with paper, by the microscope, and by chemistry.

By the Appearance.—A *pure sugar* is light-coloured, highly crystalline, and very dry. *Impure sugars* are dark-coloured, imperfectly crystalline, small-grained, often presenting an earthy appearance, damp, and heavy.

By the Touch.—A good sugar should be perfectly dry to the touch, and should not feel in the least sticky or clammy when pressed between the fingers; on the other hand, a bad sugar, when treated in the same way, feels moist and sticky.

The Effect of Contact with Paper.—The thickness of the sugar-paper used by grocers has often attracted observation, and it has been supposed that it is employed on account of its weight. The true reason, however, is to be found in the absorbent powers of the paper.

Now the quantity of moisture present in most of the sugars of the shops is very great, and its amount may be taken as an indication of the extent of their admixture with grape-sugar, treacle, &c.

When the quantity of water is great, the thick sugar-paper absorbs a portion of the fluid, and becomes wetted and stained, the extent of the discoloration, and the state of the paper, as respects moisture, affording a very good criterion as to the quality of the sugar.

This is a very simple and excellent method of ascertaining, in many cases, the quality of sugar, which, in addition to staining the paper, if impure from admixture with treacle and grape-sugar, will also become hard and caked; in doubtful cases, the sugar should be allowed to remain in the paper two or three days.

Judged by this simple test, we perceive that the quality of no less than eight out of thirty-six sugars, the results of the examination of which we have already considered, is open to objection, as in that number the papers were more or less discoloured and wetted; in some instances the paper was saturated with wet, and the change of colour involved the whole of the paper; in others, that side of the paper only was affected upon which the sugar had been allowed to rest, the watery and treacly parts of it having passed to that side by gravitation.

Now the quantity of this water present in many sugars is so great, that *it adds very considerably to the weight;* for every drachm of water to the pound of sugar there must be just so much less of pure cane-sugar; so that, as a question of economy merely, puting aside all ideas of purity, cleanliness, and health, it is very doubtful whether the public—even that large portion of it, the poor—

become gainers by the purchase of the cheaper, less pure, and much heavier, sugars.

By the Microscope.—By means of this instrument the presence of the sugar acari, the sporules of fungus, fragments of cane, wood, and starch granules, may be ascertained, and the adulteration by means of flour &c. determined.

By Chemistry.—The presence of grape-sugar, vegetable albumen, lime, &c., may be ascertained.

A Few Words of Advice, addressed to the Public on the Purchase of Sugar, to the Grocer, and to the Refiner of Sugar.

We have now adduced incontestable evidence of the impure condition of the majority of brown sugars, as imported into this country, and particularly as vended to the public. These impurities prevail to such an extent, and are of such a nature,—consisting of live animalculæ or acari, sporules of fungus, starch, grit, woody-fibre, grape-sugar, &c.,—that we feel compelled, however reluctantly, to come to the conclusion, that *the brown sugars of commerce are, in general, in a state wholly unfit for human consumption.*

One portion of our advice to the public must therefore be, not to purchase the inferior brown sugars of the shops.

We have also clearly shown that lump-sugar is free from the greater part of the impurities and adulterations by which brown sugar is so largely contaminated and deteriorated; it does not contain *acari*, fungi, grape-sugar, albumen, or grit, the chief impurities consisting of starch granules and microscopic chips or fragments of woody fibre.

We recommend, therefore, the more general use of refined or lump-sugar.

The quality of the lump-sugar is comparatively a secondary consideration, as the worst lump-sugar is infinitely more pure than the best brown sugar that can be obtained.

To secure, however, the great desideratum of a pure sugar, clean, wholesome, and free from contamination, animal, vegetable, or earthy, the public must be content to pay somewhat higher prices than they do now for a heterogeneous article called by a misnomer, "sugar."

But we would at the same time address a few words to the grocer and the refiner.

To the grocer we remark, it is not in general the public who dictates prices to the tradesman, but the tradesman to the public; let the grocer therefore determine to abandon the present vicious system of mixing a sugar, at the best very impure, with another sugar, still more impure, and resolve to sell nothing but a good article, demanding for it a fair and remunerative price. To all who will follow the straightforward and honest course here recommended, we will give the utmost encouragement and assistance in our power, and such may rest assured that, in the long run, they will be largely the gainers, in pocket, character, and in their own conscientious feelings.

The sugar-refiner we strongly urge to prepare a cheaper form of purified sugar, in powder, analogous to crushed lump; such a sugar, we are informed, is extensively employed in Scotland, and we doubt not but that it would meet with a large and ready sale in this country.

ARROW-ROOT, AND ITS ADULTERATIONS.

The term "arrow-root" was originally applied to the rhizome or root of *Maranta arundinacea*, in consequence of its supposed efficacy in counteracting the effects of wounds inflicted by poisoned arrows.

Of late years, the signification of the term has been much extended, and it is now employed to designate almost every fecula which bears any resemblance to true or Maranta arrow-root, no matter how dissimilar the plants may be from which it is obtained.

Attending this enlarged use of the word arrow-root are certain disadvantages. Many persons consider that all arrow-roots constitute one and the same article, varying only in quality, and according to the place from which they are procured; while but few persons are aware that there are several distinct kinds of arrow-root, the produce of distinct plants, great uncertainty and confusion being thus created.

To increase this confusion, the word "genuine" is often prefixed to the term "arrow-root," and as there are several kinds of arrow-root, so must there be several genuine arrow-roots: these vary in value from a few pence to two or three shillings the pound—from, in fact, the value of genuine Maranta arrow-root to that of genuine potato arrow-root. With these particulars the public at large is but ill acquainted.

The difficulty and confusion is still further enhanced by applying to the arrow-root, as is generally done, the name of the place from which it is obtained: thus we have genuine West Indian, Jamaica, Demerara, Bermuda, St. Vincent, East Indian, Brazilian, African, Guinea, Sierra Leone, Portland, British, and a variety of other arrow-roots. Some persons suppose that each of these names represents a different kind of arrow-root; others imagine that they all indicate one and the same production; while the fact is, that in some cases, as in that of East India arrow-root, one name may be indiscriminately applied to two distinct kinds of arrow-root, and in others, six or eight names all signify but a single kind or species, as is the case with West India arrow-root. This great variety of names is objectionable, not merely because it tends to confuse the public, but because it offers to the fraudulent great facilities for adulteration and imposition, of which, as we shall see hereafter, they have not failed to avail themselves.

The remedy for this state of things is simple: each really distinct arrow-root, that is, every arrow-root which is the product of a distinct plant, should be designated by the name of the species from which it is derived, as Maranta, Curcuma, Tacca, Manihot, Arum, Potato Arrow-root, &c.

The employment of these terms should not be optional, but *compulsory*, for the better protection of the public against fraud in this article of food. The propriety of this suggestion will become still more evident as we proceed.

We shall now describe each kind of arrow-root separately, observing of them all, that when pure they are non-nitrogenised substances, and therefore adapted to the formation of the fat of the body, and to the maintenance of respiration and temperature.

Maranta Arrow-Root.

Maranta arrow-root is obtained from the rhizomes of *Maranta arundinacea*, one of the family of the *Marantaceæ*.

A rhizome is an underground jointed stem placed horizontally in the earth, giving off from its upper surface, branches, and from the lower, roots; the starch or fecula is contained in the joints of the rhizome, being deposited in innumerable minute cells.

The following account of its preparation is given by Dr. Pereira in the new and greatly improved edition of his "Materia Medica:"—

"The starch, or fecula, is extracted from the roots (tubers), when these are about ten or twelve months old. The process is entirely a mechanical one, and is performed either by hand or by machine.

"In Jamaica it is procured as follows:—The tubers are dug up, well washed in water, and then beaten in large, deep, wooden mortars to a pulp. This is thrown into a large tub of clean water. The whole is then well stirred, and the fibrous part wrung out by the hands and thrown away. The milky liquor being passed through a hair-sieve, or coarse cloth, is suffered to settle, and the clear water is drained off. At the bottom of the vessel is a white mass, which is again mixed with clean water, and drained; lastly, the mass is dried on sheets in the sun, and is pure starch.

"In Bermuda, the roots are first deprived of their paper-like scales, and then rasped by a kind of wheel-rasp, and the fecula well washed through sieves and carefully dried.

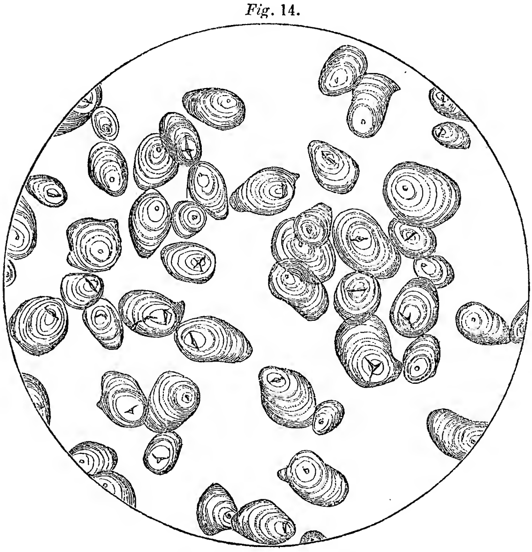
"Upon the Hopewell estate in the island St. Vincent, the carefully skinned tubers are washed, then ground in a mill, and the pulp washed in tinned-copper cylindrical washing machines. The fecula is subsequently dried in drying-houses. In order to obtain the fecula free from impurity, pure water must be used, and great care and attention paid in every step of the process. The skimming or peeling of the tubers must be performed with great nicety, as the cuticle contains a resinous matter, which imparts colour and a disagreeable flavour to the starch. German silver palettes are used for skimming the deposited fecula, and shovels of the same metal for packing the dried fecula. The drying is effected in pans covered by white gauze to exclude dust and insects."

Pure and unadulterated Maranta arrow-root should be of a dull and opaque white-colour, crepitating or crackling when pressed between the fingers, and treated with about twice its weight of concentrated hydrochloric acid it should yield an *opaque* paste.

The above characters and appearances may all, however, be assumed by certain of the other arrow-roots; the microscope, therefore, affords the only ready and certain means of distinguishing this arrow-root from all other species, and these again from each other.

Examined with that instrument the granules or particles of Maranta arrow-root are found to be usually more or less oblong and ovate, but sometimes they are mussel-shaped or even almost trianguar; they vary considerably in size, but each of the larger granules is marked by a number of delicate concentric lines; at the broad or large extremity of each a distinct spot is visible, ordinarily considered to be a cavity, and denominated the "hilum;" this spot is sometimes circular, but most frequently it is seen as a short, sharp line, running transversely across the granule; it furnishes a most distinctive feature by which Maranta arrow-root may be at all times very readily identified.

Fig. 14.



Starch granules of MARANTA arrow-root, called commonly West India arrow-root. Drawn with the Camera Lucida, and magnified 240 diameters.

When boiling water is added to Maranta or any other arrow-root, its physical condition undergoes a great and surprising alteration, the nature of which may be clearly traced by means of the microscope. A table-spoonful of arrow-root, on which a pint of boiling water is poured, immediately loses its whiteness and opacity, becomes transparent, and the entire of the water is as it were converted into a thick and jelly-like substance. If a little of this be diffused through cold water, and examined with the microscope, it will be seen that the starch granules are altered amazingly: they have increased to twenty or thirty times their original volume; they are more or less rounded; the concentric lines and the hilum are obliterated; the membrane of each granule is ruptured, and a granular matter has escaped from its interior.

The appellations which have been bestowed upon Maranta arrow-root are very numerous; their use ought to be wholly discontinued, for the reasons already assigned: thus it is sometimes called West India arrow-root, Jamaica, Demerara, Bermuda, Berbice, St. Vincent arrow-root, &c. The impropriety of denominating it West India arrow-root is shown by the circumstance, that the Maranta plant is cultivated in the East as well as the West Indies.

The duty on this arrow-root is 2*s.* 6*d.* per cwt.; its price to the public varies from 1*s.* to 3*s.* 6*d.* per lb.

Curcuma Arrow-root.

Curcuma arrow-root is obtained from the tubers of *Curcuma angustifolia*, one of the family of the *Zingiberaceæ.*

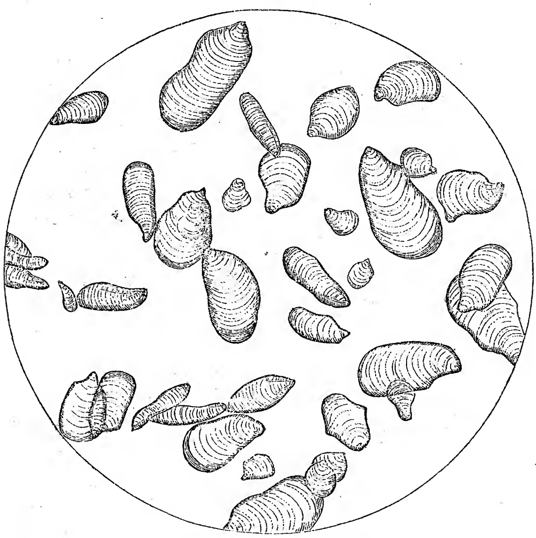
The mode of its preparation does not differ materially from that practised in obtaining the fecula from the tubers of Maranta arundinacea, and which has already been described.

Two qualities of Curcuma arrow-root are imported into this country from the East Indies, principally from Calcutta, a white and a brown variety.

The white is the best; the powder, when pressed between the fingers, feels less firm, and does not crepitate to the same extent as Maranta arrow-root; the two species can, however, be distinguished from each other only with certainty by means of the microscope.

Examined with that instrument, the granules appear elongated, and are irregularly ovate; being flat, they present but little lateral shading; the lines which mark the surface are tolerably distinct, but they describe segments of circles only, and the hilum, which is usually very indistinct and sometimes invisible, is placed at the narrow extremity of each granule. In size the particles vary considerably, but many of them much exceed the largest contained in Maranta arrow-root.

Fig. 15.



Curcuma arrow-root, commonly denominated East India arrow-root. Drawn with the Camera Lucida, and magnified 240 diameters.

Curcuma arrow-root, therefore, is distinguished from Maranta arrow-root by the size and form of the granules, the position of the hilum, and the incomplete rings seen on the surfaces of the granules. Curcuma arrow-root is commonly called East India arrow-root, the same name being sometimes applied to Maranta arrow-root cultivated in the East, and sent to this country; we have thus two distinct species of arrow-root, of different qualities and value, confounded together under one name.

Tacca Arrow-root.

Tacca arrow-root is obtained from the tubers of *Tacca oceanica*, a native of the South Sea Islands, after the chief of which, Tahiti or Otaheite, it is usually designated.

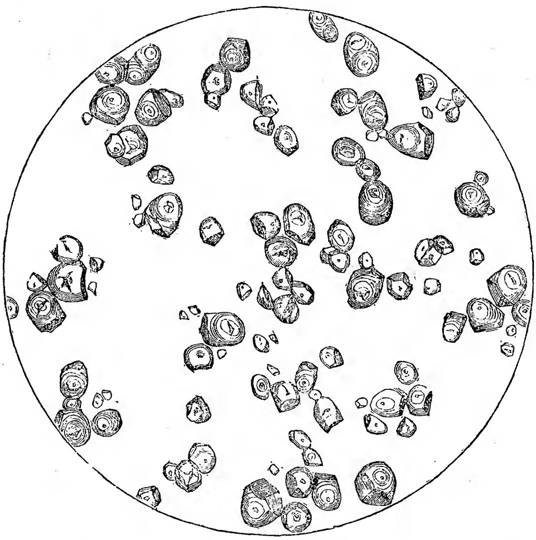
According to Ellis*, it grows on the high sandy banks near the sea, or on the sides of the lower mountains.

In "Pereira's Elements of Materia Medica" the following account is given of

* Polynesian Researches.

the preparation of the fecula:—"At Tahiti this is procured by washing the tubers, scraping off their outer skin, and then reducing them to a pulp by friction on a kind of rasp, made by winding coarse twine (formed of the cocoa-nut fibre) regularly round a board.* The pulp is washed with sea-water through a sieve, made of the fibrous web which protects the young frond of the cocoa-nut palm. The strained liquor is received in a wooden trough, in which the fecula is deposited; and the supernatant liquor being poured off, the sediment is formed into balls, which are dried in the sun for twelve or twenty-four hours, then broken and reduced to powder, which is spread out in the sun to dry."

Fig. 16.



TACCA arrow-root, called usually Tahiti or Otaheite arrow-root. Drawn with the Camera Lucida, and magnified 220 diameters.

Tacca arrow-root is a white, starch-like powder, having a slightly musty odour. The granules resemble somewhat those of sago-meal, but are very much smaller; when viewed sideways, they are muller-shaped, with truncate or dihedral bases, and when seen endways they appear circular, and occasionally angular or polyhedral. The rings are few and indistinct, and the hilum circular, sometimes fissured in a stellate manner.

Tacca arrow-root has been sold in London for some years, in packages, as "arrow-root prepared by the native converts of the missionary stations in the South Sea Islands." It is sometimes spoken of as "Williams's arrow-root," after the missionary of that name.

The slightly musty odour which it usually possesses shows that it is not in general prepared with quite the same amount of care as is bestowed on Maranta arrow-root.

Manihot Arrow-root.

The flour or farina of *Manihot utilissima*, the plant which yields "tapioca," is sometimes imported into this country, under the name of "Brazilian arrow-root."

To the application of the word arrow-root to the fecula of this plant there exists no objection, since it resembles closely the other arrow-roots in its properties.

The description of *Manihot utilissima*, the Cassava or tapioca plant, and of the manner in which the fecula is first obtained, and subsequently converted into the substance called tapioca, we shall reserve until we come to treat, in a distinct report, upon "Tapioca and its Adulterations."

Manihot arrow-root, like the other kinds already described, may be distinguished by the size, form, and other characters of its constituent granules, which resemble somewhat closely those of Tacca arrow-root, but are considerably

* Ellis states that the rind of the root is scraped off by a cowry shell, and the root then grated on a piece of coral.

smaller, with a larger proportion of granules, which exhibit a circular outline, as seen in the field of the microscope: the hilum is usually fissured.

The price of tapioca to the public varies from 6*d.* to 10*d.* the pound; now, as greater time and labour are expended in the manufacture of this substance than is required for the preparation of the arrow-root, the price of the latter ought to be still less than this.

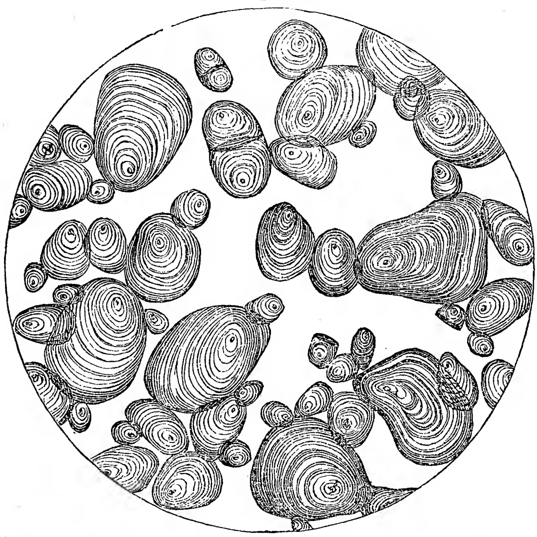
Potato Arrow-root.

Potato-flour, or arrow-root, sometimes called *British* or *English* arrow-root, is prepared by rasping and grinding the well-cleansed tubers of *Solanum tuberosum* into a pulp. This is repeatedly washed, and the water strained through a sieve, which retains the cellular tissue, and allows the starch to pass through. After a time, the starch is deposited at the bottom of the vessel, is again well washed, and finally dried.

Potato-starch forms a white and somewhat glistening powder, which crackles like genuine Maranta arrow-root when pressed between the fingers.

The granules vary greatly in size and shape: some are very small and circular, others large, ovate, or oyster-shaped. The larger granules exhibit numerous very distinct concentric rings, and the hilum, which is small, but well defined, is situated in the narrow extremity of each granule: not unfrequently granules may be observed of an oval form, divided by a fine line into two portions or segments, each of which is provided with a hilum. We have noticed the same compound granule in some of the other arrow-roots, particularly the Tacca species.

Fig. 17.



Potato arrow-root, commonly called British arrow-root. Drawn with the Camera Lucida, and magnified 240 diameters.

The granules of potato arrow-root differ from those of the previously described starches, in their larger size, in their form, and in the number and distinctness of the concentric rings which each granule presents to view.

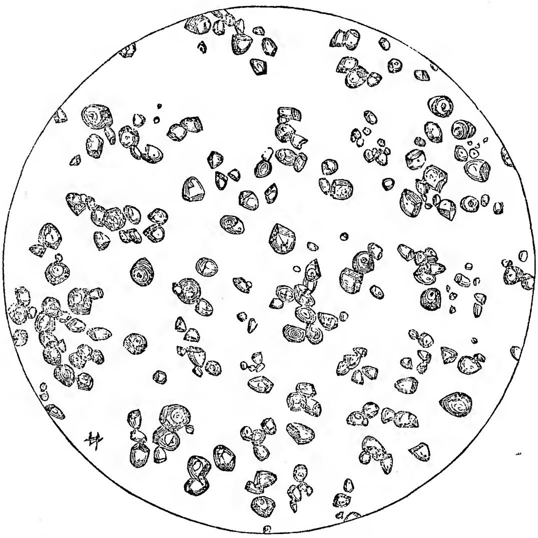
No means exist by which potato arrow-root may be distinguished so satisfactorily as by the microscope; yet it is proper to state, it has been observed that this substance is acted upon by certain reagents in a manner different from Maranta arrow-root: Mixed with twice its weight of concentrated hydrochloric acid, Maranta arrow-root yields an opaque paste; whereas that formed with potato arrow-root is transparent and jelly-like. When boiled with water and sulphuric acid, the latter evolves a peculiar and somewhat disagreeable odour, which is not the case with the former, when treated in the same munner. Lastly, alcohol extracts from potato-flour an acrid oil, not contained in the fecula of Maranta plant.

Potato arrow-root is the cheapest of all the starches regarded as arrow-roots, the retail price varying from 4*d.* to 6*d.* per pound. Although a cheap and useful article of diet, it is of course inferior to Maranta arrow-root.

Arum Arrow-root.

Arum arrow-root is procured from the tubers of *Arum maculatum*, the common "cuckoo pint," "wake robin," and "lords and ladies:" it is prepared chiefly in Portland island; hence it is generally called "Portland arrow-root."

Fig. 18.



Arum arrow-root, commonly called "Portland arrow-root." Drawn with the Camera Lucida, and magnified 220 diameters.

The mode of its preparation is very similar to that adopted with the other arrow-roots: the tubers are pounded in a mortar, the pulp repeatedly washed, and the water subsequently strained. As the tubers are very acrid, great care is required in the washing and straining of this arrow-root, so that the acridity may be completely removed.

The starch granules of arum arrow-root are very small, and, except in size, they resemble very closely those of Tacca arrow-root; but this difference is sufficiently constant and considerable to ensure the ready identification of the two kinds.

On the Adulteration of Arrow-root.

The adulterations to which arrow-root is subject consist in the mixing together of arrow-roots of different qualities and prices in different proportions, in the substitution of an inferior for a superior arrow-root, and in the addition to a genuine arrow-root of other starches not usually recognised as arrow-roots, and of low price.

On the Adulteration by mixing together Arrow-roots of different Qualities and Prices in various Proportions.—This most frequently consists in the addition of potato-flour or arrow-root to Maranta arrow-root, the proportion being subject to every variation, the potato-flour in many cases forming the largest portion of the article.

In some cases Manihot or tapioca starch or arrow-root is added to Maranta arrow-root; and in other instances, again, this as well as potato-flour are employed together.

On the Substitution of an Inferior for a Superior Arrow-root.—The fraud of this nature most commonly practised is the substitution of potato-flour for Maranta arrow-root, of which we have met with several instances.

In some few cases, tapioca or Brazilian arrow-root has been substituted for Maranta arrow-root; and in others both it and potato-flour have been used.

On the Adulteration by the Addition to a Genuine Arrow-root of other Inferior Starches not usually recognised as Arrow-root.—The starch usually had recourse to in the adulteration of arrow-root is sago starch, or meal: indeed this, independent of potato-flour, which we have included amongst the arrow-roots, is the only kind which we have ourselves met with, although it is very probable that in some cases other starches may yet be noticed. Next in frequency to potato-flour, sago-meal is the starch most commonly employed, and several samples, declared to be genuine arrow-root, have consisted of but little else than sago-meal.

As, under the head of "Sago and its Adulterations," we intend to give a particular description of that article, we shall now only describe the form of the particles of which sago-meal is constituted.

The starch granules of sago are of considerable size; they are either ovate or more usually somewhat muller-shaped, rounded at one extremity, the other being truncated or else terminating in a dihedral summit; the hilum is placed in the larger and rounded part of the granule, is usually surrounded by a distinct ring, and is circular, cracking frequently in a radiate manner. An engraving of these granules will be given hereafter.

The price of sago to the public varies from 3*d.* to 6*d.*, and is usually 4*d.* per lb.; the cost of sago-meal to the grocer probably does not exceed 2*d.* or 3*d.* The dishonesty of substituting such a cheap and inferior farina for Maranta arrow-root, which costs from 1*s.* to 3*s.* 6*d.* per lb., is most flagrant.

While foreign arrow-root pays 2*s.* 6*d.* per cwt. duty, sago pays only 6*d.*, that is, one fifth only of the duty on arrow-root.

A favourite receipt with grocers for the adulteration of arrow-root, consists of equal parts of potato-flour and sago-meal.

For clearer ideas of the nature and extent of the adulterations of which arrow-root is made the subject, the reader is referred to the following Table of Analyses.

Results of Microscopical Analyses of Fifty Samples of Arrow-root of different Qualities and Prices.

The samples enumerated in the following Table were sold (with the exception of the two last) as *Genuine West India Arrow-root.*

Arrow-roots of High Price.

1*st Sample.*—Purchased in Oxford-street, north side.
Adulterated — with *sago-meal,* which forms the principal portion of the article.

2*nd Sample.*—Purchased of Edwin Frost, 288. Oxford-street, south side.
Genuine Maranta Arrow-root.

3*rd Sample.*—Purchased in Oxford-street, south side.
Adulterated—with *much sago-meal.*

4*th Sample.*—Purchased in Oxford-street, north side.
Genuine Maranta Arrow-root.

5*th Sample.*—Purchased of Knight and Sons, 83. Gracechurch-street, City.
Genuine Maranta Arrow-root.

6*th Sample.*—Purchased in Drury-lane.
Adulterated—with *much sago-meal* and *some potato-flour.*

7*th Sample.*—Purchased of Elford, 26. Drury-lane.
Genuine Maranta Arrow-root.

8*th Sample.*—Purchased in Clare-street.
Adulterated—with *very much sago-meal.*

9*th Sample.*—Purchased in High-street, St. Giles's.
Consisting entirely of *potato-flour*, *sago-meal*, and *tapioca-starch;* not a particle of Maranta arrow-root.

10*th Sample.*—Purchased of W. Martin, 6. New Church-street, Edgeware-road.
Genuine Maranta Arrow-root.

11*th Sample.*—Purchased of H. Thorpe, 29. Chapel-street, Edgeware-road.
Genuine Maranta Arrow-root.

12*th Sample.*—Purchased in Westminster-road.
Adulterated—with *much potato-flour* and *some sago-meal,* both together forming more than half the article.

13*th Sample.*—Purchased of Farmer and Co., 41. Mount-street, Westminster-road.
Genuine Maranta Arrow-root.

14*th Sample.*—Purchased of Lindsay and Co., 1. Waterloo-road.
Genuine Maranta Arrow-root.

15*th Sample.*—Purchased in Lower Marsh, Lambeth.
Adulterated—with *potato-flour.*

16*th Sample.* — Purchased in the Lower Marsh, Lambeth.*
Genuine Maranta arrow-root.
17*th Sample.* — Purchased of W. Barber and Son, 142. Lower Marsh, Lambeth.
Genuine Maranta arrow-root.

The prices of the samples referred to in the above list varied from 1*s.* 8*d.* to 3*s.* 6*d.* per lb.

Arrow-roots of Low Price.

18*th Sample.* — Purchased in Oxford-street, north side, at the same shop as Sample, No. 1.
Adulterated — with a great quantity of *sago-meal* and some *potato-flour.*
19*th Sample.* — Purchased of W. Holland, 127. Oxford-street, north side.
Genuine Maranta arrow-root.
20*th Sample.* — Purchased of Edwin Frost, 288. Oxford-street, south side.
Genuine Maranta arrow-root.
21*st Sample.* — Purchased of Hawthorn and Co., High Holborn.
Genuine Maranta arrow-root.
22*nd Sample.* — Purchased of Ashley and Co., 9. High Holborn.
Genuine Maranta arrow-root.
23*rd Sample.* — Purchased of Dakin and Co., No. 1. St. Paul's Churchyard.
Genuine Maranta arrow-root.
24*th Sample.* — Purchased in Aldgate.
Adulterated — consisting principally of *potato-flour*, with a good quantity of *tapioca* starch, and some *sago-meal;* only a few granules of Maranta arrow-root to be seen.
25*th Sample.* — Purchased in High-street, Whitechapel.
Adulterated — with *potato-flour*, which forms about a third of the article.
26*th Sample.* — Purchased of Sampson, Drury-lane.
Genuine Maranta arrow-root.
27*th Sample.* — Purchased of C. Belchem, 120. Drury-lane.
Genuine Maranta arrow-root.
28*th Sample.* — Purchased of Hall, Drury-lane.
Genuine Maranta arrow-root.
29*th Sample.* — Purchased of Quintrell, 114. Drury-lane.
Genuine Maranta arrow-root.
30*th Sample.* — Purchased in Clare-market.
Consists of *potato-flour* and *sago-meal*, in nearly equal proportions, with scarcely a particle of Maranta arrow-root.
31*st Sample.* — Purchased in Clare-market.
Consists entirely of *potato-flour.*
32*nd Sample.* — Purchased of White and Fairchild, Blackmoor-street, Clare-market.
Genuine Maranta arrow-root.
33*rd Sample.* — Purchased of W. Barber, 142. Lower Marsh, Lambeth.
Genuine Maranta arrow-root.
34*th Sample.* — Purchased in Tottenham-court-road.
Adulterated — with *much sago-meal* and some *potato-flour*, both together forming nearly the whole of the article.
35*th Sample.* — Purchased of Palmer, 1. Broad-street, Bloomsbury.
Genuine Maranta arrow-root.
36*th Sample.* — Purchased of Hy. Thorpe, 29. Chapel-street, Edgeware-road.
Genuine Maranta arrow-root.
37*th Sample.* — Purchased in Edgeware-road.
Adulterated — with *much sago-meal.*
38*th Sample.* — Purchased in Broad-street, Bloomsbury.
Adulterated — with *potato-flour.*
39*th Sample.* — Purchased in High-street, Bloomsbury.
Consists entirely of *potato flour.*

* The name is omitted in this case, because, of two other samples of arrow-root purchased at the same establishment, one was found to be adulterated with tapioca-starch.

40*th Sample.* — Purchased of W. Harper, 24. James-street, Lisson-grove.
Genuine Maranta arrow-root.

41*st Sample.* — Purchased in Tottenham-court-road.
Adulterated—with *potato-flour.*

42*nd Sample.* — Purchased of N. Hall and Co., Edgeware-road.
Genuine Maranta arrow-root.

43*rd Sample.* — Purchased in New Church-street, Portman-market.
Adulterated—with *sago-meal.*

44*th Sample.* — Purchased of Hawthorn and Co., Tottenham-court-road.
Genuine Maranta arrow-root.

45*th Sample.* — Purchased of Clark, Tottenham-court-road.
Genuine Maranta arrow-root.

The prices of the samples referred to in the second division of the Table, varied from 1*s.* to 1*s.* 6*d.* the lb., the greater part being sold at the former price, but when retailed in ounces the 1*s.* arrow-root was sold at 1*s.* 4*d.* the lb.

We have now to give the analyses of certain samples of arrow-roots, sold either in lb. canisters, or in packages, these bearing upon the wrappers in which they are inclosed the names of the proprietors, the title of the arrow-root, a warranty of its freedom from adulteration, and certain notices or advertisements setting forth that the articles in question were superior, and possessed of unusual qualities and advantages, thus challenging observation and scrutiny. We therefore consider that we should not be discharging our duty to the public were we in these cases to withhold the names.

Tradesmen now resort to the press extensively. They are authors and puffers on an extensive scale; witness the numerous handbills, circulars, and advertisements, used to announce the various articles of food and drink. It is but right, therefore, that the press should make an exposure of the adulterations perpetrated, and thus supply the antidote as well as the bane.

In ordinary cases, when the articles have been purchased without there having been any attempts to force them into notice by puffs or advertisements, the names of the dealers are not given, in conformity with the intimation contained in our first article, on coffee.

46*th Sample.* — Purchased of Henry Dolamore, Tea and Coffee Merchant, 32. Westminster-bridge-road.

The following announcement or advertisement is copied from the wrapper:—

" Superfine West India
ARROW-ROOT,
Warranted Genuine,
1*s.* THE POUND CANISTER.
To be procured only of
Henry Dolomore.

" The attention of FAMILIES and INVALIDS is particularly directed to a Trial of the above article, being of the finest quality ever imported into this country."

Adulterated — with a *considerable proportion of potato-flour.*

47*th Sample.* — Purchased of Westbrook and Company, Italian and Family Grocery Warehouse, 21. Oxford-street.

" West India
ARROW-ROOT,
1*s.*
per lb.
(With Tin Canister.) "

Adulterated — with *very much potato-flour* and *sago-meal.*

48*th Sample.* — Purchased in lb. canister, price 1*s.*, of N. S. Hart, Tea and Italian Warehouse, 21. Holborn-hill, opposite Furnival's-inn.

" Genuine
West India Arrow-root.
Recommended by the Faculty as the most Nourishing of all Food for Children and Invalids."

Adulterated — consisting *almost entirely* of *tapioca-starch*, with a few granules of Maranta or West India arrow-root only.

49th Sample.—Purchased of T. Horne, Importer and Dealer in Teas, Coffees, Spices, &c., No. 124. Edgware-road, opposite Harrow-road, in packages, 1*s.* the lb., 6*d.* the half-lb.

"Fine West India Arrow-root,
Warranted free from adulteration."

Adulterated — with *much potato-flour.*

50th Sample.—Purchased of Marshall, 17. Adams-row, Hampstead-road.

"Walker's
ARROW-ROOT.
Sold in packages, 2*d.* the quarter lb."

Consists entirely of potato-flour.

51st Sample.—Purchased of Milton, Drury-lane.

"Edwards's
ARROW-ROOT.
In quarter lb. packages, price 2*d.*
Sold wholesale by Edwards, Brothers, Albion Steam Mills, 233, 234. Blackfriars-road."

Consists entirely of potato-flour.

We have already stated that the retail price of potato-flour varies from 4*d.* to 6*d.* per lb., the articles denominated Walker's and Edwards's arrow-root are therefore sold to the public at an advance of from 25 to 50 per cent.; and this advance is inevitable on all articles sold by agency or commission, because the agents as well as the proprietors require a profit.

We now distinctly state, that we do not charge the adulterations which we have brought to light upon the retail dealers, as it is possible that they themselves have, in some instances, been deceived by other parties.

It will be observed that we have not indicated any differences in the qualities of the articles above enumerated; our object has been rather to discriminate between the *genuine* and the *adulterated* article, and to draw a broad line of distinction between the two. It is remarkable, however, that while the retail price of Maranta arrow-root, known commonly as West Indian arrow-root, varies from 1*s.* to 3*s.* 6*d.* the pound, no corresponding differences could be detected in the appearance and characters of the various samples; in some instances, *but not always*, the lower-priced samples were less white, and, examined with the microscope, occasionally presented a few irregular fragments, consisting probably of the cellular tissue of the rhizome of the Maranta plant, and some of the granules themselves appeared rough and eroded: these differences indicate less careful preparation, but not being constant or considerable, they seemed to us to be insufficient to account satisfactorily for the variation in price to which this article is subject, and we are led to suspect that this variation is not regulated by any fixed or accurate data, but is arbitrarily determined. In two or three samples of arrow-root we noticed a very few sporules and threads of the thallus of a fungus.

In our report on Coffee, we advised the public not to purchase that article in canisters, because with each separate pound of coffee so purchased a canister would have to be paid for, and because, as the grocer professes to sell the coffee contained in cases at the same price as he would charge for the same quality of coffee wrapped up in paper only, and as he must realise a profit, the canisters operate as an inducement to increased adulteration. We must here repeat the same advice with respect to the purchase of arrow-root in cases or packages; for this article they are less necessary than for coffee, since arrow-root possesses no aroma, the loss of which would be attended with injury to its condition.

The price of a pound tin canister is not less than from 2½*d.* to 3*d.*, thus increasing the cost of a shilling article twenty-five per cent.

We will now proceed to examine more particularly the results to be deduced from the Table of Analyses.

It appears then —

1st. That out of the *fifty* samples of arrow-root submitted to analysis, *twenty-two were adulterated.*

2nd. That in *sixteen* samples the adulteration consisted in the addition of a single article, much cheaper in price, and very inferior in quality, to genuine arrow-root, this, in ten instances, being *potato-flour ;* in five, *sago-meal ;* and in one case *tapioca-starch.*

3rd. That in *five* samples it consisted in the employment of two different articles, *potato-flour* and *sago-meal.*

4th. That in *two* instances three different starches were employed in the adulteration —viz., *potato-flour*, *sago-meal*, and *tapioca-starch* or fecula.

5th. That *ten* of the arrow-roots *contained scarcely a particle of genuine Maranta or West Indian arrow-root*, for which they were sold. *One* consisted almost entirely of *sago-meal ; two* of *potato-flour* and *sago-meal ; two* of *potato-flour*, *sago-meal*, and *tapioca-starch ; one* of *tapioca-starch ;* and *four* were composed entirely of *potato arrow-root* or starch.

The above comprehend the chief results deducible from the Table of Analyses ; one or two others, however, still remain to be noticed.

It is somewhat remarkable, that not one of the fifty samples examined contained a particle of Curcuma or East India, Tacca or Tahiti, Arum or Portland, arrow-root—a result, especially as regards Curcuma arrow-root, scarcely anticipated, and which shows how little of these three kinds of arrow-root find their way into the market.

Again, where two arrow-roots, a high and low-priced, were purchased at the same establishment, it was curious to observe that *both were either genuine or both adulterated.*

It thus appears, that in the useful article arrow-root, the public is extensively defrauded of its money, and the revenue of its income.

Against practices so gross and dishonest as those which we have exposed in this Report, it behoves every honest tradesman to set his face ; or the time will come—in fact it has already in part done so—when the honest trader will have to suffer for the wrong-doings of the dishonest, and when the whole trade of grocers will be looked upon by the public with the greatest mistrust.

Since the above report was written, the duty on arrow-root has been reduced ; it is now only $4\frac{1}{2}d.$ per cwt., whether from a foreign or British possession, being the same duty as is now paid on all kinds of flour and meal.

PEPPER, AND ITS ADULTERATIONS.

The natural family *Piperaceæ* includes four plants of great utility to mankind ; two of these, *Piper nigrum*, or black pepper, and *Piper longum*, more recently named *Chavica Roxburghii*, or long pepper, are chiefly employed for dietetic and culinary purposes ; whilst the others, *Piper Cubeba*, now *Cubeba officinalis*, and *Artanthe elongata*, or the matico plant, are principally employed in medicine.

The plant which yields cayenne, *Capsicum annuum*, often improperly termed cayenne pepper, does not belong to the family of *Piperaceæ* at all, but to that of *Solenaceæ.*

The pepper of commerce is furnished by Piper nigrum, and it is to this species, therefore, that on the present occasion we shall have to direct attention.

The black pepper plant grows both in the East and West Indies, in Sumatra, Java, and other islands ; it is a shrubby, climbing plant, which attains the height of from eight to twelve feet. The berries, or peppercorns, grow on terminal flower-stalks or spadices ; they are at first green, but change subsequently to red and then to black. When any of the berries on a spadix have begun to turn red, the whole are gathered, dried in the sun, and the stalks separated by the hand. In drying, the succulent part of each berry becomes contracted and wrinkled, forming a hardened wrinkled cortex ; the corrugations being much raised, and describing a kind of elevated network.

The following more detailed particulars concerning the growth of the pepper plant and the gathering of the berries are extracted from M'Culloch's "Dictionary of Commerce."

"It climbs to the height of twenty feet, but is said to bear best when restrained to the height of twelve feet. It begins to produce at about the third year, and is in perfection at the seventh; continues in this state for three or four years, and declines for about as many more, until it ceases to be worth keeping. The fruit grows abundantly from all its branches, in long, small clusters of from twenty to fifty grains; when ripe it is of a bright red colour. After being gathered it is spread on mats in the sun, when it loses its red colour, and becomes black and shrivelled as we see it. The grains are separated from the stalks by hand-rubbing. That which has been gathered at the proper period shrivels the least; but if plucked too soon, it will become broken and dusty in its removal from place to place. The vine produces two crops in the year, but the seasons are subject to great irregularities."

Those berries are the best which are not too small nor too much corrugated; which are heavy, and sink readily in water.

The two varieties of pepper known as "black" and "white" pepper are both obtained from the same plant: black ground pepper is the entire berry reduced to powder, while the white consists of the same berry, decorticated or deprived of its outer and black husk or covering.

We learn from Periera that three kinds of *black pepper* are distinguished by wholesale dealers. These are:—

"*Malabar pepper.*—This is the most valuable; it is *brownish-black*, free from stalks, and nearly free from dust."

"*Penang pepper.*—This is *brownish-black*, larger, smoother, free from stalks, but very dusty. It is sometimes used in England to manufacture white pepper."

"*Sumatra pepper.*—This is the cheapest sort; it is *black*, mixed with stalks, and contains much dust. Under the name of Sumatra pepper, some dealers include the Penang or brownish-black sort, and the black Sumatra sort."

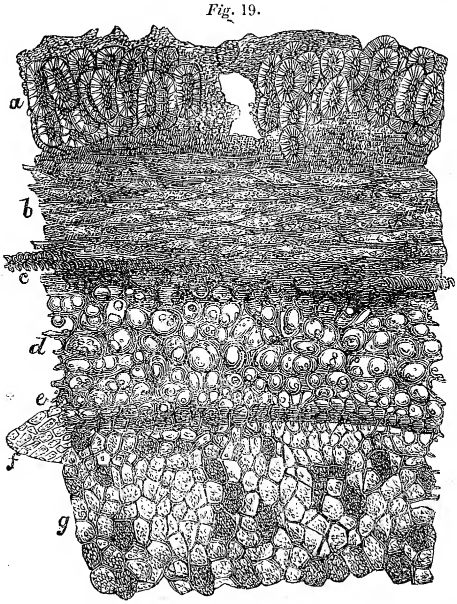
Three kinds or varieties of *white pepper* have also been distinguished.

"*Tellicherry pepper*, which is of two kinds: large or fine Tellicherry pepper is larger and whiter than any other description of white pepper, and fetches a higher price; small or coriander-like pepper is shrivelled."

"*Common white pepper* comes from Penang by Singapore; it is round, and not shrivelled; its value depends on its size and whiteness."

"*English bleached, or White pepper.*—When the two preceding sorts are scarce, brown Penang pepper is bleached. The yellowest and largest grains are chosen for this purpose, for neither an expensive nor small sort would pay."

Fig. 19.



Section of a PEPPER BERRY, showing the several layers of cells of which the *cortical part* is constituted, and the junction of this with the central portion, *e*. Drawn with the Camera Lucida, and magnified 80 diameters.

Structure of the Berry.—The berry of the black pepper plant possesses a structure of considerable complication, and of much interest; and since without an accurate knowledge of its minute organisation we cannot hope to be in a position to detect the numerous adulterations to which this article is subject, it becomes necessary to describe somewhat minutely the tissues which enter into its formation.

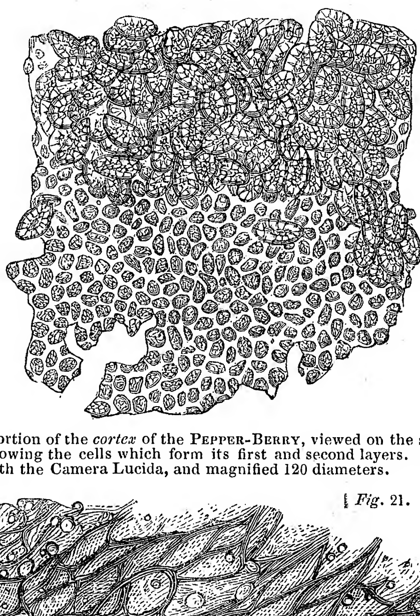
In a section of the berry, two parts are to be distinguished—an outer and an inner: the first is black, or reddish-black; and the second more or less white, hard, and brittle, except in the centre of the seed, where it is frequently soft and pulverulent.

When a thin vertical section of the outer or cortical part of the berry is examined, by means of the microscope, it is seen to be composed of several distinct parts, each of which is constituted of one or more layers of cells. Such a section is represented in *fig.* 19.

The external part of the berry, marked *a* in the preceding figure, is constituted of cells of an elongated form, placed vertically. These cells are provided with a central cavity, from which lines, probably minute canals or channels, radiate towards the circumference; when viewed sideways, they appear rather more than twice as long as broad; and when seen endways, they appear mostly oval in shape, and but little longer than broad. Cells of a somewhat similar character are described in the Report on Sugar, as entering into the formation of the epidermis of the sugar-cane.

The cells next in order, and upon which the previously described cells rest, are small, angular, and dark coloured (see the engraving); their position is indicated at *a* in the first woodcut, and they, as well as the radiate cells, are shown in *fig.* 20.

Fig. 20.



A portion of the *cortex* of the PEPPER-BERRY, viewed on the surface, showing the cells which form its first and second layers. Drawn with the Camera Lucida, and magnified 120 diameters.

The small angular cells, just noticed, do not appear to separate readily from the cells which occur immediately beneath them, and of which they are probably mere modifications; strictly speaking, therefore, they ought to be considered as forming part of the layer next to be described, and we have spoken of them separately only for convenience of reference and description.

Fig. 21.

A portion of the *fourth lamina* of the cortex of PEPPER BERRY, showing the oil contained in the cavities of the cells. Drawn with the Camera Lucida, and magnified 120 diameters.

The cells now to be described are two or three times larger than those previously noticed, and very numerous, forming about half the thickness of the cortex; they are all more or less coloured, and the colour deepens as the cells approach the next layer. The position of this second layer is pointed out at *b*, *fig.* 19. The third layer is very thin, and is composed of woody fibre, bundles of spiral vessels of small size, and formed of single threads, *fig.* 19. *c*.

The junction of the second with the third layer is pointed out by a dark line situated about the middle of the cortex; see *fig.* 19. *c*.

The fourth layer is composed of numerous large cells, and it constitutes the greater part of the remaining half of the cortex (*fig.* 19. *d*). As the cells approach the central part of the berry, they become much modified, two or three times smaller, and of a deep red colour (*fig.* 19. *e*); these cells might be described as forming a fifth and distinct layer.

The numerous cells which form the fourth layer contain a very great abundance of oil-globules, and it is in it that the essential oil of the pepper-berry is chiefly located.

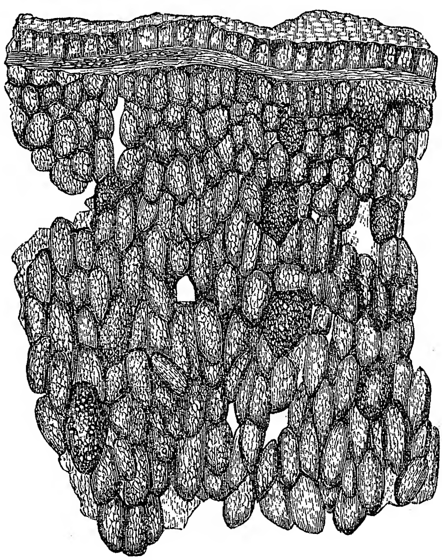
The cells which form the fifth and last tissue which enters into the composition of the cortex of the pepper-berry are divisible into two or three layers, the outer are coloured, and the inner invariably colourless; the colourless cells present a reticulated appearance, forming a transparent lamina which frequently separates, as a distinct tissue. *Fig.* 19. *f.*

The *central part* of the berry or seed is constituted of cells of large size and angular shape; they are about twice as long as broad, and disposed in a radiate manner; in the outer part of the seed they are adherent, hard, and stonelike, while in the centre they are readily separable, and often form a powder resembling flour. *Fig.* 19. *g*, and *Fig.* 22.

When the pepper-berry is macerated in water for some hours, the cortical part apparently separates without difficulty from the seed proper; if, however, we examine the surface of this closely, we observe that it is of a reddish colour, and it becomes evident that a portion of the cortex is still adherent, this consisting of part of the fourth layer, containing much of the oil and the fifth layer.

It now becomes apparent that the terms in common use, "white pepper," and "decorticated pepper," are not altogether correct, for the berry is not entirely denuded of the cortex, nor is its powder white, for if a little of it be diffused through water on a slip of glass, reddish particles immediately become visible: these are fragments of that portion of the cortex, which remains firmly adherent to the seed itself.

Fig. 22.



Section of the *central portion* of the PEPPER-BERRY, showing the two kinds of cells of which it is composed, the colourless and coloured cells, and also its junction with the cortex. Drawn with the Camera Lucida, and magnified 120 diameters.

When sections of the inner part of the pepper-berry are immersed in water for a short time, they assume a yellowish or canary tint, and when examined with the microscope, the colour is seen to be confined to certain of the cells only, of which the sections are composed; these cells are rather larger than the ordinary cells; they are placed at tolerably regular distances from each other, and they reflect a deep yellow colour. In recent sections which have not been immersed in water, the cells, which afterwards become yellow, may be distinguished by a darker shading, and sometimes by a faint tint of colour. The deepening of colour is determined by the action of the salts contained in water on the contents of these cells, which differ chemically from those of the ordinary cells.

It is in these coloured cells that the piperine chiefly, if not exclusively, is located. Alcohol and nitric acid deepen the tint very greatly, and on the application of concentrated sulphuric acid to dry sections of the pepper-berry, they become of a reddish hue, the change of colour being limited, in the first instance, to the peculiar cells in question. These results of the use of the above re-agents are such as ensue with piperine itself.

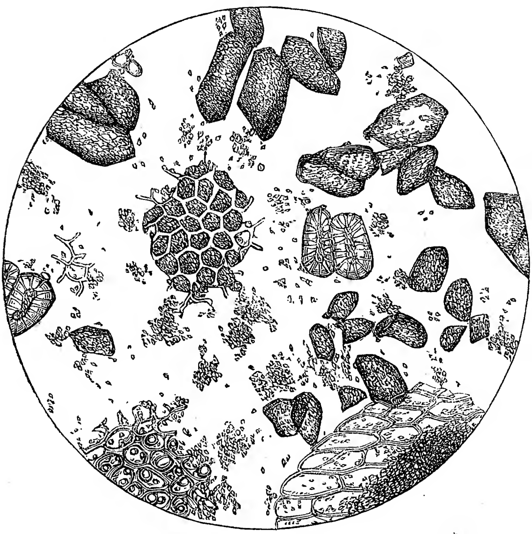
The structure of the central part of the pepper-berry, and the position and character of the coloured cells, are shown in *fig.* 22.

Now, in ground black pepper, all the structures which we have described may be traced out in a broken and fragmentary condition, but in white pepper certain of these tissues only exist—viz., a part of the fourth layer of cells, which contains the oil, and the fifth cellular lamina.

Before the observer is in a position to detect the adulterations of pepper, it is necessary that he should well understand the appearances and structure of ground pepper, both black and white.

When black pepper is diffused through water, little particles of three different kinds, intermixed with a fine powdery substance, are visible; some of these are black, others reddish, and the last white; the black are fragments of the outer, and the red those of the inner cortex, while the white are the pulverised seed itself. The white powder is formed of the cells of the seed, some united in twos and threes, but the majority either separate and entire, or broken into pieces: these cells contain starch-granules of extreme minuteness. The engraving (*fig.* 23.) will serve to convey a good idea of the appearances presented under the microscope by ground and unadulterated black pepper.

Fig. 23.



Ground and unadulterated BLACK PEPPER. Drawn with the Camera Lucida, and magnified 120 diameters.

In the black particles but little evidence of structure is in general to be seen, and where doubt is entertained of their nature, it is necessary that they should be first bleached with chlorine, torn into pieces with needles, and then examined with the microscope.

In genuine white pepper no black fragments ought to be seen, but numerous reddish-brown particles are always present, usually adherent to the white cells which form the central part of the berry.

These white cells, when separated from each other, whether entire or broken, being of angular form, very hard, and reflecting deep shadows, bear a strong resemblance to particles of stone or grit, for which they would be very apt to be mistaken by persons unacquainted with the microscopic structure of the pepper-berry.

The cavities of these cells are filled with starch-granules of exceeding minuteness, and, as in ground pepper, many of the cells are broken into pieces, some of the granules become effused; these are so very small that they are generally in a state of molecular movement, and they resemble spherules of oil rather than starch-granules. No other starch-grains exist in the pepper-berry besides those just described.

So great is the quantity of starch contained in the seed or central part of the berry, that the cells when touched with a solution of iodine become deep blue; the yellow cells being affected in the same manner, but more tardily and to a less extent.

The active properties of black pepper depend upon an acrid resin, a volatile oil, and a crystallisable substance called piperine, which exists also in long pepper, and in cubebs; the resin is situated chiefly in the outer part of the cortex, the volatile oil in the inner part or fourth layer, and the piperine in the yellow cells of the seed itself.

On the Adulteration of Pepper.

It has long been notorious that pepper is one of those articles most liable to adulteration; notwithstanding which fact, and the importance of the subject in a fiscal point of view, but little has hitherto been effected in bringing to light the nature of the sophistications practised, and more particularly in describing the methods of their detection. Of statements indeed we have several, but of either proofs or directions scarcely any worthy of notice or entitled to confidence.

In support of these assertions, we proceed to make reference to the more important as well as recent authorities on the subject of the adulteration of food.

Thus in the "Supplement" to Dr. Ure's "Dictionary of Arts, Manufactures, and Mines," we do not meet with any information respecting the adulteration of pepper worth quoting.

In M'Culloch's "Commercial Dictionary" we observe the solitary remark, "Black pepper, sold ground, is said to be adulterated with burnt crust of bread."

In Mitchell's "Treatise on the Falsification of Food," under the head "Pepper and its Adulterations," we find the following observations:—

"In the state of powder, pepper is nearly always adulterated, substances being sold for the express purpose. It is often mixed with powdered husks of mustard, which are openly sold for this purpose, as is also the sweepings from the pepper warehouses, under the name of P. D. or pepper-dust; and yet an inferior kind of this adulteration is sold under the name of D. P. D., signifying the dust, or dirt of pepper-dust."

No directions, be it observed, are given for the detection of the adulterations referred to in the above quotation.

Normandy, in his "Commercial Handbook of Chemical Analysis," remarks, "Both *black* and *white pepper*, when ground, are very often adulterated, and sometimes in an extraordinary degree, with ground *oil-cake*, *linseed-meal*, and other like substances. The best way of providing against adulteration is, like that for coffee, to buy the article in the grain, and to examine whether it has the appearance which we have described above, and which is the criterion of a good quality." And in a subsequent paragraph he writes, "For the purpose of ascertaining whether ground pepper is genuine and of good quality, the best way consists in ascertaining the amount of piperine contained in the pepper under examination."

Thus here, again, no instructions are given, by which the nature of the adulterations practised in each case may be determined, but we are recommended to ascertain the amount of piperine present, and which, when known, tells us nothing about the adulteration of the article, but simply indicates quality; a pepper may be either good or bad, and accordingly contain much or little piperine, and yet be perfectly "genuine."

Although the work of Mr. Normandy was published in the year 1850, not a syllable is said about the application of the microscope to the detection of the adulterations of pepper.

The last authority to whom we shall refer is Pereira, who, in the description of Piper nigrum as contained in the new edition of his "Materia Medica," and under the head "Adulteration," writes, "Sago is said to have been used to adulterate ground white pepper. The microscope would readily detect the fraud; the starch grains of sago being very much larger than those of pepper, from which they also differ in shape."

The above paragraph comprises the whole that is said by Dr. Pereira on the adulteration of pepper.

We have now to state, that by means of the microscope, applied to the elucidation of structural botany, we have succeeded in detecting, in the most satisfactory and conclusive manner, the adulteration of pepper by not less than five different substances—namely, linseed, mustard-seed, wheat-flour, pea-flour, and ground rice.

Of the adulteration with sago-meal, strange to say, we did not meet with a single instance in the whole of the forty-three samples submitted to examination.

Now we believe that we are correct in stating that the samples of pepper upon which the recent prosecutions and convictions were founded, were adulterated with some form of starch, principally sago-meal; and that in no case were proceedings instituted on the ground of the pepper being admixed with either linseed or mustard-seed, although these are the sophistications most frequently practised. This is probably explained by the difficulty which has hitherto been felt in determining these adulterations in a manner sufficiently conclusive to ensure conviction.

We will now proceed to describe the structure of linseed, and mustard-seed, and also refer briefly to the characteristics of the starch of wheat, the pea, sago, and rice.

Structure of Linseed.—Linseed possesses a very beautiful structure; two coats or tunics enter into the composition of the covering of the seed, and require description.

The outer coat gives the polish to the seed, and is composed of several layers of large and colourless cells, of a rounded or hexagonal form.

It is in the cells which form this tunic that the mucilage which linseed yields so abundantly, on infusion, is contained.

Of this interesting fact a little observation with the microscope furnishes sufficient evidence: thus, in many cases, this instrument does the work of the chemist, and more than the chemist in some cases can effect, even in his own art and science: not to pass beyond the limits of this paper, by means of the microscope we have determined three interesting facts, which may be denominated chemical—the position of the essential oil, and the nature of the contents of the yellow cells of the pepper berry, as well as the tissue in which the mucilage of linseed is located.

The second membrane is that in which the colour of the seed resides: it is composed of narrow, elongated cells, which give it a striated and very characteristic appearance; being firm and strong, it forms the protecting tunic of the seed.

The substance of the seed consists of cells, in the cavities or meshes formed by which the oil and starch granules are enclosed.

The oil is contained principally in the outer or more superficial cells, in the form of brilliant and pearl-like minute drops or spherules.

The starch granules are most abundant in the interior of the grain; they are angular, minute, and two or three times larger than those of the peppercorn.

The very frequent association, in ripe seeds, of oil and starch—both non-nitrogenised substances, resembling each other so closely in chemical composition—suggests the consideration, whether the latter is not, in some cases, and under certain circumstances, convertible into the former. In those seeds, in which, when mature, we do not meet with starch, we usually find oil to be present; and in many of these cases starch grains are actually contained in the unripe seeds or berries.

The whole of the structures above described may be satisfactorily detected, by a little patient investigation, in the linseed reduced to powder or meal. The parts, however, most frequently and clearly seen, are fragments of the fibrous coat, and little masses of starch, from the edges of which, portions of the cellulose forming the transparent cells project, in a radiate and very characteristic manner.

To discriminate the cases in which linseed-meal has been employed for the purpose of adulteration, from those in which the seeds from which the oil has been expressed have been used, we apprehend would not be difficult.

Structure of Mustard-seed.—The seed of mustard exhibits a very characteristic organisation, and by means of which, even when it is ground into powder, it may be readily detected.

We shall not at present offer a detailed description of its structure, but will merely notice, in a very brief manner, the chief tissues which enter into its composition.

The external membrane is formed of large, transparent, and mucilaginous cells.

The second tunic is constituted of very minute, angular cells, which contain part of the colouring matter of the seed.

The third coat is likewise composed of angular cells, two or three times larger than those of the second investing membrane, and possessing well-defined parietes; they also enclose colouring matter.

The seed itself consists principally of cellulose, the cells of which are filled with oil-globules, and contain but few starch-granules.

Characters of Wheat-flour.—As we shall hereafter have to describe fully the structure and characters of wheat-flour, it will be sufficient, at present, to say, that the grains are rounded, flattened discs, very variable in size, and without distinct concentric rings.

Characters of Pea-flour.—The principal characters of the starch-granules of pea and bean flour have already been adverted to in the Report on Coffee: they are oval bodies, with strong lateral shading, provided with a few concentric rings, and exhibiting an elongated central furrow.

Characters of Sago-meal.—Sago-meal has likewise been described, in the Report on Arrow-root. The starch granules of which it is composed are large, oval, or rounded at one extremity, and truncate at the other, with a circular hilum, often cracked in a stellate manner, and with but few rings visible.

On Pepper-dust.—Pepper-dust, known in the trade as P. D., or H. P. D., that is, hot pepper-dust, consists either of the sweepings of the floors of the spice-warehouses, or of the siftings of the whole pepper-berry.

It is used to mix with ground pepper, and when composed of pepper-dust only, although a very inferior article, its admixture with pepper cannot be regarded as an adulteration.

Its presence is to be suspected in those peppers which present a dry, earthy appearance, and the powder of which is extremely fine.

Several of the samples, the results of the examination of which are given in the annexed table of analyses, presented the above-described characters, and therefore in all probability contained a considerable quantity of H. P. D.

On Pepper husks.—The pepper-berries from which white pepper is made, are usually imported in a decorticated state; sometimes, however, they are deprived of their husks in this country, these being ground up and used for black pepper.

There is reason to suspect the presence of an undue quantity of husk whenever pepper presents a darker appearance than ordinary; we have seen several samples in which there appeared to be a considerable excess of cortex.

The cortical part of a pepper-berry being firmer and tougher than the central portion, the former in grinding is not reduced to the same state of division as the latter, but its particles are usually much larger. Of this fact, we have been informed, dishonest tradesmen have availed themselves, and by simply sifting, and thus removing the larger particles of the husk, have contrived to make out of common black pepper both the black and white kinds.

On Factitious Pepper-berries.—Some years since it was not uncommon to meet with artificial peppercorns; instances of their occurrence are mentioned in "Thompson's Annals of Chemistry," and also by Accum, in the second edition of his celebrated "Death in the Pot."

Thus Accum writes:—"I have examined large packages of both black and white pepper by order of the Excise, and have found them to contain about sixteen per cent. of this artificial compound. This spurious pepper is made of oiled cake (the residue of the linseed from which the oil has been pressed), common clay, and a portion of cayenne pepper, formed into a mass, and granulated by being first pressed through a sieve, and then rolled in a cask."

The period during which this fraud prevailed was probably confined to the time, which expired in 1823, when the duty amounted to no less than 2*s.* 6*d.* on a single pound of pepper.

Results of the Microscopical Analysis of Forty-three Samples of Black and White Pepper in Powder.

The following samples were purchased previous to the recent Government prosecutions and convictions:—

Black Peppers.

1*st Sample.*—Purchased in Oxford Street.

Unadulterated, but containing much fine pepper-dust.

2*nd Sample.*—Purchased in High Holborn.
Unadulterated, but containing a large excess of husk.
3*rd Sample.*—Purchased in New Church-street, Portman-market.
Unadulterated.
4*th Sample.*—Purchased in High-street, Marylebone.
Unadulterated.
5*th Sample.*—Purchased in Tottenham-court-road.
Adulterated—with *much linseed-meal* and *wheat-flour.*
6*th Sample.*—Purchased in James-street, Lisson-grove.
Adulterated—with *mustard husk or seed.*
7*th Sample.*—Purchased in Tottenham-court-road.
Unadulterated.
8*th Sample*—Purchased in Drury-lane.
Adulterated—with *much pea-flour.*
9*th Sample.*—Purchased in Clare-market.
Unadulterated.
10*th Sample.*—Purchased in Oxford-street.
Adulterated—with *much wheat-flour.*
11*th Sample.*—Purchased in Kensington.
Adulterated—with *much linseed-meal.*
12*th Sample.*—Purchased in Edgeware-road.
Adulterated—with *much linseed-meal.*

White Peppers.

13*th Sample.*—Purchased in Oxford-street
Adulterated—containing a considerable quantity of *ground rice.*
14*th Sample.*—Purchased in New Bond-street.
Unadulterated.

The following samples were purchased subsequent to the Government prosecutions and convictions:—

Black Peppers.

15*th Sample.*—Purchased in Lower Marsh, Lambeth.
Unadulterated.
16*th Sample.*—Purchased in New-cut, Lambeth.
Unadulterated, but dry and earthy-looking, from the great quantity of pepper-dust contained in it.
17*th Sample.*—Purchased in Westminster-road.
Adulterated—containing a small quantity of *pea-flour.*
18*th Sample.*—Purchased in Lambeth Marsh.
Unadulterated.
19*th Sample.*—Purchased in Westminster-bridge-road.
Unadulterated.
20*th Sample.*—Purchased of Henry Dolomore, Tea and Coffee Merchant, 32. Westminster-bridge-road.*
Unadulterated.
(Noticed in a previous Report as a vendor of *adulterated arrow-root.*)
21*st Sample.*—Purchased in Lambeth Marsh.
Adulterated—containing a considerable quantity of *ground rice.*
22*nd Sample.*—Purchased in Waterloo-road.
Unadulterated, but rather earthy-looking.
23*rd Sample.*—Purchased in New-cut, Lambeth.
Unadulterated.
24*th Sample.*—Purchased in White-cross-street.
Adulterated—with *mustard-seed.*
25*th Sample.*—Purchased in King-street, Snow-hill.
Unadulterated.
26*th Sample.*—Purchased in Whitecross-street.
Adulterated—with *mustard-seed.*
27*th Sample.*—Purchased in Snow-hill.
Unadulterated.

* As an act of justice we publish the names of Mr. Dolomore and two others, as the vendors of *unadulterated* pepper, because they were in a former Report mentioned as the sellers of *adulterated* arrow-root.

28*th Sample.*—Purchased in Barbican.
Unadulterated.
29*th Sample.*—Purchased in Holborn.
Unadulterated.
30*th Sample.*—Purchased at Notting-hill.
Unadulterated, but contains much dust, which gives it a dry, earthy appearance.
31*st Sample.*—Purchased in Chapel-street, Somers-town.
Unadulterated.
32*nd Sample.*—Purchased in Skinner-street, St. Pancras.
Unadulterated.
33*rd Sample.*—Purchased in Edgeware Road.
Adulterated—with *mustard-seed.*

White Peppers.

34*th Sample.*—Purchased in Holborn.
Unadulterated.
35*th Sample.*—Purchased of N. S. Hart, Tea and Italian Warehouse, 21. Holborn-hill, opposite Furnival's Inn.
Unadulterated.
(Noticed in a former Report as a vendor of *adulterated arrow-root.*)
36*th Sample.*—Purchased in Holborn.
Unadulterated.
37*th Sample.*—Purchased in Blackfriars road.
Adulterated—with *much linseed-meal.*
38*th Sample.*—Purchased in King-street, Snow-hill.
Unadulterated.
39*th Sample.*—Purchased in Barbican.
Unadulterated.
40*th Sample.*—Purchased near Battle-bridge.
Unadulterated.
41*st Sample.*—Purchased in White-cross-street.
Unadulterated.
42*nd Sample.*—Purchased of Westbrook & Company, Italian and Family Grocery Warehouse, 21. Oxford-street.
Unadulterated.
(Noticed in a former Report as a vendor of *adulterated arrow-root.*)

At a future period, as we have already promised, the *names* and *addresses* of *all* the tradesmen from whom the purchases are made will be *regularly published.*

We give the name in the following case, for the same reasons that we published, in the Report on arrow-root, the names of those parties who were found to sell an adulterated article, and who had recourse to the press, in the shape of puffs and advertisements, to make it known, and so obtain the confidence of the public.

43*rd Sample.*—Purchased of Wm. Bowley, Oilman and Tallow-chandler, 110. Tottenham-court-road.
Sold in packages, price 1*d.*, and from the wrapper of which the following is copied:—

"*Finest*
WHITE PEPPER.

"One package of this article, which is the interior part of the kernel of the finest pepper, being equal in strength to nearly three times the quantity of black pepper (which is the inferior small shrivelled berries, and often little more than husks), it will be not only the best but the cheapest for every purpose."

Adulterated—consisting of finely ground *black pepper*, and a *very large quantity of wheat-flour.*

The package submitted to examination by us, and which is now in our possession, was one of a large pile placed upon the counter, the attention of the purchaser being particularly directed to the article as one of great superiority and undoubted purity, the proprietor or shopman, in order to inspire his customers with confidence, remarking, "We have had 'em here; we have had the Excise chaps here, but they could do nothing with us."

On an examination of the preceding Table it appears—

First, that *more than half of the peppers purchased previous to the recent convictions were adulterated.*

Second, that *a much less, although still a considerable proportion of the samples procured subsequent to those convictions were likewise adulterated.*

It cannot therefore be doubted, but that the recent enforcement of the law by the Excise authorities has exercised a salutary effect, and that it has checked, partially at least, and for a time, the scandalous practices so extensively resorted to in the adulteration of pepper.

When, however, the paucity of the convictions—some five or six only,—and the number of those traders who sell pepper, amounting to not less than eight or ten thousand, as well as the rarity of Excise interference, are considered, it is to be feared that the little good thus effected will be but of brief duration, and that very shortly the public revenue will be plundered as before, unless, indeed, through the operation of the Analytical Sanitary Commission, the good effects of which have already been extensively felt.

The present duty on pepper is 6*d.* per pound, and 5 per cent. thereon, which yielded, for the year 1850, no less than 85,526*l.* 8*s.* 1*d.* We thus perceive how great is the interest of the Government to prevent the adulteration of this article, by which thousands are lost to the Exchequer annually.

The sum of 85,526*l.* 8*s.*, reduced to sixpences, gives the number of pounds of pepper consumed in the year 1850—viz., 1,710,536 pounds.

M'Culloch estimates the quantity of pepper retained for consumption in the year 1842, at 2,679,624 pounds, and the income derived from the duty at only 70,348*l.* 3*s.* 4*d.* These two statements it is impossible to reconcile, for, if correct, upwards of 1,000,000 pounds must have escaped the duty altogether.

There were entered for home consumption, in the year 1852, 3,524,502 lbs.; in 1853, 3,461,333 lbs.; and in the first six months of 1854, 1,656,721 lbs.

We believe, that were the duty on pepper still further reduced, the revenue would be found to suffer scarcely at all, and that the increased consumption and lessened inducement to adulteration which would exist, would cause the sum fully to equal, if it did not exceed, the present amount.

WATER, AND ITS IMPURITIES.

As the time is fast approaching when the great question of the Water Supply of London will again be brought under the notice of the public and of parliament, we propose to place before the reader, in a clear and concise manner, the whole of the facts connected with a subject of such vast social importance.

We shall discuss it under four heads or sections. Under the first head, the impurities of water will be considered; under the second, the different kinds of water will be treated of; under the third, the present sources of supply will be examined; and under the fourth, a detailed examination will be given of the proposal of the General Board of Health for the supply of water to the metropolis.

SECTION I.

THE IMPURITIES OF WATER.

The various contaminations to which water is liable may all be arranged under two heads; they are either *organic* or *inorganic.*

Organic Impurities.

The organic impurities again naturally resolve themselves into the *dead* and the *living.*

Dead Organic Impurities.—Inasmuch as the dead organic substances present in impure waters form the material or food upon which the living impurities are sustained, it is proper to allude first to them.

The dead organic contaminations again admit of still further division into those derived from the vegetable kingdom, or *dead vegetable impurities*, and those from the animal kingdom, or *dead animal impurities*.

Dead Vegetable Impurities.—The dead vegetable substances very frequently present in impure water are water-plants, leaves, and other fragments of land plants, which find their way into it in a variety of ways, and particularly at the period of the fall of the leaf.

These dead vegetable tissues are in a state of continual decay and change; deprived of life, they become subject to the action of the laws of chemical affinity, by which their structure is speedily destroyed, and their whole fabric resolved into substances of more simple forms and constitution, as *carbonic acid*, *carburetted hydrogen*, *ammonia*, sometimes *sulphuretted hydrogen*, as well as probably, in some cases, other bodies of more subtle nature, the characters of which have not hitherto been determined.

Dead Animal Impurities.—The dead animal organic impurities present are the bodies of infusoria, annelidæ, insects, fish, and animals, as well as the soluble proteine compounds, as albumen, gelatine, mucus, &c., derived from and dissolved out of these by the water.

These several animal substances and compounds are likewise in a state of constant change; their elements, obedient to the laws of chemical action, become rearranged, and form combinations more simple, as *ammonia*, *nitric acid*, *cyanogen*, *sulphuretted hydrogen*, *phosphuretted hydrogen*, water, and many other bodies, some of which, like certain of those just enumerated, are probably of a highly deleterious nature. These changes, decompositions, and recombinations, are greatly facilitated and hastened by increased temperature, and therefore are effected more rapidly in summer.

LIVING ORGANIC IMPURITIES.—The living organic impurities are in direct dependence, as already remarked, upon the dead, from which they derive their nourishment and support, and like them, are either vegetable or animal.

Living Vegetable Impurities.—The living vegetable productions contained in impure water are, algæ, which are the freshwater types of the plants commonly known as sea-weeds, and water-plants.

Living Animal Impurities.—The principal animal productions contained in water are, fish, zoophytes, worms, larvæ of insects, mollusca, and animalculæ or infusoria.

Circumstances which favour the Growth and determine the Kinds of Organic Life present in Water.

Analysis has shown that *every vegetable* is composed of oxygen, hydrogen, and carbon, with a variable but usually a small quantity of nitrogen.

For the growth, therefore, of vegetables, it results as essential conditions that they should be supplied with material containing the whole of these substances.

Now as one vegetable resembles in its general constitution another, it follows that decaying vegetable matters contain the whole of the materials necessary to the life of a plant, and thus one generation of plants affords the food requisite for the growth and sustenance of a second.

But certain inorganic substances also favour greatly the growth of plants, as the phosphates and ammonia; the latter probably on account of the nitrogen it contains; and hence the value of animal manures, which contain these compounds largely, in promoting the growth of vegetation.

Again, analysis has shown that *every animal* contains precisely the same elements as the vegetable, with this important difference, however, that the proportion of nitrogen is much greater in the former.

It thus appears, that while vegetable substances in a state of decay are best adapted to the maintenance of vegetation, animal matter, in a similar state, is the best suited to sustain a large amount of animal life.

These particulars are capable of important practical application, inasmuch as they declare to us that every water which abounds in living animal forms, especially infusoria, must also contain dead organic, and especially animal matter in abundance.

The true interpretation to be placed on the presence of infusoria in water was not well understood until we called particular attention to the condition of animalcular life in Thames water near to London, to which we shall hereafter have occasion again to refer.

The relation of dead to living organic matter is well shown by simply diffusing a little albumen through a wine-glass of distilled water: in a few days, and especially if the weather be warm, the infusion will be found literally to swarm with animalculæ.

But there are some other circumstances, independent of the amount of dead organic matter contained in water, which determine the kind of living productions present in it.

One of these, and a very important one, is the condition of the water as to alkalinity or acidity. If the water have a decided acid reaction, and contain a large amount of animal matter in solution, there will be an abundant development of fungi in the course of a few days; but if, on the other hand, it exhibits an alkaline reaction, then, instead of fungi, animalculæ principally will be developed.

These curious and important facts may be readily shown by experiment. Let two solutions of albumen in water be prepared, the one being rendered alkaline, the other acid; in the first, in the course of a short time, infusoria will appear, while in the second, in an equally short period, a scum of fungus will become visible to the naked eye.

Now fungi are usually regarded by the naturalist as vegetable productions, having, however, a resemblance to animals in the amount of nitrogen which they contain, and in their subsistence on decomposing animal matter.

But other differences may be observed between acid and alkaline animal solutions; while the animal matter contained in the alkaline fluids quickly undergoes putrefactive changes, and begins to smell disagreeably, that in the acid fluid scarcely alters at all, and emits no unpleasant odour.

From these facts it may be fairly concluded, that these two waters stand in very different relations to each other in a sanitary point of view, and from them important practical applications will in another part of this Report be deduced.

But there are occasionally found in nature waters which, although largely impregnated with dead organic matter, yet contain neither animal nor vegetable productions in a living state; these are generally well waters contaminated by sewage or the contents of cesspools. The reason of the absence of life in these cases it is not difficult to divine; from the water in the deep and covered well, air, light, and warmth, are excluded, conditions essential to development.

The *kinds of vegetable and animal life* present in water vary much according to their nature and chemical composition.

In the *still waters* of ponds, cisterns, and reservoirs, which contain dead vegetable matter, in the spring and summer, which is the great season of the development of vegetation, we encounter living vegetable forms, especially confervæ.

In the same waters, holding in solution much animal matter, we meet with living animal productions, particularly infusoria and entomostraceæ.

The forms of life inhabiting the *running waters* of springs and rivers are usually very different from those which dwell in still waters; they belong to different species and genera, and are provided with an organisation by which they are adapted to the very different life they are destined to lead.

The *quantity of animal and vegetable life* contained in water, also varies according to its nature and composition.

Thus pure *distilled water* contains no organic matter, either dead or alive.

Rain water, caught at a distance from houses, towns, or other sources of contamination, contains none.

Uncontaminated well water contains no organic matter.

Neither does pure *spring water* contain any form or trace of organic matter.

In *river water* there is present usually a considerable but variable amount of organic matter; this amount varies according to certain well-determined circumstances; thus, at the source of the river, where the stream is comparatively pure and unpolluted, the quantity of organic matter, either dead or living, is but small.

As the stream flows along, however, it becomes exposed to numberless sources of contamination: it receives the contents of still smaller streams, and the impurities of innumerable ditches, the refuse of the dwellings of persons who live near its banks, the contents of drains, and very frequently the sewage of whole and populous towns, so that at last, when it reaches its outlet into the sea, great and manifold are the corruptions, and large is the amount of dead and living organic matter, pervading its waters.

Were it not that for the continually increasing impurities of river water there is a daily means of escape by the ocean, that description of water would be the most contaminated of all.

The *water of ponds* usually contains a large quantity of organic matter, because these also are exposed to many sources of contamination; the leaves of trees which grow near, fall each year into them, and successive crops of aquatic vegetation are developed and pass to decay in their waters.

The *water of reservoirs* likewise usually contains much organic matter; into these, water which is itself very impure is poured from time to time; on each occasion a portion of the contained organic matter subsides to the bottom, and thus at last a great accumulation of organic impurities occurs, sufficient in the course of a very short time to spoil and render unfit for use even the very best water.

Lastly, the *water of cisterns* generally contains much organic matter. A cistern may be compared to a reservoir; it is, in fact, a reservoir on a small scale, and in it, also, organic impurities increase from day to day, both by accumulation and growth.

It should be remembered that the actual quantity of organic matter present in a large body of water, or even in a river, cannot be estimated from an examination of samples of water obtained by merely dipping a jar or bottle into it, because by far the greatest portion of organic matter is contained in the mud or other deposit at the bottom of the reservoir or river. This fact has very generally been overlooked, and hence the proportion of organic matter given by chemists in many cases as present in certain waters is by far too low.

The effect of the presence of organic matter in the sediment of a reservoir or river on the entire body of the water contained in it is shown by placing a little of such sediment in distilled water in a bottle; in a short time, especially if the weather be warm, the water will begin to smell offensively.

But there are certain circumstances which are closely connected with the *kinds* as well as the *quantity* of organic life present in water, beyond those already noticed; these are, free exposure to air, light, and warmth, which all greatly favour development, and so assist in determining the kind and amount actually present.

For the purpose of showing clearly the influence of these agents, we instituted a considerable variety of experiments; as, however, the powerful operation of the causes referred to are well known and undisputed, it is unnecessary to detail their nature.

Now rivers, reservoirs, and other large bodies of water are exposed to the influences alluded to, whereby the water contained in them is greatly deteriorated.

We have dwelt thus long, and fully, on the *Organic Impurities* of water, because of their extreme and primary importance, for it is on these that the deleterious properties of impure water for the most part depend.

Until very recently, chemists did not in general attach sufficient importance to these organic contaminations, and in most of their analyses we find the different kinds of organic matter, vegetable and animal, living and dead, all lumped together, and included under the word "Traces."

Indeed, chemistry is but ill-adapted to investigate the nature of these organic matters; it gives but a very rough estimate only of their gross amount, and does not discriminate, as we have said, the animal from the vegetable, the dead from the living, and tells us nothing about the families, genera, and species, to which the numerous living productions contained in impure waters severally belong, or of their habits and modes of life, &c.

This inquiry belongs to the naturalist, the physiologist, and the microscopist, and to ourselves belongs the credit of having first applied the resources of these, extensively, and in a practical as well as a scientific manner, to an examination of the actual condition of water in general, and particularly the state of that now in use in the metropolis.*

Uses of Vegetables and Animals in Impure Water.—In the existence in impure water of different kinds of living organic productions, we recognise the fulfilment of wise and beneficial purposes.

If all the organic matter present in some waters were to be removed by the ordinary processes of putrefaction, decomposition, and the formation of offensive and deleterious gases and compounds, incalculable mischief would constantly ensue.

To obviate this, nature has ordained that some of the organic matter of impure water, in place of undergoing decomposition, should be imbibed by other and living forms, and these dying, that other generations should take their place, and fulfil a similar important office.

In the deep well, where the conditions necessary to animal life do not exist, the same end is accomplished, as we have already stated, by the formation of nitrates out of the nitrogen of the organic matter.

The purposes fulfilled by living vegetable and animal productions in water, are then of an eminently useful and preservative character; and this observation is true particularly of the vegetable productions contained in it, including both the lower forms, as the confervæ and other algæ, and the higher plants, as the flowering; for these not only remove the organic matter dissolved in water, by absorbing it into their own tissues for appropriation, but they still further purify water by the effect of their respiration.

Animals, during respiration, exhale a large amount of carbonic acid, vegetables absorb this, fix the carbon in their own tissues, and restore the oxygen to the air, if the plant be aerial, and to the water, if it be submerged and aquatic.

Inorganic Impurities.

Water is a substance formed by the chemical combination of two gases, oxygen and hydrogen, in certain proportions: these alone being necessary to its constitution, all other inorganic matters contained in it are to be regarded as unnecessary, extraneous, and frequently injurious additions.

Under the head "Inorganic Impurities," therefore, we include, first, all those inorganic substances which are merely suspended in the water, as sand and grit; and, second, those substances which are in a state of actual solution, as the saline, earthy, and metallic salts, present in most waters, and the gases.

Inorganic Impurities in Suspension.— The inorganic impurities which are merely suspended in the water are the least important of all, since they do not impart any deleterious properties; they consist chiefly of particles of a stony nature, which are therefore heavier than water, and are readily separated, either by sudsidence or filtration.

The quantity of grit or sand in suspension in water varies with the condition of the water, and the state of the weather.

If the water be kept in continual agitation, as by the passage of boats, barges, and steam-vessels, it will always contain a very large quantity of earthy matter diffused through it, sufficient, indeed, to impart an opaque appearance and an earthy colour: the water of the Thames near to London is usually in the state described, and a sample of it is generally opaque and discoloured, by reason of the immense quantity of earth and mud suspended in it.

Again, water kept in a state of motion by storms, wind, and rain, will be affected in a similar way, and will be laden with earthy matter.

The water just poured into a dirty reservoir or cistern remains in the state described for some hours after, in consequence of its stirring up the accumulated sediment contained in it.

Inorganic Impurities in Solution.—The salts contained in water may be divided into the *earthy*, *alkaline*, and *metallic*, and it is to their presence that many of the sensible properties of water are due, as its softness, hardness, alkalinity, and acidity.

* Results of a Microscopical Examination of the Water supplied to the Metropolis, and the Suburban Districts.—The Lancet, March, 1850.

A Microscopical Examination of the Water supplied to the Inhabitants of London and the Suburban Districts, Illustrated with coloured plates. Samuel Highley, Fleet-street.

Evidence before the General Board of Health; Report, Appendix.

Evidence before Committee of the House of Commons on the Water Supply of the Metropolis.

Softness is a property common to all the purer waters, as distilled, rain water, &c., and is possessed in greatest proportion by those waters which contain the least amount of earthy salts.

The alkalies or alkaline salts, however, possess the property of imparting softness, and hence their employment in soap and washing powders.

The degree of *hardness* of water depends upon the amount of earthy salts dissolved in it, that is, of sulphates and bicarbonates of lime and magnesia, but particularly of the bicarbonates.

The *alkalinity* of water is dependent upon the amount of alkalies present in solution, the principal of these being the carbonates of soda and potash.

The *acidity* arises of course either from the presence of acid salts, or some free acid, as the carbonic.

When we come to consider "the different kinds of water," we shall have again to refer to the sensible qualities we have thus briefly alluded to.

The two great metallic impurities or contaminations of water are those by lead and iron, each of which, but especially the first, we shall consider in detail.

On the Action of Water on Lead.

Notwithstanding that lead has now been employed for ages in the storage and conveyance of water, the principles of its action on that substance have been, in general, but ill understood and defined: much uncertainty and contradiction have prevailed, even amongst scientific men, as to what waters act most on lead, and what least, some asserting that soft waters do so, and others, that hard waters affect lead most.

These principles will be found to be in strict accordance with the laws of chemical combination.

In speaking of lead in connexion with water, we commonly make use of the phrase, "the action of water on lead;" this phrase, unless clearly explained, is liable to be associated in the mind with error.

Water, as we before observed, consists of oxygen and hydrogen; the only combination, therefore, which could by possibility result from the decomposition of water, and the union of its elements with lead, consists in the formation of the hydrated oxide of that metal—an almost insoluble compound.

But the waters in general use contain several gases and salts; these act on lead in a variety of ways, or, in other and more definite words, form various combinations with lead.

Lastly, water imbibes air and other gases; the oxygen of the former combines with the lead, and forms the oxide.

When, therefore, we speak of the action of water on lead, in general terms, water in the condition in which it is commonly met with is implied; but in our scientific inquiries we must carefully discriminate between the effects of the action of pure water on lead, and those effects which result from the presence of the salts and gases so commonly contained in water.

The effect of the action of pure water, then, on lead, supposing it to be really decomposed, is to give rise to the formation of a hydrated oxide, the oxide likewise being formed as the result of the presence in water of free oxygen, derived from the atmosphere.

But in some cases lead does not only exist in water as a slightly soluble oxide, but is in a state of chemical solution, and we have now to inquire in what conditions it may be supposed to be in such cases. The most common soluble salt of lead detected in water is the carbonate, which consists of carbonic acid in union with the oxide of lead.

Now an oxide is a body or base in combination with oxygen, which readily unites with any free acid with which it may come in contact: in a water, therefore, acid from the presence of free or uncombined carbonic acid, stored in a leaden vessel, and exposed to the air, all the chemical conditions necessary for the formation of a soluble and dangerous salt of lead exist; the cistern is the metal, the water itself, or the air contained in it, supplies the oxygen by which a portion of that metal is oxidized; and with the oxide thus formed the free acid also present readily combines.

We shall now inquire how far these preliminary statements are supported by direct evidence, and shall detail a number of experiments which we have instituted for the purpose of ascertaining the effects of pure water, air, and the gases and salts contained in ordinary water, upon lead.

These experiments may be arranged under three heads: in the first experiments, pure water (that is, water free from gaseous or saline impregnation), oxygen, carbonic acid, and atmospheric air, separately and in combination, were employed; in the second, various salts and solutions of the caustic alkalies were operated upon; while, in the third set of experiments, the effects of certain waters now used for domestic purposes, on lead, were ascertained.

Experiments showing the Action of Distilled Water, Oxygen, Carbonic Acid, and Air, on Lead.

1st Experiment.

A piece of lead, having a clean and bright surface, was introduced into an eight-ounce bottle, filled with *distilled water* from which any oxygen or other gaseous admixture which it might possibly have imbibed had been expelled by previous boiling.

Results.—In the course of a very few minutes the metal lost its brightness, and when examined at the end of the fourth day the surface of the lead was found to be much dulled, was covered with a whitish crust, and adhered slightly to the glass by means of the same substance, which formed a coating on the metal, and which extended on to the glass for some distance around; the water itself also presented a slightly dull and opaque appearance, and contained a small quantity of sediment evidently derived from the metal itself; from time to time minute bubbles of gas were observed to collect on the sides of the vessel.

Tested with sulphuretted hydrogen the water became very *slightly darkened*, but when acidulated with a little acetic acid the test acted more strongly.

Remarks.—The white substance coating the metal, adhering to a portion of the glass, rendering the water very slightly opaque, and forming a small quantity of visible sediment, was the oxide of lead, a compound which is but little soluble in water. The rapid and almost immediate formation of this oxide cannot be satisfactorily explained, except on the supposition of the decomposition of a portion of the water itself, the oxygen going to the metal, and the hydrogen being liberated, and forming bubbles in the liquid. It is indeed possible that a trace of oxygen, notwithstanding the precautions taken to free the water of it, might have remained, but it appears scarcely probable that the whole of the very sudden, marked, and considerable effects noticed were attributable to this cause.

This experiment was repeated, and with the same results.

2nd Experiment.

A similar piece of lead was introduced into the same quantity of carefully prepared distilled water, into which *oxygen* gas had been passed.

Results.—In a very short time the lead lost its brightness, and at the end of the fourth day the following appearances were noticed: floating on the surface of the liquid a broken iridescent pellicle was observed; the water was somewhat opaque, and contained a powdery sediment; around wherever the metal had been allowed to rest for a time the glass had become coated; the surface of the metal was very much dulled and encrusted, presenting here and there greenish patches.

Tested with sulphuretted hydrogen, *a considerable discoloration* of the water took place.

Remarks.—The water in this case was more opaque than in the first experiment; it contained more sediment, and the metal was evidently affected to a greater extent; the oxygen had acted energetically upon the metal, had, in fact, combined with it, and formed the sparingly soluble hydrated oxide of lead.

A repetition of this experiment confirmed the results first obtained.

3rd Experiment.

In this experiment *carbonic acid* was substituted for oxygen.

Results.—For some time the lead did not appear to be perceptibly affected; at the end of the fourth day, however, it had evidently become very slightly dulled and rough-looking, the liquid remaining perfectly transparent, but having upon the surface a broken and iridescent pellicle.

Tested.—The sulphuretted-hydrogen test *acted very decidedly*, much more so than in Experiments 1 and 2.

Remarks.—The marked action of the test in this case, and the perfect transparency of the water, showed that it contained much lead in solution. Now, as the oxide is but sparingly soluble, the clear inference is, that the compound formed in this instance was the deleterious carbonate of lead, the water probably by its own decomposition affording the oxygen required for the oxidation of the lead, the oxide itself as quickly as formed being taken up and dissolved by the carbonic acid purposely introduced into the water.

This experiment was likewise repeated, and with the same results.

4th Experiment.

In this experiment the water was made to contain both *oxygen* and *carbonic acid.*

Results.—At the end of the fourth day the metal was slightly dulled only, and the water perfectly transparent and without sediment.

Tested.—The sulphuretted-hydrogen test *acted most energetically*, and a visible precipitation of sulphuret of lead took place.

Remarks.—In this experiment all the conditions necessary for the formation of a carbonate of lead existed—viz., the presence of oxygen and carbonic acid, the result being that the salt in question was formed abundantly.

5th Experiment.

Distilled water saturated with *carbonic acid*, and containing a piece of lead, *was exposed to the air* for four days.

Results.—At the end of that time the metal was slightly dulled, and presented a whitish appearance; the vessel also was coated with oxide at the spot where the lead rested.

Tested.—The water was *very slightly acted upon only* by sulphuretted hydrogen, even after acidulation; but the part of the vessel coated with the oxide, and near which the metal had rested, became quite black.

Remarks.—In this case a considerable amount of oxide was found, but only a small quantity of the carbonate of lead; the metal was oxidized chiefly through the oxygen of the air absorbed, while the principal part of the carbonic acid at first present in the water escaped during its exposure to the air.

Experiments showing the Action of various Salts contained in Water on Lead.

6th Experiment.

A scruple of crystallised *sulphate of potash* was dissolved in six ounces of distilled water; solution neutral.

Results.—Metal dull and greenish, adherent slightly to bottle; water not perfectly transparent, and containing a little sediment.

Tested.—After the lapse of a month, with sulphuretted hydrogen, *no perceptible effect* was produced.

Remarks.—In this experiment a little oxide of lead was evidently formed, but not nearly equal in amount to that noticed in the experiment No. 1, with distilled water only; nor was any of it taken up by the water, otherwise the test would have afforded indications of the presence of the lead.

7th Experiment.

A scruple of dried *carbonate of soda* was dissolved in the same quantity of water; solution alkaline.

Results.—Metal slightly dulled, but no opacity of the water and no sediment observed.

Tested.—At the expiration of a similar length of time, *no perceptible effect* ensued with sulphuretted hydrogen.

Remarks.—In this experiment, still less oxide—in fact, scarcely any—was formed.

8th Experiment.

A scruple of crystallised *carbonate of potash* was dissolved as before; solution alkaline.

Results. — Metal dulled, and in places covered with patches of a brownish colour; no sediment; water transparent.

Tested. — A *decided reaction* ensued with the sulphuretted-hydrogen test, although the lead had only been immersed in the solution three days.

Remarks. — The results of this experiment show that all alkaline carbonates even do not act in the same manner on lead. As the solution did not contain free carbonic acid to combine with the metal, it is probable that a plumbite of potassa was formed.

9*th Experiment.*

In this experiment a *slightly alkaline* solution of *bicarbonate of magnesia* was employed.

Results. — At the expiration of twenty-four hours the metal was very slightly dulled only on the upper surface, and the water was transparent, and without sediment.

Tested. — A few hours after the immersion of the lead in the solution, sulphuretted hydrogen was passed through it, and produced *a very decided discoloration.*

Remarks. — As in this instance, also, no free carbonic acid was present, the action of the solution on the lead is probably to be referred to the magnesia.

10*th Experiment.*

This experiment was made with a scruple of *phosphate of soda;* solution nearly neutral.

Results. — Metal quite bright; no opacity, and no sediment.

Tested with sulphuretted hydrogen; *no reaction.*

Remarks. — This experiment, as well as experiments No. 6 and 7, seem clearly to show, that certain salts exert a protective influence over the lead, and almost prevent its oxidation.

11*th Experiment.*

In this experiment a scruple of *chloride of sodium* was used; solution neutral.

Remarks. — The lead was dull, and rather green; the water slightly opaque, with a very little precipitate.

Tested with sulphuretted hydrogen the solution became *decidedly discoloured* and darkened.

Remarks. — The quantity of oxide present was very small, too much so to account satisfactorily for the decided action of the test; it is therefore evident that in this instance a soluble chloride of lead was formed.

12*th Experiment.*

In this experiment *chloride of calcium* was substituted for the chloride of sodium; solution slightly acid.

Results. — Metal nearly as bright as when first immersed; water transparent.

Tested. — *No perceptible reaction* with sulphuretted hydrogen.

Remarks. — The non-effect, or, at all events, the scarcely perceptible effect of the solution on lead in this experiment is probably to be explained by the great affinity of the chlorine for the calcium, and which exceeded that of the metal itself for that base. We thus perceive that chlorides, like the carbonates, do not all act on lead in the same manner, and that it is necessary that each salt met with in water should be made the subject of experiment, and its effects on lead thus ascertained.

13*th Experiment.*

A solution of *chlorine* and distilled water was prepared; reaction slightly acid.

Results. — At the end of twenty-four hours the metal presented marked evidences of the action of the chlorine; it was rough and eroded, with here and there bright crystalline spots.

Tested. — The *reaction* of sulphuretted-hydrogen test was *exceedingly well marked.*

Remarks. — In this experiment it is scarcely necessary to say that the chlorine united directly with the metal, and formed the soluble chloride of lead.

14*th Experiment.*

In this experiment a solution of *nitrate of baryta* was prepared, which was at first neutral to test-paper, but became subsequently slightly alkaline.

Results.—Metal very greatly affected, covered with a thick whitish crust, and yellowish-green patches; water somewhat opaque, containing much sediment, which also coated the sides of the bottle extensively, and was of a yellowish-green colour wherever the metal had been allowed to rest for a time.

Tested, with sulphuretted hydrogen, *a slight reaction* ensued, much increased after acidulation.

Remarks.—Although in this case a large quantity of oxide of lead was formed, yet but little became dissolved: the formation of the oxide is explained by the decomposition of the nitric acid of the nitrate, its oxygen combining with the metal.

15*th Experiment.*

A scruple of *liquor potassæ* was dissolved in water.

Results.—Upper surface of metal thickly coated with a yellowish crust, lower much less affected; fluid transparent, without sediment.

Tested, with sulphuretted hydrogen, the fluid became perfectly *black,* and after a time deposited a copious sediment.

Remarks.—The water in this case contained an enormous quantity of lead, probably in the form of plumbite of potassa.

16*th Experiment.*

A piece of lead was introduced for a few minutes only into *lime-water,* which, on being tested, gave *abundant evidence of the presence of lead.*

Remarks.—The salt formed in this instance was also, probably, a plumbite. It thus appears that the alkalies act with extraordinary energy.

17*th Experiment.*

A scruple of *chloride of calcium* and half a drachm of *sulphate of potash* were dissolved in distilled water; solution neutral.

Results.—At the end of three days the metal appeared slightly dulled only, the solution retaining its transparency.

Tested.—*A decided reaction* with sulphuretted hydrogen.

Remarks.—By previous experiments we ascertained that while chloride of sodium acts very decidedly on lead, sulphate of potash not only did not form any deleterious compound with it, but it was even evident that it exerted a protective influence, preventing the excessive oxidation of the metal. The above experiment, therefore, was devised to ascertain to what extent this protective influence might be relied upon, and from its results it appears that the chloride was not completely prevented from producing its ordinary effects, although, perhaps, these were scarcely so strongly marked as in the experiments in which chloride of sodium alone was employed.

In addition to the above experiments, some others were made, but of these it is unnecessary to give any lengthened description. Thus, precipitated carbonate of lime was diffused through distilled water in contact with lead; the fluid exhibited a slightly alkaline reaction, and, tested at the end of four days, indications of the presence of lead were afforded. Again, a sufficient quantity of carbonic acid to render the solution feebly acid, was passed into distilled water, containing the same carbonate of lime. In this case distinct traces of lead were detected. Lastly, crystallised carbonate of magnesia, obtained by the evaporation of Sir James Murray's "fluid magnesia," after being well washed, was diffused through distilled water; the solution became strongly alkaline, and was found at the end of four days to contain much lead.

Experiments showing the Action on Lead of certain of the Waters now in use.

The results of these experiments will be given in another part of this Report; their omission for the present will not, however, interfere with the conclusions to be deduced from the preceding experiments, and which have been devised for the purpose of illustrating the "principles" which determine the action of water on lead.

Conclusions to be deduced from the preceding Experiments.

Reviewing, then, the results of the experiments just detailed, we arrive at the following conclusions :—

1st. That lead in contact with water is oxidised in at least two, if not three, ways, through the oxygen of the atmosphere imbibed by water, through the decomposition of certain substances present in water which contain a large quantity of oxygen, as the nitrates, and probably in some instances by the decomposition of water itself.

2nd. That the oxide formed in these cases is the hydrated oxide, a compound sparingly soluble only in water, but which readily enters into combination with any free acid present; the ordinary acid contained in water being the carbonic, with which the oxide will form either a soluble or insoluble salt, according to the amount of acid existing in the water.

3rd. That as pure distilled water, freed as far as practicable from oxygen, and enclosed in a sealed vessel, acts quickly and energetically on lead, the action depending most probably upon the decomposition of the water; rain, snow, or other water, free from gaseous or saline impregnation, and thus closely resembling distilled water, acts in a similar manner. It is to be remembered, however, that the compound formed is the hydrated oxide of lead, which is but little soluble.

4th. That in distilled water, also included in a sealed vessel, from which the oxygen has been expelled by boiling, carbonic acid being subsequently passed into it, a soluble carbonate of lead is readily formed, the salt in question being generated still more quickly and abundantly when oxygen as well as carbonic acid is freely added to the water.

5th. That while dried carbonate of soda does not act injuriously on lead, crystallised carbonate of potash, the carbonates of magnesia and lime, and the alkaline or neutral bicarbonates of the same, exert a marked solvent action.

6th. That solutions of the caustic alkalies, soda and lime, act in a most energetic and destructive manner on lead.

7th. That while chloride of calcium exerts little or no effect, chlorine and chloride of sodium act very decidedly.

8th. That certain salts, as sulphate of potash, phosphate of soda, and some other salts, principally sulphates and phosphates, appear to exert a protective influence on lead, as is shown by the slight oxidation of the metal which takes place when these salts are dissolved in distilled water.

From the foregoing results we deduce the further conclusion —

That distilled or any other water approaching this in character, cannot with perfect safety be stored in open reservoirs or cisterns, on account of the oxidation which takes place; this oxide, as already stated, is, however, but sparingly soluble, and is rendered still more so by conversion, when exposed to the air, into a peculiar and very insoluble carbonate.

That water containing free carbonic or any other acid, and which therefore exhibits an acid reaction, cannot be stored in lead, or conveyed to considerable distances in that metal, without the greatest danger to health.

Neither can water containing carbonate of potash, the carbonates of magnesia and lime, or alkaline or neutral earthy bicarbonates, in considerable amount, be thus stored or conveyed with safety.

The same remark applies to waters containing either free chlorine or much chloride of sodium.

Also to those which contain nitrates in any considerable quantity.

It likewise particularly applies to waters containing caustic lime or potash.

It is possible that the deleterious effects of some, but certainly not the principal, of the salts referred to, may be counteracted by the presence of protective salts: we have seen, however, by experiment, that half a drachm of sulphate of potash did not protect the lead from the action of a scruple of chloride of sodium.

We thus perceive how formidable are the objections which exist to the indiscriminate storage and conveyance of water in lead. We will now, however, refer to certain circumstances, which show that the danger of the use of lead, although on the whole very great, is not quite so much so as might be supposed on a perusal of the above statements.

Thus the number of *acid waters* in use is but very small, still some exist, and are employed for domestic purposes.

Again, of all known waters, probably Thames water contains the greatest proportion of chloride of sodium, nearly the whole of this salt, consumed by the inhabitants of London, being poured into it from the sewers; in most other waters the amount is not nearly so great.

Lastly, the nitrates are present in large quantity in very few waters stored in cisterns; although they are contained in appreciable amount in Thames water.

The most frequent causes, therefore, of the action of water on lead are the earthy bicarbonates, and next the carbonate of potash and free carbonic acid.

But the whole of the preceding observations and experiments relate to the effects of *chemical action* on lead; we have now to consider those produced by *galvanic action.*

It has been frequently observed, that leaden cisterns and pipes are not uncommonly corroded away, and even eaten into holes, the parts of the cisterns most subject to this erosion being the bottom and the soldered joints.

So well are plumbers acquainted with this important fact, that the bottoms of cisterns are always made much thicker than the sides.

Now this erosion or eating away of the substance of the lead into holes is regarded by many as attributable to galvanic action; it is difficult, however, without instituting many experiments, to say how much of these effects is due to chemical, and how much to galvanic, causes.

Where the corrosion takes place at the soldered joints, or where the cistern or pipe itself is made up of two metals unequally blended, as lead and pewter, which is frequently the case, it may fairly be attributed to galvanic action.

To the same cause the corrosions which occur immediately around pieces of mortar or lime, cinders, and fragments of dead organic matter, have been referred by eminent chemists. From Experiments 16 and 17, which show the powerful action of even dilute solutions of the caustic alkalies on lead; it is evident that the cause in these instances is purely chemical.

Cinders and organic fragments likewise contain earthy alkalies and salts, and no doubt are well fitted by their chemical composition to act powerfully on lead.

The fact that it is the bottom of the cistern which chiefly suffers is explained partly by the circumstance, that on this constantly rest all the solid impurities, earthy and organic, so largely contained in the great majority of waters now in use. Another probable cause is the partial precipitation of the earthy salts, which frequently takes place in the cistern on the exposure of water to air.

There are still some other facts connected with the action of lead on water, to which we have not as yet particularly adverted.

Much has been written on the subject of the *protective crust* formed on lead; we have but little faith in any such protection. When the white film or coating forms but slowly in water, in most cases we may probably safely conclude that this water does not act quickly and energetically on lead, but its absence should invariably excite the suspicion that the water contains some salt or acid, which takes up the oxide as soon as formed, in which case the metal preserves a clean and bright surface.

Another subject for consideration is the different effects on lead of the constant and intermittent supply of water. There can be little question but that the evil effects are less with the constant than with the intermittent system, since the latter allows of the periodical admission of the atmosphere to all parts of the moist cistern and pipes, whereby an increased formation of oxide ensues.

Lastly, it has been noticed that the lead of the cistern is particularly liable to be affected at the line of the watermark. Two causes conspire to produce this effect: one is, the constant action of air and moisture; and the second, the vapour which arises by evaporation from the surface, and which resembles in its composition, and therefore in its action, distilled water.

From a review, therefore, of the whole of the arguments and experiments now advanced, respecting the action of different waters on lead, we deduce the following general conclusions:—

That while very soft water cannot be stored for a lengthened period, with impunity, in leaden vessels, the danger of the storage of hard water, under the same circumstances, is in most cases much greater. This danger, however, is to *be estimated neither by the qualities of hardness or softness, but altogether depends upon the chemical constitution of each different kind of water: thus, if this be ever so soft, and contain free carbonic acid, its action on lead will be great; whereas, if it be hard, from the presence of sulphates and phosphates, principally, and contain but few bicarbonates, &c., little or no solution of the lead will result.*

We will now proceed to examine the evidence given on the subject of the action of water on lead by different authorities; and first we advert to that of Dr. Christison, the eminent toxicologist.

Evidence of Dr. Christison.—So far back as the year 1829, Dr. Christison made known some valuable observations on the action of water on lead. To these, however, it is unnecessary to refer, since that gentleman has recently been called upon by the General Board of Health to state the opinions now entertained by him on that subject,

From an examination of this statement, we find that Dr. Christison, recognises two causes of the corrosion of lead—the one *chemical*, the other *galvanic*.

The first action of water, he states, results in the formation of the hydrated oxide, which is dissolved by the water, but which, under exposure, is for the most part separated quickly in the form of a peculiar variety of carbonate of lead, which is insoluble.

"Another essential condition," Dr. Christison writes, "is purity. The purest water acts most intensely; distilled water most of all; rain and snow water next; very pure spring-water next, but much more feebly; and of all spring-waters, those called *hard*—that is, which largely contain sulphate and carbonate of lime—act least, producing, indeed, no effect at all when these salts abound."

Now, while it is admitted that the partially soluble oxide of lead is quickly and abundantly formed in distilled and other very soft waters, to be soon converted, as Dr. Christison states, into a peculiar and insoluble carbonate; while, also, it is conceded that certain of the salts ordinarily contained in water retard the oxidation, and thus exert a protective influence, we demur to the general conclusion, that hard waters, especially those containing carbonates, act least. This conclusion is inconsistent with several of the experiments previously detailed, and also with actual observation; it is, in fact, wholly untenable.

Again: Dr. Christison writes—"The action" (that is, the formation of the oxide) "is counteracted by the presence of salts in the water. All salts more or less impede the action. But their energy in this respect is very different."

"Those act most energetically whose acid forms with oxide of lead the most insoluble oxide of lead. Hence phosphates and carbonates are most powerfully protective; chlorides, acetates, and nitrates, least; sulphates intermediately. As carbonates and sulphates are contained in most terrestrial waters, few of them exert the corrosive action now complained of."

We have shown clearly and beyond question, that chlorine, certain chlorides, the nitrates, and nearly all the carbonates, especially the earthy carbonates, exert marked injurious effects on lead. It is therefore obviously improper to include these salts amongst such as appear really to possess limited protective powers.

Again: "The bases of the salts have nothing to do with the action, farther than that some base is necessary to form a salt. It does not in the least, therefore, signify what the base is."

This assertion, likewise, is manifestly incorrect, as proved by experiments No. 16 & 17, in which it is shown that dilute solutions of the caustic alkalies act in a most extraordinary manner on lead.

"The protective power of these salts may possibly be counteracted by certain ingredients in the water. This has been hitherto supposed, at least. For example, it is thought that an excess of carbonic acid may counteract the protective influence of the salts. There is no sufficient evidence, however, to that effect; nor am I acquainted with any other counteracting ingredient. My present opinion is, that when corrosion occurs, in spite of the presence of protecting salts, the real agent is the second cause of corrosion, to be noticed immediately."

In answer to the above observations, we reply, that there can be no question but that an excess of carbonic acid does counteract any protective influence which the salts present may exercise. The action of free carbonic acid is shown by experiment No. 4; and hereafter we shall have to speak of the effect produced on lead by a water, acid from the presence of carbonic acid.

To the second cause of corrosion on lead—viz., galvanic action, Dr. Christison attributes all the partial actions often seen on the inside of lead pipes or the bottom of lead cisterns, particularly when lumps of mortar &c. have been left in the cisterns.

We consider that several of the effects enumerated by Dr. Christison are rather due to chemical than galvanic causes, and we have already adduced our reasons for regarding the action of mortar on lead as chemical.

Amongst the circumstances which favour this partial corrosion, Dr. Christison admits that a superabundance of salts is very probably one; for salts, he remarks, increase the exciting power of water in an ordinary galvanic apparatus.

This admission, coupled with the fact that leaden cisterns are scarcely ever destroyed by a general and uniform action over their whole surface, but nearly always by partial and irregular corrosion, from whatever causes produced, chemical or galvanic, is in itself alone sufficient to establish a clear case against the indiscriminate storage of hard water in leaden vessels.

What is regarded as the second cause of action on lead by Dr. Christison is evidently, therefore, very much the more destructive of the two, and is that which hitherto has been least considered.

We have now to cite the general conclusions at which Dr. Christison is inclined to arrive—1st. "That lead may be safely and conveniently used for service pipes and cisterns in the case of almost any water that can be obtained in this country." 2nd. "On the whole, my present opinion is, that the fewer difficulties will be encountered in using lead pipes and cisterns in the case of waters of considerable purity. Theory would lead to this conclusion; for while the tendency of such water to exert a simple solvent action may be easily counteracted by certain precautions, there will be less risk of troublesome corrosion by galvanic influence. And actual experience confirms theory, at least in regard to some pure waters of the ordinary constitution. For long usage has established the perfect safety and convenience of lead for service pipes and cisterns in Edinburgh, where the water is certainly very pure. And I may mention that I am well acquainted with the circumstances of a confirmatory incident in regard to a water of much greater, indeed, of very rare purity."

We need scarcely state that we entirely dissent from the first conclusion.

We shall now briefly consider the evidence given before the General Board of Health by Mr. Thomas Spencer and the Hon. W. Napier.*

Evidence of Mr. Thomas Spencer.—After some preliminary remarks, Mr. Spencer writes:— "We thus arrive at two conclusions—one, that air and water jointly form an oxide which *is insoluble in soft water;* the other, that hard water and air also form this oxide, but that *in the latter it becomes soluble.* We are therefore fully justified in stating, that hard water in connexion with lead is more dangerous than that which is soft."

We have shown, particularly by Experiment 1, that the oxide formed in distilled water *is partially soluble.* The nature of the chemical operations whereby the oxide is dissolved by hard water, are not explained by Mr. Spencer; he simply states that it is dissolved.

"After making a series of experiments," the nature and details of which are not described, Mr. Spencer remarks:—

"I find that water which derives its hardness chiefly from supercarbonate of magnesia is more dangerous than water which altogether or in greater part derives its hardness from supercarbonate of lime. I find, then, that the following salts of hard water are capable of dissolving the hydrated oxide of lead. They are placed in the order of their solvent power, and consist of supercarbonate of magnesia, supercarbonate of lime, chloride of sodium, chloride of magnesium, chloride of calcium.

"As it may be necessary to verify these results by some readily made experiments requiring little chemical experience, I subjoin the following:—

* Report on the Supply of Water to the Metropolis. Appendix III.

"Make a hydrated oxide of lead, by dropping its acetate (sugar of lead) into a solution of ammonia. The resulting powder is the oxide, and represents that which is formed by atmospheric action in water. Let it be washed until the water shows no indications of lead by sulphuretted hydrogen. A few grains of the oxide thus formed are to be put, while moist, into a bottle containing a few ounces of what is termed fluid magnesia (sold in the shops as Sir James Murray's fluid magnesia). It may be diluted with half or four or five times its bulk of water, its solvent power being in the ratio of its strength. After agitation for a few minutes let it be filtered, and when the usual tests are applied to the filtrate of magnesian water, it will be evident that the oxide of lead has been dissolved.

"This fluid magnesia is chemically identical with the supercarbonate of magnesia found in hard water; the simple carbonate being in both cases held in solution by carbonic acid. This experiment shows the solvent power of magnesia when found in hard water.

"Another experiment may be made to prove that the supercarbonate of lime also dissolves this oxide. To do so it is only necessary to repeat the foregoing, but substituting carbonate of lime-water for the magnesian. That sold in the shops as "Carrara Water" (being carbonate of lime held in solution by carbonic acid) precisely represents the carbonate of lime which is found in hard water.

"Upon applying the test as before, it will be found that this also dissolves the oxide, but less so than in the preceding instance.

"The free carbonic acid, which is to be found in these artificial waters, does not contribute to these results, for should it combine with the oxide the resulting carbonate is insoluble."

These experiments are open to grave objections; the fluid solutions of magnesia and lime referred to, contain much free and uncombined carbonic acid, so much indeed as to cause them to exhibit an acid reaction. Now, as we have elsewhere shown, free carbonic acid acts very strongly on lead, forming, when in excess, a soluble salt; the effects observed in these cases, therefore, were partly due to that acid; and it is impossible to state how much of them was owing to the acid, and how much to the bicarbonates of lime and magnesia. These salts as contained in water are not acid, but either alkaline or neutral, and in order to obtain correct results it is necessary to experiment with non-acid solutions.

We must not omit to state, however, that the conclusion at which Mr. Spencer arrives is, that "hard water, in connexion with lead, is more dangerous than that which is soft."

With this conclusion we fully concur.

Evidence of the Hon. W. Napier.—It now only remains that we examine the evidence of the Hon. W. Napier. This evidence is of a very useful character; and is directed to the purpose of ascertaining, by observation, the positive effects produced by different waters on lead pipes, pumps, and cisterns.

Mr. Napier examined no less than sixty-four cisterns and pumps: the properties of the waters, their degrees of hardness, and their action on lead, are exhibited in a tabular form; the period during which the cistern or pump had been in use being likewise noted down.

On looking over the table, we observe that one water, having twenty degrees of hardness, but no carbonic acid, had not produced any visible effect on the pump-cistern, even after upwards of forty years' use; and that other waters, containing much carbonic and sulphuric acid, but of only one degree of hardness, had acted considerably on the pump-cisterns. These are forcible illustrations of the principle which we have already laid down, that we are to look rather to the chemical qualities of the water than to the degree of its hardness, although, at the same time, the very fact of a water being hard affords presumptive proof that it contains those salts of magnesia and lime, &c., which, by experiment, have been ascertained to act strongly on lead.

From the data afforded by the table, it will be seen,—

"1. That 13 house-cisterns were examined, which had contained, for periods varying from $1\frac{1}{2}$ to 12 years, the pure soft spring water of Farnham Hill, of 1

degree in hardness, and that in no case was any action whatsover visible on the lead.
2. That one pump, erected in 1808 over the soft-water tank at the market-place, showed slight traces of erosion after 42 years.
3. That 50 cisterns of leaden pumps over shallow wells of old and modern date were examined.
4. That 10 of these showed scarcely perceptible, or total absence of erosion.
5. That the remaining 40 bore evidence of varied action, from trifling to very extensive erosion and eating up the lead.
6. That in the case of the 13 house-cisterns containing soft spring-water, no trace of carbonic acid is detected.
7. That in the case of the 10 pump-cisterns which exhibited no erosion, no carbonic acid gas, or mere traces, were detected in the water
8. That in the other 40 which bore marks, in most cases, of a violent action—the existence of carbonic acid was ascertained almost in proportion to the extent of the ravages on the lead.
9. That the hardness or softness of the well-waters does not seem to bear any proportion as to their erosive action."

Following these results, the evidence of several experienced plumbers is given, which confirms, in the strongest manner, the now unquestionable fact, since it is based both upon scientific experiments and principles, as well as positive observation, that as a rule, hard waters act much more on lead than soft; this conclusion being the very reverse of that commonly but erroneously entertained.

The testimony brought forward by Mr. Napier is of such a striking character, that had we space we should have been glad to quote some portions of it.

We have dwelt thus long upon the subject of the action of water and its contained salts, on lead, because, first, of the contradictions and uncertainties involved in the scientific evidence hitherto given; and, second, because of the extreme importance of the subject in a sanitary point of view. We believe, however, that after an attentive examination of all the facts contained in this Report, *there can be but one opinion respecting the impropriety of the general use of leaden vessels for the storage of water, and the corrosive action of hard water in particular.*

On the Action of Water on Iron.

It will not be necessary to consider the subject of the contamination of water by iron as fully as we have discussed the action of water on lead; because, first, the same chemical facts and principles referred to under the head of lead, for the most part are equally applicable to iron, and because, also, the salts formed with that metal are not of the same poisonous character as those of lead, nor do they exist in any great quantity in the waters furnished to the inhabitants of this metropolis.

In most of the waters supplied by the public companies, however, traces of iron are generally to be detected: this metal is not in general present in the water at its source, but is derived from the iron pipes in which it is conveyed and distributed.

To show that the action of water on iron is regulated by nearly the same principles as those which determine its operation on lead, we will give the results of four experiments only.

Experiments showing the Action of Distilled Water, Oxygen, and Carbonic Acid, on Iron.

1*st Experiment.*

A piece of polished iron was introduced into a six-ounce bottle filled with *distilled water*, and from which all gaseous admixture had been as far as possible expelled by previous boiling.

Results.—For the first two or three days the metal preserved its brightness, but at the end of a week its upper surface was covered with a powdery substance, of a red colour, and the lower encrusted with several dark green patches; a small quantity of the red sediment was also present in the liquid.

Tested.—A solution of ferrocyanide of potassium acted decidedly without acidulation, thus showing that a portion of the iron was held in solution. Tincture of galls scarcely produced any effect.

Remarks.—The red substance found in this case was the sesquioxide of iron, and the patches of a green colour were probably constituted of the hydrated black oxide.

2nd Experiment.

In this experiment *oxygen gas* was passed into distilled water in contact with iron.

Results.—The metal became affected more quickly than in the first experiment, and to a much greater extent; its upper surface was covered with red oxide, and the under with black patches; the water, also, contained a copious sediment of the same red oxide.

Tested.—The test acted less decidedly than in the previous case, but much more strongly after the solution had been rendered acid.

Remarks.—The oxidation of the metal was evidently much increased by the presence of the oxygen.

3rd Experiment.

In this experiment *carbonic acid* was substituted for oxygen.

Results.—At the end of a week the metal was very slightly rusted only, with patches of black oxide on its under surface; the liquid was but slightly tinged, and contained no sediment.

Tested.—The reaction with ferrocyanide of potassium was very strongly marked, and the ferridcyanide of the same base showed slight traces of the presence of a proto-salt of iron.

Remarks.—The carbonic acid present had united with all the oxide of iron formed, and so held it in solution.

4th Experiment.

In this experiment both *carbonic acid* and *oxygen* were employed.

Results.—After a few days the metal became covered with rust, the liquid assumed an ochreous colour, and was found to contain some granular sediment.

Tested.—On the addition of a solution of ferrocyanide of potassium, the water became of a deep prussian blue, and the ferridcyanide also gave evidence of the presence of a proto-salt.

Remarks.—In this experiment, all the conditions necessary for the formation of a soluble carbonate of iron existed, and, as shown by the action of the test, that salt was abundantly formed.

On the Gasses Present in Water.

Water possesses the remarkable power of absorbing, in certain definite proportions, the majority of those gases with which it happens to come in contact; thus it even imbibes a certain amount of the gases of which the atmosphere itself is constituted, as well as of any other gaseous impregnations or impurities which it may contain.

This power of absorption is not equal for all gases, water being capable of taking up a much larger quantity of some gases than of others, but of all the ordinary kinds it absorbs several times its own volume.

The amount of any particular gas present in water also depends very much upon its temperature: in general, the colder the water the greater its power of absorption, and the greater will be the quantity of that gas contained in it; while, on the other hand, the warmer it is the less gas will it retain, a portion of that previously imbibed escaping from it. The knowledge of this fact explains why a water which when cold tastes brisk and pleasant, when slightly warmed only, as by exposure to the sun, becomes insipid and flat, the gases consisting chiefly of oxygen and carbonic acid, which impart to cold water its freshness, having in great part been expelled.

So great is the power of temperature in determining the amount of gas contained in water, that nearly the whole of it may be driven off by the simple act of boiling. This circumstance, whilst it in some cases affords us the means of getting rid of certain of those noxious gasses not unfrequently imbibed by water, explains also why recently boiled water is so flat and tasteless.

Now the quantities of any particular gas absorbed by water are, at equal temperatures, and under the same pressure, equal; when therefore, a water, from any circumstance, contains a less proportion of any gas at a certain temperature than is proper to it, its power of absorption is greatly increased, so that when freely exposed, it quickly imbibes the quantity of which it is deficient, and then, unless other disturbing causes are in operation, it ceases to absorb more.

It should follow, then, from the preceding, that the power of absorption of water deprived of its gases by boiling, and afterwards allowed to become cold, is very great; and this is really the case.

In the important law just noticed, we recognise a beautiful manifestation of contrivance: the oxygen of water is constantly varying in amount, even at the same temperature, and under the same pressure, it being continually used up in the oxidation of the various substances present, and in the respiration of the animal productions contained in water; and were it not for the law, that in exact proportion with this reduction in the amount of oxygen is the power of absoption of the water augmented, these living productions would be in constant danger of perishing.

A proof of the existence of this law is obtained by observing what happens when water is frozen over: the uncongealed water beneath the crust of ice is cut off from any further supply of oxygen from the atmosphere, but the sources of waste to which we have referred by the respiration of fish and other animals, continue; and hence the oxygen being exhausted, unless the crust of ice be broken, and air admitted, all living things, especially fish, speedily die.

Between the crust of ice and the surface of the water a stratum of air is interposed, and from this, so long as it lasts, the water continues to derive its supply of oxygen.

It is in obedience to the law that water, at a certain temperature, and under a given pressure, takes up a definite quantity of oxygen, that the loss of oxygen sustained by it during the heat of the day is made up at night by the increased absoption which takes place as soon as the temperature has become reduced.

Having thus briefly referred to the chief circumstances which affect the aëration of water, we will next treat of the gases contained in it, in an equally brief manner. These may be divided into such as are natural to water, and with which it is almost constantly associated, and into those which are only occasionally present, and which perform no useful purpose connected with it.

The gases which may be said to be natural to water are, *oxygen* and *carbonic acid*.

The free *oxygen* of water is entirely derived from the atmosphere by imbibition; the quantity of this gas present in any water is, as already stated, to a great extent dependent upon temperature.

Well aërated water, that is, water containing its proper proportion of oxygen, must therefore, of necessity, be cold; if it has been recently boiled, or has been made warm in any way, as by exposure to the sun or the warmth of a close room, much of the oxygen will have been expelled, and it will taste flat and insipid from deficient aëration.

The larger the amount of oxygen present in water, the more wholesome will it be as a beverage, for this gas is necessary to the active performance of several of the more important vital functions.

The *carbonic acid* of water is derived from two sources—the atmosphere and the alkaline and earthy carbonates contained in most hard waters.

The atmosphere contains one part in a thousand only of this gas, and hence the chief part of it present in water, is in combination with the alkaline and earthy bases in water.

As a rule, therefore, soft water contains much less carbonic acid than hard.

When present in large quantity, this gas contributes to the briskness of water; it is not, however, a necessary adjunct to good water; indeed, we are disposed to think an excess of carbonic acid would be rather injurious than otherwise to water used as a beverage.

The gases which are only occasionally present in water, and which are not natural to it, are *carburetted*, *phosphuretted*, and *sulphuretted hydrogen;* to these *ammonia* may be added.

Carburetted hydrogen, the "fire-damp" of coal mines, and the "marsh gas," is formed in large quantity by burning coal, and is also generated in small amount during the decay and decomposition of vegetable tissues.

It is an inflammable, irrespirable, and therefore noxious gas.

Phosphuretted hydrogen is formed during the decomposition of animal matter.

It is a spontaneously inflammable gas, and forms the "Jack-o'-Lanterns" and "Will-o'-the-Wisps," sometimes observed in damp and marshy spots, and which have often been the cause of much needless terror.

Sulphuretted hydrogen is generated during the decomposition of both vegetable and animal matter, but principally the latter.

This gas is possessed of a highly offensive smell, and gives rise to injurious and not unfrequently fatal effects when introduced into the animal frame.

It is always present in large quantity in sewer water, and when disengaged has been the cause of many fatal accidents, which have from time to time occurred in the sewers themselves. It may very generally be detected, as pointed out by ourselves, in the water of the Thames near to London, and as might have been anticipated when the fact is called to mind, that the sewer water of the whole of London, which contains such immense quantities of this gas, is daily poured into the river.

We shall hereafter adduce experiments, showing the action of the sulphuretted hydrogen of sewer water upon animal life.

The *ammonia* sometimes present, in water containing a large amount of organic matter, is also derived from decomposition. It is not usually to be detected in a free state, but exists in the form of carbonate of ammonia, in which condition it may also be frequently discovered in Thames water, as will be shown hereafter.

In addition to the above described impurities, organic, inorganic, metallic, and gaseous, impure water frequently contains a variety of other substances, the nature of the greater part of which has not hitherto been determined, and to which many of the injurious properties of bad water are to be referred.

Thus, the water of the Thames near London contains *urea*, *bile*, and a *variety of other effete and deleterious animal substances*, which reach it through the sewers.

The deleterious and abominable qualities of Thames water near London may frequently be shown by simply boiling it, when it will emit an odour in the highest degree offensive and disgusting.

On the Purification of Bad Water.

Having now considered the different impurities of water, we will next treat of the means by which these may, to a greater or less extent, be removed.

Several means are known by which the bad qualities of very impure water may be to some extent improved.

On Filtration.—One of the most common as well as effectual means of freeing water from a portion of its impurities, is filtration.

Now filtration is of two kinds, *mechanical* and *chemical*. The principal methods of filtration in use, however, are chiefly mechanical in their action, and effect only the solid impurities of water, or those which are in suspension merely.

The chief media of chemical filtration are soils: animal charcoal is partly mechanical, although it exerts some chemical action as well on the water which passes through it.

The mechanical powers of "patent filters" are by no means perfect, since they separate only the larger particles, earthy and organic, and allow of the passage of the smaller, including even many of the lesser animalculæ.

Since, then, filters do not completely separate the whole of the solid impurities of water, those which are fluid and in solution of course readily pass through them.

It is therefore evident that *the best filter is no substitute for bad water*.

Much useful and interesting matter on the subject of filtration might have been introduced had we space; we, however, refer the reader to our work on the "Supply of Water to the Metropolis," already mentioned, as well as to the evidence of Professor Way, given before the General Board of Health.

On the Addition of Lime to Water.—The hardness of water, as has already been stated, is, to a great extent, dependent upon the earthy salts contained in it.

While the carbonates of lime and magnesia are insoluble, the bicarbonates are soluble in water; it therefore occurred to Professor Clark, that by adding an additional quantity of caustic lime, in the form of lime-water, to water rendered hard by earthy bicarbonates, the excess of acid of these would unite with the lime of the lime-water, and thus the whole of the lime be converted into the insoluble carbonate, which would readily separate from the water by precipitation. Now practice has fully confirmed the simple theory above referred to.

Professor Clark, in evidence before the General Board of Health, states:—

"In the case of the East London water, I found the hardness $16\frac{1}{10}^\circ$, the alkalinity $15\frac{6}{10}^\circ$. It may be interesting to mention, that having kept the water for a long time in open vessels in a large laboratory, the hardness fell to $15\frac{4}{10}^\circ$. By mixing the water of $16\frac{1}{10}^\circ$ of hardness with lime-water, in the proportion of 4 bulks of lime-water to 44 of the original water, I found the hardness reduced to $4\frac{1}{10}^\circ$. In another trial, in the proportion of 4 to 45, the hardness became 4°. In subsequent trials, when the hardness of the water was 15°, I found the purified 4°; when the hardness was $14\frac{2}{10}$, the purified was 4°. In one case, when the hardness was $14\frac{4}{10}^\circ$, the purified was $3\frac{1}{10}^\circ$. The general result was 4° of hardness in the purified East London water."

But the precipitation of the lime and the consequent softening of the water are not the only effects produced by the addition of lime-water; much of the organic matter present is thrown down at the same time with the lime, a result of considerable importance.

The quantity of lime-water necessary depends, of course, upon the quantity of bicarbonates present in any water. As it is better to use rather too little than too much lime-water, the proportion to be added to Thames and other river waters coming to London may be stated at about a twelfth.

As the process, although highly ingenious and useful, entails trouble, we fear that it is not to be expected that the public at large would be induced to have recourse to it.

On the Addition of Oxalate of Soda or Ammonia to Water.—The use of oxalate of ammonia or soda has lately been recommended for the removal of the lime from water to be used for washing purposes.

Mr. Philip Holland, in reply to questions by the General Board of Health, gives the following evidence on this subject:—

"Is there any danger in using the oxalate of ammonia or soda?—Not the slightest with common care; the water does not require quite two grains of oxalic acid to the pint, to precipitate all the lime it usually contains. None of this remains in solution, and if a slight excess should accidentally be used, no harm is done, the neutral oxalates being innocent; nay, even a small quantity of oxalic acid, if largely diluted, would be quite harmless.

"How is the oxalate of ammonia prepared for convenient use?—By dissolving one troy ounce (480 grains) of oxalic acid in a quart of water, and adding as much carbonate of ammonia as will saturate it. Until the acid is saturated, the addition of the carbonate will be accompanied by effervescence; if somewhat more be added, it will be advantageous rather than otherwise. This quantity ought not to cost more than 3*d.*, and would soften above thirty gallons of water. A small tea-spoonful of the solution is enough to precipitate the lime contained in a pint of Thames water; less, indeed, will be sufficient, if part of the lime be precipitated by previous boiling. More ought not to be added if the water is to be used for making tea, as more will give a taste like that of soot.

"Do you recommend this mode of softening water for washing?—It answers very well; but I think the use of caustic soda still better, if cautiously employed. Common soda, which is a carbonate, is rendered caustic if a solution of it be shaken with some quick-lime, which unites with the carbonic acid, and leaves the soda free. It must be kept from the air to preserve it caustic, and used cautiously, or the clothes will be injured by it.

"Do these chemical expedients enable you to avoid the evils of hard water?—To some extent they enable those who have sufficient knowledge and care to avoid those evils. It is idle, however, to expect that the population generally can employ such processes as I have described, properly; or even if they could, that they would do so regularly. It is evidently the duty of those who have to supply a large population with water, to procure the pleasantest, softest, and purest water which is obtainable at any reasonable expense."

On the Effects of Boiling on Water.—The effects of boiling on water are very numerous; the chief, however, are the expulsion of the oxygen contained in it, as well as of the excess of carbonic acid, which holds the earthy salts in solution; this causes the precipitation of the salts of lime, and the consequent softening of the water: for these effects to be produced fully, it is necessary that the boiling should be long continued.

Professor Clark gives the following evidence on the effects of boiling on water:—

"Connected with this water, I may mention that all water holding carbonate of lime is softened by prolonged boiling. There is a misapprehension, however, in regard to the effect of boiling; a short boiling has very little effect indeed in softening water: when you subject water to even a sharp boiling, under the most favourable circumstances, I find two hours and three quarters, or three hours, necessary for decomposing all the bicarbonate of lime, precautions being taken to prevent any evaporation of water in the form of steam. By boiling, this water was reduced to $3\frac{7}{10}°$. In the case of the New River water the hardness was $13\frac{2}{10}°$, the alkalinity was $12\frac{5}{10}°$; this purified by lime-water, in the proportion of 3 to 40, was reduced to $3\frac{7}{10}°$ of hardness; by prolonged boiling it was reduced to $3\frac{6}{10}°$ of hardness. I got another specimen of New River water, $11\frac{6}{10}°$, which, by using the proportion of 1 of lime-water to $14\frac{5}{10}°$ of the water, was reduced to the hardness of $2\frac{6}{10}°$.

"At University College a large boiler of water, being kept heated for two hours and a half, showed $8\frac{2}{10}°$ of hardness. [There is a very remarkable fact that I have observed on the comparative result of the process of prolonged boiling, and of the process of softening by means of lime-water. Both processes result in nearly the same degree of hardness, but the lime process gives a result much less alkaline than the boiling process, although the contrary might have been expected.]"

Other effects of boiling on water are, to dissipate the greater part of any noxious gas which may be contained in it, as well as to destroy the vitality of the living animal and vegetable productions which may happen to be present.

It is to the precipitation of the earthy carbonates that the incrustation which takes place in kettles, boilers, and pipes which convey hot water, is due. In the case of steam-boilers, this accumulation often results in fatal accidents.

On the Addition of Acids to Water.—In a previous part of this Report, it has been shown that the kind of living productions contained in impure water are dependent, not only upon the quality and quantity of dead organic matter present, but upon the reaction of the water, whether it be alkaline or acid.

Thus it was evidenced, that if water contain much animal matter in a fluid condition, and exhibit an alkaline reaction, the living productions present in it will consist principally of infusoria.

Also, that if the same water be rendered acid, then little or no development of infusoria will take place, but fungi principally form in it.

It was stated, further, that while alkaline waters, containing much fluid animal matter, smell offensively, and betray evidence of progressing decomposition, acid waters, on the contrary, evolve little or no odour, the process of putrefaction in them being much retarded.

From these facts it has occurred to us that a practical application of much importance might be deduced.

Thames water, within some miles of the metropolis, holds in solution a large quantity of fluid animal matter; it swarms with infusoria, exhibits an alkaline reaction, and when kept for any length of time it emits an offensive smell, indicative of decomposition.

Now, if to this, or any other water resembling it, we add a small quantity of acid, these changes will be arrested, the animalcules will be killed, and the water will soon cease to smell disagreeably.

The best acid probably which can be employed is the acetic, and the quantity added should be just sufficient to impart an agreeable, refreshing, and slightly acid taste.

We recommend, therefore, to all persons who have the great misfortune to be supplied with Thames, or any other water which approches it in character, the adoption of the simple and inexpensive proceeding here described. In times of epidemic visitations, this precaution should on no account be omitted, and we anticipate, from its general employment, results of a highly satisfactory character.

The benefits which may be expected to follow the adoption of the proceeding recommended may be estimated by a consideration of the following important fact—viz., the immunity of those districts from cholera in which the acid beverage, cider, is generally drank.

Impure Water a Source of Disease.

We now approach the consideration of a very important division of our subject—viz., the evidences which exist in proof of the statement that impure water is a source of disease.

That the air of the country is more healthful than that of towns and cities is admitted by all, and that vitiated or impure air is capable of affecting the health injuriously, and of giving origin to diseases, is universally allowed.

Now we have shown, that whatever the air contains in the shape of impurity, the water imbibes in certain proportions; and from this single fact it must be admitted that water may and does frequently prove a source of disease, for that which is true of air out of water can scarcely be less true of air imbibed by water.

Now the effects of vitiated air are usually slow and insidious, but not on that account the less important or the less to be guarded against; and analogy leads us to believe that the bad effects produced by impure water, excepting those which occur during the prevalence of epidemics, are of the same slow and insidious character.

Disease occasioned by the Earthy and Alkaline Impurities contained in Water.—The whole of the waters in use in this metropolis and its vicinity are of the kind termed *hard.*

Now, as has been repeatedly stated, the hardness of water is dependent principally upon the earthy bicarbonates contained in it, but not entirely, as free carbonic acid, and the sulphates also, to some extent, when present, contribute to this hardness.

But hard waters usually contain other salts, as the chlorides and alkaline carbonates; these last possess the property of imparting softness to water, so that the degree of hardness and the amount of those salts which impart that quality, by no means, as a general rule, indicate the whole quantity of the saline constituents of water.

Thus the degree of hardness of *Thames* and other *river waters* supplied to the metropolis varies from 11° to 18°, but the gross amount of saline matter to the gallon ranges from 20 to 24 grains. In *well waters* the quantity of earthy and alkaline salts present is subject to the greatest possible variation.

The waters of *Artesian wells* are only of from 4° to 6° of hardness, but they contain, in addition to the earthy, alkaline salts, frequently to the extent of 40 grains to the gallon.

Lastly, the hardness of some well waters in use, mounts so high as to 50° and even 60°, also with variable proportions of the alkaline salts.

Now, allowing *two quarts* of Thames or other river water to be the average daily quantity consumed in some form or other by each person, there is introduced into the system every day ten, twelve, or more grains of earthy and alkaline salts.

In the same quantity of the waters of Artesian wells there is contained from fifteen to twenty grains of alkaline salts, with the addition of a very small quantity only of earthy salts.

While in a half-gallon of the waters of some wells as much as half a drachm of saline matter is present.

When it is remembered, therefore, that about five grains of the earthy or alkaline carbonates constitute a medicinal dose, the conclusion is indisputable that the amount of those salts contained in the waters now in use is sufficient to produce medicinal action, and therefore in some cases to affect the health.

So convinced of this fact are many physicians, that it is their practice in derangements of the digestive and renal organs frequently to prescribe distilled water. This practice was extensively adopted by the late Dr. Prout.

In health the urine exhibits an acid reaction; but a very large proportion of those who are out of health, and who are suffering from debility, pass feebly acid, and more generally alkaline urine.

Now, there can be no question but that the daily use of alkaline waters, which those now supplied to London really are, as is shown by their action on reddened litmus paper, tends to perpetuate this condition of the urine, and to prolong this stage of debility.

This view of the action of the waters at present in use, we are satisfied, is a very important one.

Another serious and well established result of the use of hard water is the liability incurred to the formation of calculus, especially calculi of lime.

In proof that the above statement of the effects of the daily use of hard and alkaline waters on health are not over estimated, we will now proceed to quote medical evidence.

In Dr. Sutherland's report on water, contained in the Appendix III. of the Report of the General Board of Health on the Supply of Water to the Metropolis, Dr. Leech gives the following evidence:—

"It has been observed, that since this change urinary diseases have become less frequent, especially those attended by the deposition of gravel. So far as experience has gone, my own opinion is, that dyspeptic complaints have become diminished in number. With the same reservation as to time, it is the opinion of the medical profession that fever has numerically diminished, and that the cases that occur are more amenable to treatment, by the use of the soft-water supply, than they were with the former supply.

"During the late cholera there was a remarkable circumstance which deserves notice as compared with the epidemic of 1832. Since the former period, the population of Glasgow, south of the Clyde, has nearly doubled; and with this exception, and the introduction of the soft-water supply, the circumstances might be considered as the same at both periods. In one district, the parish of Gorbals, the attack in 1832 was fearful; while Glasgow, north of the Clyde, also suffered severely. During the late epidemic, Gorbals parish furnished comparatively a small number of cases, while the epidemic in other parts of Glasgow was very severe. The unanimous opinion of the Medical Society was, that this comparative immunity was to be attributed to the soft-water supply."

In the same Report, Dr. Paton, of Paisley, gives nearly similar evidence.

"I was not in town previous to the filtered river water being used, but in the first ten years of my practice here, from 1827 to 1838, cases of calculous disorders were very numerous; the last ten years I have seen few or none, unless a few old cases previously affected, or in parts not accessible to the water of the company, and a few from some of the chalk counties of England. With regard to the time previous to the introduction of the filtered river water, which must have been about 1804 or 1805, I can communicate nothing of my own knowledge; but from frequent conversations with my partner—the late Dr. White, of this place, who had been upwards of fifty years in practice when I joined him —I was given to understand that the cases of stone were very numerous. The same thing was often mentioned by other old practitioners. They also mentioned the rapid diminution of them after the river water came to be used in part, and now there is not a single case of calculous disease, except those previously mentioned."

But there is also some evidence to show that the diffusion of fever and cholera are also favoured by the use of hard water.

On this point Dr. Paton makes the following important observations:—

"Cholera appears, during this last and former attack, to have been more severe in those places where the water is obtained from calcareous wells, or where it is impregnated with other mineral matters, than in those places where it issues from wells over trap, or where it flows over a rocky soil of that nature. . . . I may mention that in Charleston, a district of Paisley, standing higher and possessing purer air than most of the town, and containing about 4500 inhabitants, mostly supplied with water from wells, and not from the company, cholera made its most severe attack, hardly missing a family, except a few who were supplied with pure water. . . . When cholera prevailed, I attended many cases of diarrhœa, particularly in the parts of the town supplied with wells."

And again, Dr. Paton remarks, in commenting upon the Report of the Local Board of Health in Paisley—

"You will perceive that where pure water has been supplied there have been only 346 cases of fever during twelve months; and where it has not, the numbers have been 502. This difference is not so marked; but when it is considered that the larger number comes from one-tenth of the inhabitants, and the smaller from the remainder, it is then fully seen what is the value of the pure water."

Disease occasioned by the Metallic Impurities contained in Water.—Numerous are the cases which have been recorded of serious and even fatal results following the use of water containing *lead* in solution.

Since it has been shown that many hard waters act energetically on lead, the presumption has become extremely probable that many obscure affections and attacks, especially of colic, are really to be referred to the lead introduced into the system through the water.

It is to be remembered that lead is one of those substances which accumulate in the system, so that although a very minute quantity only finds its way into the body each day, yet after the lapse of weeks or months, the accumulation may be so considerable as to produce disease.

The amount of *iron* present in the London waters is but very small, and scarcely sufficient in itself to occasion disorder.

The effects of even very minute doses of this metal on some nervous and susceptible constitutions is extraordinary.

Disease occasioned by the Organic Impurities of Water.—In proof that water highly charged with decomposing organic matter frequently gives rise to severe and fatal diseases, often of an epidemical character, we shall be able to produce an abundance of evidence.

To occasion these effects, it is probably necessary that the organic matters should resolve themselves into certain deleterious gases and substances, as the *carburetted*, *sulphuretted*, and *phosphuretted* hydrogen gases, *cyanides*, &c., as well as doubtless many other lethal products, the nature and composition of which have hitherto eluded the detective powers of chemical science.

With respect to the effects produced by the living productions contained in impure water, we will quote the evidence given by ourselves before the General Board of Health.

"*Question* 130. What are the observed effects of the consumption of the various forms of animal and vegetable life present in water on health?—The fact of the existence in large quantities of living productions belonging to several distinct divisions of the organic world, and for the most part entirely invisible to the common eye in the waters in general use, was not, I believe, generally known until announced by myself in the pages of "The Lancet" some time since. It is therefore scarcely to be expected that there should as yet have been made many observations tending to show the effects of their consumption upon health, nevertheless, we are not altogether without data upon which to found an opinion: thus the organisation and mode of life of many of these productions, as the *entomostraceæ*, most of the *infusoriæ* and *algæ*, are such as clearly to unfit them for any prolonged existence in the human stomach and intestines, and there is no question but that when introduced therein they speedily die, the digestible portions of them being assimilated; but whether this is the case with the *fungi*, the *annelidæ*, and certain *infusoriæ* and *algæ*, admits of doubt. It is a well ascertained fact that the *fungi* have the power of attacking and even proving fatal to many vegetable and the lower forms of animal life.

I may here refer to certain experiments which I made some years since to test the aggressive and parasitic powers of *fungi*. Many fruits, such as apples, pears, and peaches, and several vegetables, as the lettuce, vegetable-marrow, potato-haulm, &c., were inoculated with the sporules of *fungi;* the result of this was that they all became speedily diseased, and in a few days many of them entirely disintegrated and destroyed. It is to be observed that these experiments were made on healthy and growing fruits and vegetables; the former were still on the trees, and the latter rooted in the earth. In the softer fruits, as the peach, and some kinds of apples and pears, the effects of the inoculation became visible in less than twenty-four hours, a dark spot, like that of mortification, first appearing, and this gradually extending in all directions until the fruit became completely disorganised. There are now also many recorded cases in which *fungi* have attacked the living animal organism, including even man himself: the disease, muscardine, which occurs in the silk-worm and many other animals of the same class, as well as the peculiar softening which the tails of fish confined in glass globes frequently undergo, is attributable to the growth within the tissue of the animal of ramifying filaments of *fungi.* Again, *fungi* have been noticed growing on ulcerated surfaces in the human intestines in cases of fever; they have likewise been observed in certain affections of the skin, and in discharges from the stomach, bowels, bladder, and vagina.

"With respect to *annelidæ*, it is commonly known that several species of worms live in the human intestines, and even grow and multiply there, greatly to the detriment of health, and it is difficult to avoid the conclusion that they are really introduced from without, either in the water, or through the medium of the food.

"Animalcules widely differing from each other have also been observed to occur in the human organism in connection with certain diseases. Thus Donnè has figured and described a vibrio, under the name of the venereal vibrio; the same observer has likewise noticed in vaginal discharges *infusoria*, which he has named *trichomonades*, and which, as well as the vibrio, are figured in my work "On the Microscopic Anatomy of the Human Body in Health and Disease." Other animal productions have been noticed in the humours of the eye, in the muscular tissue, gall bladder, &c.

"The only instance of an alga being found in connection with the human subject is that recorded by Dr. Arthur Farre; it was observed in a case attended with vomiting, and has been named *Sarcina ventriculi.* It is particularly worthy of observation that the greater part of the living productions noticed in relation to man have had their seat either on the surface of the body, in the stomach, intestines, gall bladder, or in the urinary passages, uterus, and vagina; that is almost invariably in positions accessible to the air, an observation leading to the conclusion that they found their way into the frame from without.

"*Question* 131. The *diatomaceæ* are, I believe, furnished with skeletons of silex; what becomes of them when introduced into the stomach, and is it probable that they could give rise to results injurious to health? — The vitality of the *diatomaceæ* is most probably destroyed when introduced into the system; they pass, however, in an entire state, and when consumed in any quantity, it is quite possible they might give rise to irritation, in consequence of their unyielding nature and of the elongated and needle-like character of most of the species, the extremities of the frustules frequently being finer and sharper than the points of needles."

In reference to the general effects resulting from the use of water containing decomposing organic matter, Dr. Gavin, in evidence before the Board of Health, states: —

"The connection between foul drinking-water and cholera was established by irrefragable evidence. The cases where the connection was most clear were where the parties had been recently drinking water taken from pumps near to, and contaminated by the matter of, cesspools; but wherever the water was contaminated so as to be nauseous, diarrhœa was invariably present, and affected every person in the habit of drinking such water. I am not aware of any valid exceptions to this law. The most aggravated instance of foul water developing cholera was where a thirsty navigator drank of the Hackney-brook (a common sewer), and was almost immediately attacked with cholera, and subsequently speedily died. The cases next most marked were those of the eleven persons, out of twenty-two in number, whom I have already recorded as having perished in a certain square consisting only of a few houses, where the water was contaminated with cesspool water. A similar story I have related with reference to the first outbreak of cholera at Fulham. In Hackney I have shown how, out of sixty-three inhabitants of one locality who drank of water contaminated with cesspool matter, every one had had, or then had, more or less diarrhœa, and that to avoid its excessive filthiness the whole of the inhabitants of that row were compelled to drink and use for domestic purposes the water which ran down the kennel. These are the more marked instances, but the cases where foul water led to the development of cholera were so numerous, that all the visitors under my superintendence united in their testimony as to the influence of such water in the development of the disease. I have traced in many instances the unsuspected cause of the development of cholera in the state of the drinking water. When it is recollected that the water of the poor is nearly always exposed to the noxious gases and agencies which arise from privies, and the slow decomposition of the refuse in their yards, and also from those in their close, offensive, and impure dwellings, it will at once be understood that such water produced much and severe diarrhœa during the period of cholera."

Mr. Bowie, surgeon, gives the following testimony in reference to the production of cholera from the use of impure water: —

"During the raging of the cholera I met with many cases where it was asserted that the badness of the water was the cause of the attack; and I have no doubt that it greatly tended to increase the liability to disease.

"It is well known that cholera raged with frightful and destructive violence in Merthyr Tydfil, Pen y darran, Dowlais, and other mining towns and villages in South Wales; and in all these places I heard the opinion expressed by many of the population that it was something in the water. The supply was wretchedly defective, and the water very impure."

And again —

"The water supplied to the Tower was pumped from the Thames at a certain point within 200 yards of a sewer, the contents of which were all the blood and refuse from the butchers' shops and slaughter-houses in Whitechapel." "The soldiers and all the inhabitants of the Tower complained of the water, and attributed a great deal of the disease to the bad water." "A regiment that came from Chichester had eighteen on the sick-list three days after their arrival." The sickness on that occasion was likewise attributed to the impurity of the water.

"The cases of cholera in the Tower were considered more malignant and rapid than in the worst parts of the Metropolitan Eastern District."

The evidence of Mr. Challice, surgeon, is nearly to the same effect.

"The first fatal case of cholera that I met with was that of a master of a vessel at Gravesend. He was a fine man in the prime of life, and in perfect health when he left London. He was going to the Baltic; he drank rather largely over night, parting with his owners and others, and he got up in the morning and drank heartily from one of the water casks, which had just been filled with Thames water; he was soon after attacked with purging and vomiting. I went down post, and found him just dead. I asked particulars, and I found that the death was so sudden, that it almost appeared as if he had taken poison in the water. Subsequently it was from facts that came almost hourly under notice that I formed the opinion of the direct consequences of taking impure water in producing a disordered state of the bowels, and those who had such a state of the bowels were pre-eminently in a condition to become victims to the disease."

Mr. Charles Martin, surgeon, gives the following evidence, in reference to cholera in Jacob's Island, Bermondsey: —

"I think in the greater number of houses there was no water to drink but that from the tidal ditches, until about July. At that time a great supply of water was laid on. It had been getting worse for years past; the water in the ditches becoming in some parts absolutely putrid, green, thick, and slimy. I know some clusters of houses where they had only such water to drink, and I know that out of five of those houses the inmates of four were affected with cholera. In all the early cases of cholera, the parties were found to have been supplied with water from these ditches. One case was that of a man from Maidstone, who stayed at a public-house in Mill-street for the night, on his way to Liverpool, to emigrate: he arrived on the Saturday, and on Monday was attacked with cholera. In that house no water was laid on; great numbers of the houses in the neighbourhood are still not supplied with water."

Testimony similar to the above, showing the connection between impure water, cholera, fever, and other diseases, might be multiplied to almost any extent; enough, however, has been advanced clearly to establish the relation in question.

SECTION II.

THE DIFFERENT KINDS OF WATER.

All waters are either soft or hard.

The *soft waters* are distilled, rain, and snow water. They are all characterised by the following properties: when used in washing they communicate to the hand a feeling of softness; they do not curdle soap; they are free from saline impregnation; they permeate readily all organic tissues, whether living or dead, and they possess highly solvent and extractive powers.

Some waters are occasionally called soft, which do contain a small quantity of saline matter; such waters, however, are not absolutely soft, but are merely comparatively so.

Again, other waters contain a certain proportion of alkaline salts; now as these have the property of imparting a softness to water, such waters are also frequently termed soft, although in general they are only relatively so, and, strictly considered, ought usually to be described under the head of hard waters.

The *hard waters* are river, well, and most spring waters.

They are all characterised by the following properties: they communicate a feeling of hardness to the hand in washing, they curdle soap, contain much saline matter, are less readily imbibed by organic tissues, and they possess less solvent and extractive powers.

The acids and salts which communicate to water its hardness are, carbonic and sulphuric acids, as well as the earthy bicarbonates, to which, in most cases, it is principally due.

The hardness of water varies from 1° to 60° and upwards.

Soft Waters.

Distilled Water. — This varies in quality according as the water from which it has been distilled is pure or not; if impure, then the distilled water procured from it will also be more or less impure, but if pure, and free from all organic contamination, then the product of its distillation will likewise be pure.

Pure distilled water contains only the chemical elements of water — viz., oxygen and hydrogen, and is entirely free from gaseous, saline, metallic, or organic impurities and contaminations.

Such water, contact with the atmosphere being prevented, will keep for months and years, at the end of which time it will not smell in the least degree offensive, nor will it contain a trace of organic matter dead or living.

It should be remembered, however, that distilled water is prepared in London, frequently from corrupt Thames water, and is then always contaminated with more or less organic matter, and consequently will not keep for any lengthened period.

The purest distilled water even, if exposed for some time to the atmosphere, will imbibe a portion of oxygen and carbonic acid, as well as any other gases, or impurities, organic or otherwise, which may be present.

Rain water. — This water also varies in quality according to the locality and manner in which it is obtained.

If caught near a large town or city, and particularly a manufacturing town, it will be found always to contain a certain amount of impurities, derived from the more or less contaminated atmosphere which surrounds the town, and with which in its descent to the earth it comes in contact. These impurities in part consist of soot and its constituents.

Rain-water, however, procured in the country at a distance from houses, will in general be free from saline or organic impurity, and will contain only a certain amount of those gases which exist in the atmosphere, as oxygen and carbonic acid, with sometimes a trace of ammonia.

Rain-water, therefore, differs from distilled water only in being aërated.

Snow-water. — Snow-water resembles in its properties very closely rain-water; but is even still purer, because in the form of snow it is solid, and therefore in its descent to the earth, it imbibes but little impurity from the atmosphere.

Hard Waters.

River-water.—The water of a river is derived from many sources, but usually consists of a mixture of rain, drainage, and spring waters in variable proportions; in its course it travels over different surfaces and strata, and hence as it flows along it acquires numerous saline and mineral impregnations, which cause its qualities and the degree of hardness to vary in different situations.

The degree of hardness of river-water varies, not only with the situation, but also with the season, and with the proportion of rain and drainage water present. The hardness of Thames and those other river-waters with which London is supplied ranges from 11° to 17°; the total amount of earthy and alkaline salts contained in each gallon being from twenty to twenty-four or even more grains.

But river-water contains not only saline and mineral substances, but also a considerable quantity of organic matter, dead and living, derived from the ditches, smaller streams, sewers, and numerous other sources of contamination, to which rivers in their course are peculiarly liable.

River-waters, therefore, *are the most impure of all waters, and contain the largest amount of organic matter.*

Spring and Well Waters. — The waters of springs and wells do not differ from each other in any material respect, and therefore may be considered together.

Spring and well waters issue from the earth at a considerable distance from the surface, and in their course come in contact with rocks, strata, and soils, from which they dissolve out a certain amount of saline and mineral ingredients.

The qualities of these waters, therefore, stand in relation to the surfaces with which they come in contact.

As a rule, spring and well waters are harder than river-water, reaching in some instances, to 60° and upwards.

There are some well-waters, however, which are less hard than river-water; thus the water of most Artesian wells is of only 6° of hardness, but it contains, at the same time, a considerable quantity of alkaline salts, which do not contribute to the hardness of water, but which, on the contrary, render it soft.

Coming direct from the depths of the earth, well and spring water is exposed to but few sources of contamination, and contains usually little or no organic matter.

This freedom from organic impurity is observed particularly with deep well-water: the shallow wells of towns and cities are frequently largely contaminated with organic matter (a portion of which is converted into nitrates), derived from adjacent cesspools, privies, churchyards, &c.

On the Comparative Advantages of Soft Water.

From what has been stated already, the reader will find himself in a position to form some opinion respecting the advantages resulting from the use of soft water, as well as the disadvantages attending the employment of that which is hard.

The advantages of soft water are of three kinds — dietetic, economic, and sanitary.

The dietetic benefits depend upon the facility with which soft water is imbibed by organic structures, dead and living, and hence it forms the best vehicle for the introduction of alimentary substances into the living organism.

The economic advantages, as in making tea and in washing, likewise, in a great measure, proceed from the readiness with which soft water makes its way into organic structures, and in consequence of which it exerts a solvent or extractive action.

The sanitary advantages principally result from its freedom from admixture with saline matters, which, as we have elsewhere shown, are calculated to give rise to dyspeptic and calculous affections.

As the results of the use of soft water are of a more striking character than might be at first conceived, we will proceed to adduce evidence on this head.

The subjoined testimony is extracted from the Report to the Board of Health by Dr. Sutherland: —

"The following are notes of evidence obtained from Mr. Lawton, waterman to the Company: —

"All the consumers like the higher level water better than the lower level water, because the higher level water is the softest." The consumers "want it for tea, and for washing; it makes much better tea, it uses less tea, it uses decidedly less soap. It is cheaper for washing, and there is less labour attending it. It is preferred by the brewers, because it brews better ale. The soft water does not corrode boilers. At large tea parties the soft water is used by preference, because it makes tea cheaper and better.

Being asked, "What is the reason people pay for your water, when they can get a supply from their own wells without paying for it?" — he replies, "For the reasons I have already given. These give the universal opinions of the people, so much so that the company has determined to supply all the districts with soft water on account of its being preferred."

John Manchester, a bleacher in Stockport, gives evidence as to the superior economic value of the soft water supply. He says, "Where we should use 50 lb. of alkali with hard water, we use 45 lb. with soft. Hard water takes more alkali and soap to produce the same colour than soft water does. The saving of soap is still more in proportion."

In reply to the question, "What is your experience with regard to the use of hard and soft water for calico printing?" he says, "Soft water takes decidedly less drugs to produce the same colour."

"Another witness, Mrs. Unsworth, of the Mersey-inn, Stockport, stated that there was an old well in the yard of the house, from which water was drawn by a steam-engine for household use, but after having gone to this expense, it was thought better to take the Company's water, on account of its softness. She states that it brews better ale than the well-water, and also makes better tea, and uses less soap in washing, so that it was found cheaper to use the soft water than the well-water, although the former had to be paid for.

"The town of Blackburn has a water-supply of from 3° to 4° of hardness, which has been extensively introduced into factories and dwelling-houses. I made personal inquiries of a number of people, as to their experience of the new supply in comparison with the water formerly in use. I found the testimony unanimous as to the superior advantages of the soft water for all culinary and domestic purposes. It was stated that it made better tea, and that it saved labour and soap in washing. A respectable chemist and druggist said that he could use no other water for making infusions, as all others were hard, and extracted badly."

The following notes of evidence will show the superior value of the soft water supply in the local manufactures: —

"Henry Smithies — Is an engineer at Blackburn. Is acquainted with the comparative use of hard and soft water for boiler purposes; is acquainted with the use of the present town water for boiler purposes. The town water is very superior; it does not produce scale, which the former hard water did. The hard water crusted the boilers so thick, that the crust had to be taken out with a pickaxe; the bottoms of boilers got corroded, and the rivets got eaten off. There is no question as to the superior cheapness of soft water, because the boilers last very much longer, and require fewer repairs."

Professor Clark gives the following testimony, showing the saving effected by the use of soft water : — " With regard to the softness of water, this quality is of importance, not merely for the saving of soap to households, for the agreeableness of washing at the toilet, for the agreeableness and utility of bathing, which I account a most important practice for promoting the health of the inhabitants of a town, but also in respect of the wear and tear of linen due to hard water. Such wear and tear comes to be a very large item of expense to the inhabitants of a town. The inhabitants of London are probably not aware so much as visitors from the country are, of the amount of destruction to clothes in consequence of the hardness of the water, and the use of soda in order to get rid of the hardness. I remember an occasion, which I may mention, where the amount of wear and tear was brought out in a very conspicuous manner. Two young men, brothers, in Glasgow, were put into counting-houses, one in London and the other in Glasgow. They had each a similar assortment of shirts given to them. Some time after, when the brother in London came back on a visit to Glasgow, the lady of the house pointed out, to the wonder of her female friends, the difference there was in the wear of the shirts of the two brothers, that had been given at the same time ; those that had undergone the London washing were so much more worn than the others which had been washed at Glasgow. I reckon the cost of soap consumed in London to be about double the gross water-rent. The quantity of soap consumed in England, Wales, and Scotland, can easily be ascertained from official returns. From these the consumption of every individual of the population appears to be nearly 7½ lbs., or 120 ounces, which, at 1*d.* for three ounces, or 50*s.* per cwt., comes to an expence of 3*s.* 4*d.* for each person. There are no official returns from which to give the consumption of soap in London alone ; but after making diligent inquiries as to the consumption of soap in families that washed on their own establishments, and obtaining what I believed was the best information the trade could afford, I came to the conclusion that the average consumption of each person was about double in London what it was over all Britain — that is to say, 15 lbs., which comes to 6*s.* 8*d.* for each person. It is to be remembered that London is a hard-water district. The Commissioners must be aware that there are at present no very accurate data for an estimate of the water-rent paid by each person in London, but 3*s.* 4*d.* seems as accurate an estimate as can now be made. Thus 10*s.* for each person is the cost of soap and water in London — 6*s.* 8*d.* for soap, and 3*s.* 4*d.* for water. Since the soap costs twice the water, whatever be the rate of saving on soap, that rate will become twice as much when reckoned on the water. For example, if the saving, by softening the water be only five per cent. on the soap, it would be ten per cent. on the water.

" What is the total soap used in London ? — About 1000 tons a month, at about 50*l.* a ton, and along with it are used about 250 tons of carbonate of soda, at about 10*l.* a ton, costing together 630,000*l.* a year."

Much additional evidence, equally interesting and striking with the preceding, might be adduced on the subject of the economic advantages of soft water had we space for their insertion.

SECTION III.

ON THE EXISTING SOURCES OF LONDON WATER SUPPLY.

London and its suburbs are supplied with water by nine different companies, each possessing the monopoly of a certain district.

The water furnished by no less than seven of these companies consists entirely of river-water, that of the eighth principally of river-water, and the ninth of a mixture of well and pond water.

These waters are all hard, and have all the disadvantages of hard water, dietetic, economic, and sanitary, which have already been fully pointed out, but which may again be briefly noticed. Thus, they are not readily absorbed by organic tissues, living or dead, animal or vegetable ; they therefore do not readily extract the soluble matters contained in dead animal or vegetable substances, and they form a bad vehicle for the solution and dilution of food. They contain a variety of saline substances, some of which act energetically on lead, and predispose greatly to calculous and dyspeptic affections; regarded in an economical point of view, they are wasteful of tea, coffee, soap, soda, &c., and are highly destructive of all articles requiring to be washed.

Such is a short enumeration of the many disadvantages attending the use of even the purest hard water, — that is, of hard water free from organic matter; but in the case of river-water we have the additional evils to consider, resulting from the presence of organic matter, often in large amount, and in a variety of forms and conditions.

On these grounds alone, and without the addition of another observation, the sources of supply of at least eight of the present water companies ought to be and are condemned.

We propose, however, to extend our inquiries still further, to examine closely the particular sources of contamination to which each river from which water is obtained for the supply of the metropolis is liable, as well as to ascertain the present condition of the water of each company as supplied to the inhabitants.

The rivers which are made subservient to the supply of London are the Thames, the Lea, the New River, and the Ravensbourne; of each of these we will treat in succession.

State of the Thames. — No less than five companies derive their supplies from the Thames in a few miles of its course — viz., from between Brentford in the one direction, and Lambeth in the other. The part embraced between these places is more impure and foul than any other division of the river of equal extent.

The great source of pollution, amongst many others of less magnitude, to which Thames water is subject, is the sewage derived from the numerous villages, towns, and cities, on or near its banks.

Now sewage consists of every conceivable filth and abomination, — the waste of the kitchen, the contents of the water-closet, the refuse of the slaughter-house, the knacker's yard, the impure manufactory of every description, &c., — the offensive, disgusting, and dangerous character of these impurities being further heightened by the decomposition which they undergo in the sewers, previous to their discharge into the river.

A clear insight into the deleterious character of the matter of sewers and sewer-water may be obtained by a perusal of the following particulars, derived from our before-quoted work on the "Supply of Water to the Metropolis."

The microscope detects in most sewer-waters numerous minute and living worms, but only a very few animalculæ; much dead and decomposing organic matter, animal and vegetable; muscular fibre, derived from the fæces; cells of potato and other vegetables; husks of wheat; spiral vessels of plants; starch granules; a black, carbonaceous matter, &c.

By means of chemistry, the presence of much organic matter, in a state of solution, is detected, as well as a large quantity of sulphuretted hydrogen, to which sewer-water principally owes its offensive smell; and numerous saline, and even *animal* substances, as *bile*, *urea*, &c.

The quantity of sulphuretted hydrogen frequently present in sewer-water, and its deadly nature, are shown by the following experiments: —

"1*st Experiment.* — A given quantity of Thames water, known to contain living *infusoria*, was added to an equal quantity of sewer-water; examined a few minutes afterwards, the animalcules were found to be either dead or deprived of locomotive power, and in a dying state.

"2*nd Experiment.* — A small fish, placed in a wine-glass of sewer-water, immediately gave signs of distress, and, after struggling violently, floated on its side, and would have perished in a few seconds, had it not been removed, and placed in fresh water.

"3*rd Experiment.* — A bird, placed in a glass bell-jar, into which the gas evolved by the sewer-water was allowed to pass, after struggling a good deal, and showing other symptoms of the action of the gas, suddenly fell on its side, and although immediately removed into fresh air, was found to be dead.

"These experiments were made originally with sewer-water obtained from the Friar-street sewer; they have since been repeated with six other sewer-waters, and with the same results as respects the animalcules and the fish, but not the bird; this, although much distressed, yet survived the experiment."

To this fearful pollution by sewer-water, the Thames and most of its tributaries is more or less subject in its whole course; the extent of contamination, however, goes on increasing as the river advances, and the pollution is at its highest point near to London, especially in the neighbourhood of the bridges, where the greatest number of sewers pour their filthy contents, the mingled refuse of a mighty city, into its reeking bed.

A good idea of the extent to which the water of the Thames, at different parts of its course, is polluted by sewer-water, will be obtained by an examination of the following estimate of the populations on the banks of the Thames, and its tributaries, at the date of the last census.

United Population of Towns on Thames and its Tributaries above Henley.

On Thame	11,151
Isis	66,763
Cherwell	7,144
Kennet	24,211
Loddon, Blackwater	12,952
Thames	26,298
Total	148,519

United Population of Towns on Thames and its Tributaries, from Henley to London, inclusive of the Metropolis and the Suburbs.

On Colne	37,659
Wey	32,537
Mole	22,733
Yelding	11,709
Brent	5,920
Wandle	22,697
Thames	2,034,499
Total	2,167,754

From this table it is manifest how very far from the required purity, particularly as respects freedom from organic matter, must be the water of the Thames in nearly every part of its course.

On this point, however, we will not dwell, our chief purpose being to ascertain the state of the river from Kew to London.

We found, in a wine-bottle of water procured at Kew, and examined with the microscope, animal and vegetable matter in a state of decomposition in considerable quantities; two or three species of worm-like animals, several kinds of living animalculæ, confervæ, fungi, &c.

In the same quantity of Thames water obtained near Lambeth, we detected an immense number of living animalcules, fungi, naviculæ, &c.; also much dead organic matter, the principal part of which was clearly derived from the sewers, and consisted of muscular fibre from the fæces, fragments of vegetables, cells of potato, husks of wheat, &c.

"The differences in the results of these examinations of Thames water," "the predominance of vegetation in the water from Brentford, and of animal life in that procured at Lambeth, struck me as so remarkable, that I was induced to make a series of observations on the river-water, both upwards and downwards, in the course of the river from London. These have brought to light the singular and important fact, that Thames water, from Brentford in one direction, to Woolwich in an opposite, swarms with living productions, principally of the genus *Paramecium*, and of one species of this genus, the *P. chrysalis* of Ehrenberg.

Fig. 24.

THAMES WATER AT RICHMOND.

This engraving exhibits the principal *animal* and *vegetable* productions contained in the water of the THAMES *at Richmond*. Drawn with the Camera Lucida, and magnified 220 diameters.*

These animalcules exist in such vast numbers, that a wine-bottle of the water obtained in any condition of the river, at high or low tide, is sure to contain large quantities of them. They are met with in the greatest abundance near to London, and in the neighbourhood of the bridges. At Barnes they may be detected at all times, although in diminished numbers, while at Kew they have in general almost disappeared: going in an opposite direction, we meet with them in abundance at Blackwall, and more sparingly even at Woolwich. It is most probable that at high and spring tides these limits are much exceeded, especially down the river; for it is to be supposed that these creatures are ultimately, together with a variety of other matters, discharged into the sea."†

It now only remains to state that sulphuretted hydrogen and carbonate of ammonia are frequently to be detected in Thames water.

The examinations of Thames water referred to above were first made in the

* The samples of water from which the engravings which illustrate this Report have been prepared, were obtained either from the Thames itself, or from service-pipes, in February 1851.

Each drawing represents *only a very small portion* of the organic matters, living and dead, contained in the several samples, of less than a quart each. On setting aside any water containing solid impurities, these of course subside, and form residues; but the living animal forms, mostly infusoria, possessing active powers of locomotion, diffuse themselves throughout the whole body of the water.

The forms exhibited by many of the lower orders of animals are often very singular, and we are not surprised that they should sometimes have been made the subject of jocose and harmless remarks. The important fact, however, should never be lost sight of, that the presence of these creatures, in considerable numbers, in water, shows that it contains a *large quantity of fluid organic matter*, and *is therefore in a state wholly unfit for human consumption*, more particularly as a beverage. Upon this point it would be simply a waste of words and arguments to offer another observation.

† A Microscopical Examination of the Water supplied to the Inhabitants of London and the Suburban Districts, pp. 5, 6.

Fig. 25.

THAMES AT WATERLOO-BRIDGE.

This engraving shows the more remarkable *animal* and *vegetable* productions found in the water of the THAMES *at Waterloo-bridge*. Drawn with the Camera Lucida, and magnified 220 diameters.

spring of 1850; they were repeated by us, and with the same results, in February 1851.

The great amount of animal life present in the water of the Thames near the bridges is directly dependent upon the organic matter contained in it, and which is derived principally from the sewer-water daily poured into the river; the animalculæ finding in it the means of subsistence and growth.

The evidence, then, as to the present condition of the water of the Thames, from Kew to Woolwich, is of the most conclusive character; it is clearly and undeniably in a state wholly unfitted for human consumption.

It has for some years been a matter of surprise to us how a people professing to be cleanly, and with a full knowledge of the fact that into the water they daily consume, the sewage of the vast population of London is constantly discharged, (a fact of which the senses of sight and smell furnish frequent and sufficient proof,) could rest content with, and continue to make use of, for any purpose, such polluted water. It might have been supposed that the knowledge of such an astounding fact would have been sufficient to have raised a storm of indignation, before which the present infamous system of water supply would have been quickly and for ever swept away.

If the source from which five of the London water companies derive their supplies be so foul, it may well be asked, how it is possible that the water furnished by them to the public can be otherwise than highly impure? Into this point we shall now inquire.

CONDITION OF THE WATER FURNISHED BY THOSE COMPANIES WHICH DERIVE THEIR SUPPLIES FROM THE THAMES.

The companies which have recourse to the Thames for their supplies of water are the Grand Junction, West Middlesex, Chelsea, Southwark and Vauxhall, and Lambeth companies.

Grand Junction Company.

From 1810 to 1821-22, this company drew its supplies from the Grand Junction Canal, which is supplied mainly by the river Colne.

Fig. 26.

GRAND JUNCTION COMPANY

This engraving represents the chief *animal* and *vegetable* productions contained in the water as supplied by the GRAND JUNCTION COMPANY.

After the last-named period, however, in consequence of complaints of the hardness of the water, the supply was changed to the Thames.

In a statement made by the directors of this company, addressed to the Board of Health, the following observations occur, in relation to the change of source: —

"In changing the source of supply to the Thames, the great and wholly unaccountable error was committed of placing the mouth of the culvert-pipe in close proximity to the point of confluence of the Ranelagh sewer. The company's engineer of that day, under whose supervision it was so placed, certainly contended that by some arrangements he had made the injury occasioned was only apparent and not real, and, as the directors believe, there was truth in the allegation; but the blunder was scarcely the more pardonable. It was, moreover, wholly gratuitous, as the works were constructed, not at the expense of the Grand Junction Company, but the Regent's Canal Company, as an equivalent for obtaining the surplus water of the Grand Junction Canal, and must have been so placed and so constructed as the Grand Junction Company should require. This position of the culvert was the cause or the pretext of the attack on the company contained in the pamphlet called the 'Dolphin,' and the occasion of the appointment of the commission of 1828 for inquiring into the state of the supply of water to the metropolis. The commissioners are aware that no general legislative interference ensued on the report of that commission; but as regarded the Grand Junction Company, the suction-pipe was extended so far into the river as to be obviously beyond the influence of the Ranelagh drainage."

This "unaccountable error," this monstrous "blunder," probably entailed the sacrifice of hundreds of lives; and as the result of its commission, we are entitled to ask—Is any body of directors, under whose superintendence such a "blunder" could be committed, fit to be entrusted with the management and direction of affairs so weighty? But mark, reader, the nature of the miserable expedient they had recourse to by way of remedy: "The suction-pipe was extended so far into the river as to be obviously beyond the influence of the Ranelagh drainage," as if a few yards of piping afforded a sufficient protection from all the accumulated pollutions of the Thames.

But hear the directors again. "The directors believe that the company now give a supply which cannot be surpassed."

Let us now ascertain how far this bold statement can be justified. We will first of all express our belief that these directors but ill understand what really constitutes a good water, or they never would have hazarded such an exaggerated statement.

The company's present supply is taken from the Thames just above Kew-bridge, and in close proximity with the outpourings of the populous and dirty town of Brentford.

But the Grand Junction Company filters its water, and here at least the public has some slight protection. Let us ascertain what this protection is worth.

It will be remembered that it has been stated that the best filter is no substitute for bad water.

Well, then, in less than a quart of this water as obtained from a service-pipe, and consequently after filtration, there were detected, by means of the microscope, living species of worms, animalculæ, algæ, fungi, organic matter, grit, &c. So much for the "supply which cannot be surpassed."

West Middlesex Company.

This company takes its supply from the Thames, nearly opposite to the large and not overclean town of Hammersmith.

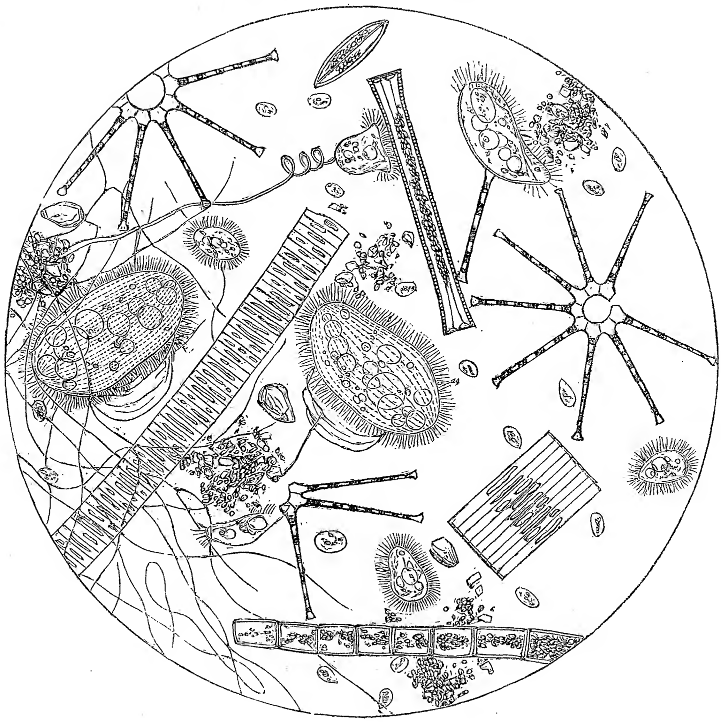
In reply to the question, "Is the whole of the water which is supplied filtered?" the company puts in the following statement:—"The water passes through a duct from the Thames to the western reservoir at Barnes, where the water rests for subsidence; thence through a duct to the eastern reservoir for the same purpose; thence under the bed of the river in a 36-inch pipe to the wells of the engines. These reservoirs are partially supplied with water through gravelly beds. The reservoirs were constructed in the year 1838, at great cost. They were formed for the purpose of rendering the water bright and pure at all seasons, by means of depuration by subsidence; and from the nature of the soil (fine gravel) they have proved eminently successful."

We will now examine a few samples of the water with which this company furnishes its customers, detailing the results of a single examination only.

There were discovered in less than a quart of this water living entomostraceæ, several species of animalculæ, especially the Thames *Paramecium*, algæ, confervæ, fungi, &c.

The water of this company betrays evident signs of contamination by sewage, as shown indisputably by the presence of the animalculæ so abundant in Thames water near the bridges.

Fig. 27.
WEST MIDDLESEX COMPANY.



The above engraving exhibits the principal *animal* and *vegetable* productions contained in the water supplied by the WEST MIDDLESEX COMPANY. Drawn with the Camera Lucida, and magnified 220 diameters.

We can now understand what degree of faith is to be placed in the assertion of the company, that the reservoirs have proved "eminently successful," and render the water " bright and pure at all seasons."

Chelsea Company.

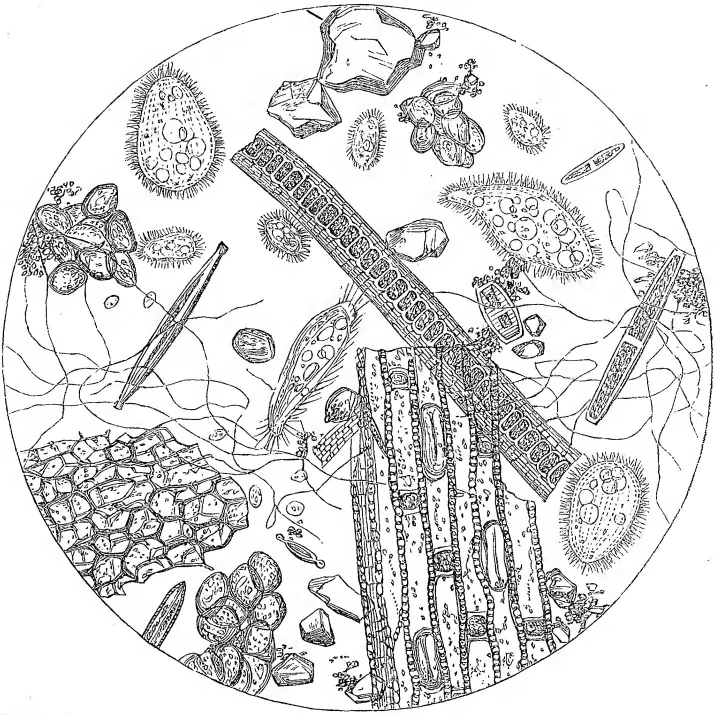
The water used by this company is obtained from the Thamas, near the Red House, Battersea.

The Chelsea Company states that it has filtered the whole of the water supplied since January, 1829, and continues to do so, the water being pumped from the river during the last four hours of ebb-tides.

The method of filtration is through gravel, shells, and sand, eight feet thick, in water-tight reservoirs, comprising 90,000 superficial feet area."

We feel bound to state, in justice to this company, that the method of filtration adopted by it is much more effective than that pursued by any of the other companies; the consequence of this is, that the water is delivered in a state of *comparative* purity, and contains but a small amount of organic matter, and but few animalculæ; nevertheless, some few are present, which betray the fact that its source is the Thames; nor can the water, independent of its hardness, be pronounced to be in that state of absolute purity now justly deemed necessary.

Fig. 28.
CHELSEA COMPANY.



This engraving represents the chief *animal* and *vegetable* productions present in the water of the CHELSEA COMPANY. Drawn with the Camera Lucida, and magnified 220 diameters.

Southwark and Vauxhall Company.

This company also draws its supplies from the Thames, near Battersea.

The following statements are urged by the directors of this company in behalf of the water supplied by them to the public.

"The only parliamentary obligation as to the quality of the water supplied to which the company is subjected, is, that it shall be filtered; how amply this obligation has been fulfilled, the replies to the queries of the commissioners satisfactorily demonstrate.

"On the quality of the water supplied by the company, the directors would only have thought it necessary to refer, first, to the very complete system of deposit and filtration by which it is rendered perfectly bright at all times of the year; and, secondly, to the various analyses already made with reference to its saline ingredients, had it not been for the sensitiveness on every question connected with the sanitary condition of the community, which the late epidemic has very naturally produced in the public mind.

"The directors, in conclusion, have only to state their full conviction that the real interests of the public and the companies coincide, and to express their perfect readiness to carry out whatever improvements the commissioners may suggest, and the legislature may sanction. In stating this conviction, however, and in intimating this disposition, they may be permitted to remind the commissioners that the Southwark and Vauxhall Company does already supply a large, and in great part a poor district, at rates low even as compared with many provincial towns, with water unexceptionably good; perfectly bright at all seasons of the year, and at least inferior to none that can be procured for the metropolis as respects its saline ingredients. They cannot but think, in con-

Fig. 29.

SOUTHWARK AND VAUXHALL COMPANY.

This engraving represents the principal *animal* and *vegetable* productions contained in the water as supplied by the SOUTHWARK AND VAUXHALL COMPANY. Drawn with the Camera Lucida, and magnified 220 diameters.

sequence, that very great consideration should be bestowed on the question, whether sufficient grounds exist for resorting, at a cost which cannot be otherwise than enormous, to new sources of supply. They see no reason to believe that water, from whatever source procured, would prove more acceptable to the company's tenants than that now furnished, of which it should be distinctly understood the company receives no complaints."

We will now ascertain how far the "statement" and the "facts" of the case are in accordance.

Well, then, a sample of this filtered water, "perfectly bright at all seasons of the year," and "at least inferior to none that can be procured for the metropolis, as regards its saline ingredients," contained a very considerable number of animalcula, especially the Thames *Paramecium,* a copious sediment, evident contamination by sewage, &c. The water supplied by this company is, with one exception, the worst water in London.

What faith, again we ask, ought the public to place in the vaunting statements of the self-laudulent directors?

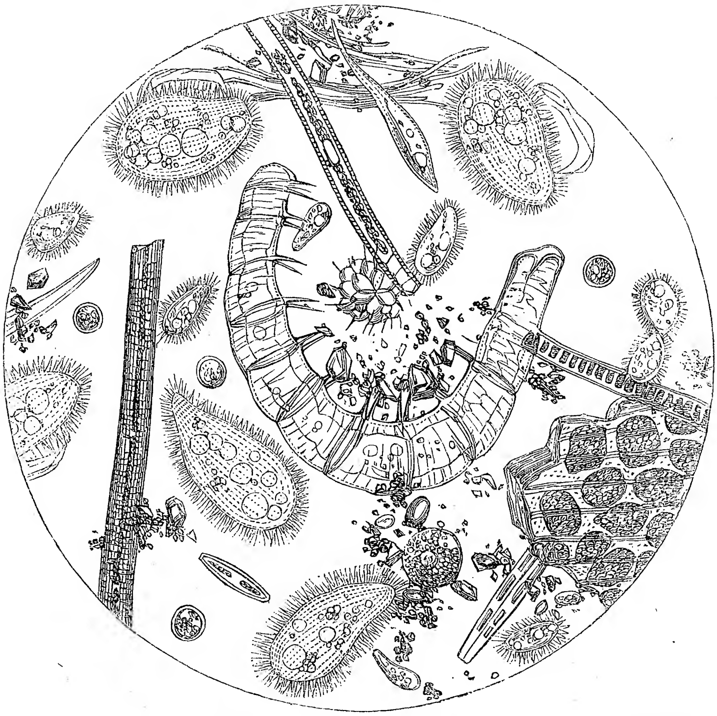
The Southwark and Vauxhall Company receives "no complaints," and so say also the directors of the Grand Junction Company. "Complaints," indeed! Where is the utility of addressing complaints to monopolist directors, who, in reply, will probably intimate their readiness to cut off the supply. If the "directors" do not receive complaints, the "collectors" of the rates do, as we can testify.

The delicate allusion to "sensitiveness" is just the very reverse of the truth; so far from the public having exhibited an over-sensitiveness, they have manifested a degree of apathy which is highly culpable.

Lambeth Company.

This company obtains its present supply from the Thames, at Lambeth; it has procured, however, the sanction of Parliament to take water from Thames Ditton, where, we believe, it has extensive works under construction, on the completion of which the supply derived from Lambeth will be discontinued.

Fig. 30.
LAMBETH COMPANY.



This engraving exhibits the *organic matter living and dead*, especially the Thames *Paramecium*, contained in the water as supplied to the public by the LAMBETH COMPANY. Drawn with the Camera Lucida, and magnified 220 diameters.

This company very properly abstains from making any laudatory observations respecting the quality of its present supply, which is, in fact, the worst in London.

The water as now delivered, very generally exhibits a thick and opaque appearance, and although professing to be filtered, differs but little from Thames water itself as procured direct from the river. In it the microscope readily discovers great numbers of the Thames *Paramecium*, much organic matter, and distinct evidences of contamination by sewage.

The improved quality of the water obtained from Thames Ditton, over the present supply, will of course be very considerable. "The water at Ditton," states Mr. Simpson, the engineer, "being usually very clear, will be passed at once from the river conduit-pipes to the filters, from them to the wells of the pumping-engines, and thence through the aqueduct or main-pipe to the reservoirs. The filtering apparatus will be erected on such a principle, that the water must of necessity pass at all times through the filtering medium before it can reach the pump-well of the steam-engines."

The waters, therefore, of the five companies, which derive their supplies from the Thames in the most polluted part of its course, are condemned, not alone by their hardness, but in consequence of excessive contamination with organic matter, animal and vegetable, dead and living, derived principally from the sewage poured into it.

We have next to bestow a few remarks on each of those companies which do not procure their supplies from the Thames.

The Course and Condition of the River Lea.

The following account of the course and condition of the River Lea is derived from personal observation and examination.

" This river rises near Dunstable, and after passing through or near to the villages of Luton, Herpenden, and Hatfield, it is joined at Hertford by the small rivers, Bean Rib, and Maran, and, below Ware, by the Ash; from Ware it flows on to Hoddesden, Cheshunt, Waltham Abbey, Chingford Green, Tottenham, Old Ford (near Stratford), and on to the Thames, which it reaches near Blackwall, forming the creek of that name.

" The united population of villages and towns on the Lea and its tributaries amount to about 70,000.

" It is at Old Ford, near Stratford, and below Lea Bridge, that the works of the East London Water Company are situated.

" The nature of Blackwall Creek is pretty generally known; the waters of the Lea in it are filthy and impure; the bed of the river at low water is small and insignificant, so much so that barges have to wait for the tide, and into it is poured the refuse of the numerous manufactories situated on the banks of the creek.

" The tide of the Thames affects the Lea beyond Old Ford, that is, some two miles above the point at which the East London Water Company has its works. It does not reach Lea Bridge, being intercepted by locks, which serve the double purpose of keeping the Thames tidal waters out, and of damming in those of the Lea, which otherwise would be lost in the Thames.

" Moreover, the Lea is a barge river, and its waters are constantly stirred up in opposite directions by the passing and repassing of the barges, which go up the stream as far as Hertford.

" It is to be observed, further, that the Lea runs through a low and marshy country, liable to become flooded in rainy seasons, and intersected with dykes and ditches, the impure washings out of which it constantly receives: the water of the Lea is therefore, to a great extent, surface-drainage water, in my opinion a very objectionable kind of water.

" The East London Water Company has a communication, by means of a small open canal, with the Lea, just below the bridge, but still not out of the influence of the barge traffic; through this it professes to receive all the supply which it requires: this may be so, yet the connection of the works by flood gates with the Lea at Old Ford looks suspicious, and should be closely examined. If it does take any part of its supply from Old Ford, then undoubtedly the water is contaminated by the impurities of Blackwall Creek and Stratford, and is for the most part Thames water itself." *

East London Company.

From what has been said of the course and character of the River Lea, the reader will scarcely expect to receive a very flattering account of the purity of the water supplied by this company.

The question was asked—Is the whole of the water filtered? " No. The water supplied (with the exception referred to in answers Nos. 3 and 9) is taken from the Lea, upwards of six miles from its mouth in the Thames, and nearly two miles beyond the flow or the influence of the tide; and after passing through a canal nearly two miles in length, cut through Hackney Marshes, it is received into large reservoirs of deposit, where its impurities subside, previously to flowing into smaller reservoirs, from whence it is pumped into the company's district."

We have several times examined the water in the canal alluded to, as well as that delivered to the houses.

* A Microscopical Examination of the Water supplied to the Inhabitants of London and the Suburban Districts.

Fig. 31.
EAST LONDON COMPANY.

Sample of the water of the EAST LONDON COMPANY, showing the chief *animal* and *vegetable* productions contained in it, as supplied to the public.

The canal water we have found to be in a very impure state, and to contain very much organic matter, dead and living, including a considerable number of living entomostraceæ and animalculæ.

The water as supplied to the houses has also always been very impure, has contained much sediment, consisting of earthy and organic matter, with many living algæ and animalculæ. The neglect of filtration satisfactorily accounts for the state of this water.

The conveyance of the water at a very slow rate, for two miles, in an open canal, we consider to be highly prejudicial to its purity, as the growth of vegetable and animal productions is thereby much encouraged.

The New River, its Course and Condition.

The New River Company.

Strictly speaking, the so-called New River is not a river at all, but a canal only.

The following account of the course and condition of the New River was also derived from personal observation and inquiry.

"This company derives its supply in part from springs at Amwell and Chadwell, near to Ware, in Hertfordshire, the principal Chadwell spring forming the 'New River Head;' in part from the river Lea, as well as from wells at Cheshunt and Tottenham; it has also, let it be particularly observed, a communication with that prolific source of London water supply, the Thames, at Broken Wharf, Upper Thames-street.

"The 'New River Head' is a pool of water of some six yards in diameter; entering it on one side is a small ditch-like stream, which carries water sufficient

Fig. 32.
NEW RIVER COMPANY.

Sample of the water of the New River Company, showing the more remarkable *vegetable* and *animal* productions contained in it as supplied to the consumers.

into the head to keep a twelve-inch pipe supplied; while on the opposite side the water flows slowly away in a small stream of a few feet in width; this, after a short and independent course of a hundred yards or so, unites with another stream broader and apparently still more considerable than itself, which is supplied from the river Lea; the conjoined streams then pass on towards Ware.

"The 'head' of the New River, therefore, is evidently much indebted to the other members of the body corporate; the independence of the river itself soon ceases, and its water quickly loses its character of spring-water by a very copious admixture of river-water not of the purest quality,—so much for New River spring-water at Ware in Hertfordshire. We shall see whether its character improves as it gets further on its journey to London.

"The condition of the water in the little stream or ditch which assists in supplying the 'head' is very bad, it containing *Infusoria* and *Algæ* in great numbers; this is owing to the unclean and weedy state of the ditch in question.

"The condition of the water in the 'head' itself, inasmuch as it receives all the water from the feeding ditch, cannot be very satisfactory; but the margins of the 'head' are also covered with *Algæ* rising up into the water like clouds, and affording a nidus for the shelter, growth, and development of *Entomostraceæ*, *Infusoria*, &c.

"The canal itself near to Ware is at the present time in a much better state than I have ever seen it before.

"The next accession of strength which the New River receives is at Cheshunt; here the company has a well worked by a steam-engine, and two reservoirs; the one of these reservoirs at least contains something more than pump-water, it being fed by a small stream nearly dry in summer, but which in rainy weather contributes as well as the pump a fair supply of water.

"These reservoirs have very recently been cleaned out, and certainly the operation was much wanted, as I was given to understand that it had not been once performed before, since the reservoirs were made, nearly twelve years since.

"The cleaning out of these reservoirs, it was stated, occupied nine weeks, and employed thirty horses and not a few labourers; the matter removed consisting of a black muddy substance of an offensive smell, and similar in nature to that contained at the bottom of old ponds, and also to that which has been recently taken out of the Serpentine. This black mud I regard as a sure indication of the presence of organic matter, of which fact those who removed it from the reservoirs seem fully aware, as it has been spread over an adjacent field, to the fertility of which it will doubtless much contribute.

"Some years since, the Cheshunt reservoirs were a favourite resort of mine, and on turning to my 'History of the British Freshwater Algæ,' I find them given as the habitats of several species; their condition at that period, therefore, cannot have been very good.

"New River water, therefore, has no very distinct or peculiar characters of its own, it being a mixture of water derived from various sources.

"The water is conveyed by means of a long canal, known as the 'New River.' As it flows to London, it creeps slowly along, and this, as already explained, is one of the circumstances favouring the development of the lower forms of animal and vegetable life.

"Other sources of impurity are to be found in the fact, that the New River, along much of its course, is accessible to the public, who use it as a resort for bathing in summer, and at all times as a receptacle for refuse animal and vegetable matter.

"The quantity of *Oscillatoreæ* and *Diatomaceæ* seen floating on the tranquil surface of this canal, during the summer months, is immense, and seriously affects the condition of its water."*

The water supplied by this company is not filtered, but is allowed to "purify itself," as the phrase goes, by subsidence; the result is, that the water frequently deposits a considerable amount of sediment, and always contains more or less organic matter, including many algæ and some animalculæ.

Hampstead Company.

The Hampstead Company derives a great part of its supply from several large ponds situated near to Hampstead Heath; these are filled, partly by surface-drainage, and partly by springs, some of the ponds being evidently contaminated with sewage.

"Of these ponds, some are the property, or at all events under the control, of the company, and these are in a tolerably clean condition; others, from which, also, part of the water used proceeds, have a different proprietorship, and are in an exceedingly unclean state: thus there is a large pond in the 'Vale of Health,' full of weeds, swarming with animal life, the receptacle of some dead animals, and into which no inconsiderable amount of sewage passes; the contents of this pond, so far as could be ascertained, drain into the company's ponds. Surely the 'Vale of Health,' if it really merit its pleasant name, would be still more healthful if this baneful pond were filled in or removed, as it ought to be. There is also a large pond belonging to the lord of the manor, full of weeds, *Algæ*, *Entomostraceæ*, and *Infusoria*, and the surplus water of which also passes into the other ponds. Again, there are two or three ponds, in the domain of the Earl of Mansfield, in a weedy condition, and from which the water undoubtedly drains into the ponds of the Hampstead Water Company."*

But it must be mentioned that part of the supply of the Hampstead Company is derived from two Artesian wells, one near the Heath, and the other at Somers Town.

Now the water of most of the Hampstead ponds has been several times subjected to careful microscopic examination, and it has been found to contain precisely the same forms of animal life which were encountered in the water of the company as supplied to the public. Regarding, then, all the facts in this case, it is impossible to say that the water distributed to the public by this com-

* A Microscopical Examination of the Water supplied to the Inhabitants of London and the Suburban Districts.

Fig. 33.
HAMPSTEAD COMPANY.

Sample of the water of the HAMPSTEAD COMPANY, exhibiting the principal living productions detected in it, as supplied by this company.

pany, containing as it does a large amount of organic matter, is in the condition which regard to health and safety demands.

At times the supply furnished by this company is either so deficient or bad, that it contracts with other companies for part of the water, and we believe that this is the case at the present time, February 1851. This company also does not filter the water previous to distribution.

Kent Company.

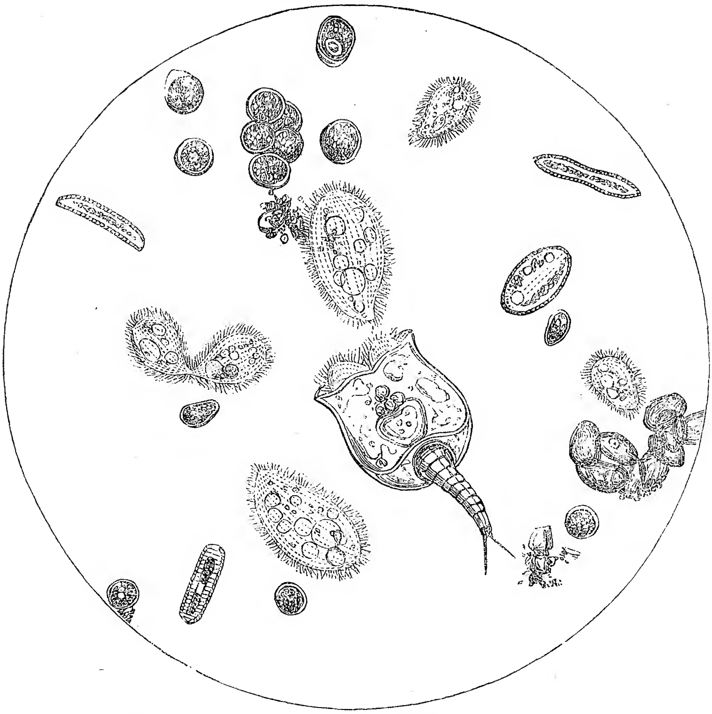
This company is supplied by the Ravensbourne, a little stream which rises near Bromley, in Kent; and after a short course, in which it passes through Rushey Green and Lewisham, joins the Thames at Deptford, forming the Deptford Creek, which is even in a worse condition than the Blackwall Creek; below Lewisham, a large branch, which comes from St. Mary's Cray, unites with the Ravensbourne.

The Ravensbourne, like the Lea, receives the washings-out of ditches, and in many parts of its course is exposed to the public, and therefore to many sources of impurity; above Deptford, and close to the waterworks, we noticed two or three dead dogs and cats.

At Deptford, and just below a large mill, there are tide-gates, which keep out the filth of the creek, it is to be hoped effectually and entirely. Notwithstanding, however, this very necessary and proper precaution, the river Ravensbourne is to be objected to, as a source of supply, on account of its smallness, its exposure to the public, and the consequent deterioration of its water.

This company filters the water, and although many animalcules are to be detected in the river, but few are present in the filtered water.

Fig. 34.
KENT COMPANY.



Sample of water of the KENT COMPANY, exhibiting the animalculæ, &c., present in it, as supplied.

To sum up, then: the waters at present in use in this metropolis are all hard, and have all the disadvantages of hard water; they are, moreover, river-waters, and for the most contaminated to a great extent with organic matter, dead and living; add to these points the fact of their further deterioration by contact with lead in cisterns and by the accumulation and growth of animal and vegetable productions, which take place in those receptacles, and the case is proved against the whole of the present supplies of the metropolis.

Other Defects connected with the Present Supplies.

Other defects, besides the very great one of *quality*, exist in connection with the present supplies of water.

In many streets, courts, and alleys, no water has been laid on at all, but the people have to obtain it, at considerable trouble and loss of time, from what are called stand-pipes; it is then stored in pails, tubs, jars, or any other vessel which they may happen to have, and placed in the passage or a close room, from which it suffers still further deterioration.

The number of stand-pipes in London is certainly not less than 1581, with an average of about 40 persons to each.

Dr. Gavin gives the following evidence in reference to these stand-cocks: —

"What proportion of the people you visited during the house-to-house visitation were supplied by stand-pipes? — In Hackney, about half the houses are supplied by stand-pipes; in Bethnal-green, with very few exceptions, the dwellings of the poor are supplied with water by means of stand-pipes; in Shoreditch a larger number of houses have water laid on, but still the number of dwellings supplied by stand-pipes is very considerable. In a few instances, some squares, or rows of houses, as Thorold-square, Bethnal-green-road; the

Crescent, Hackney-road; the Crescent, Union-street, Kingsland-road, have sunk reservoirs communicating with the main, which, by means of a pump, supply water constantly to the inhabitants. With these exceptions, all the poorer and middle-class dwellings in Hackney, Bethnal-green, and Shoreditch are supplied as I have mentioned. The poor preserve the water either in, 1., butts — cisterns are almost unknown (I only met with two attached to the dwellings of the poor and middle classes in Bethnal-green; the one was a large covered butt, the other an open wooden cistern containing the remains of cooked fish); or, 2., small tubs, or earthenware jugs, pans, or sometimes in small crockery-ware bowls, and sometimes soup-plates. Water preserved in such tubs or pans is nearly always taken in-doors. Such vessels are never covered. Even where there are small butts, the water is still preserved in-doors in small open vessels; when there are tubs, the tubs are very frequently stowed away below the beds. In one instance, a child fell into one of these tubs, which projected from below the bed, and was drowned."

Mr. Bowie, surgeon, thus replies to questions by the General Board of Health, relating to defective supply —

"You have also acted in aid of the General Board of Health? — Yes.

"Were you not directed to make special inquiries on the part of the Metropolitan Sanitary Commission as to the supply of water in the City of London? Will you explain in what state you found it? — In general very scanty, and sometimes altogether wanting. The water often thick, muddy, discoloured, putrid, and unfit for drinking or culinary purposes. I would instance, as proofs of this statement, out of a host of others, the houses in Fireball-court, Three Pigeon-court, Cock-and-Hoop-court, Seven-Step-alley, Houndsditch; Crown-court, Seething-lane; Barking-churchyard; Rose-lane, Tower-street; Pewterers'-buildings, Cannon-street; Printing-house-square, Coleman-street; Saddler's-place, London-wall; Ivy-lane, Newgate-street; Mac's-place, Greystoke-place, Fetter-lane; all in the city, where the inhabitants thus express themselves: that 'The time the water was on was too short, the fatigue of carrying it up-stairs very oppressive, and much time lost in procuring it.' 'There was no water laid on.' 'Water was got where they could, by begging, borrowing, and from the neighbouring pumps.' 'They have been without water for eight years, and often more in need of it than victuals.' 'They have been without water for nine years.' 'The water is dipped with pails, and is often very dirty.' 'The water, instead of being clear and fit to drink, often looks quite yellow.' 'The water in the cistern is only fit to rinse a pail, or cleanse the privy, as every impurity gets into it. It has even been used for drowning kittens. Two open tubs stand behind the door of the kitchen as water-butts, and have only been cleaned out once in the nine years.' 'The water (supplied from a pump) is shockingly bad, tasting as if they were drinking something putrified, and often containing live worms more than an inch long, supposed to be from the burying-ground at the back of the house.' In addition to this, a gully-hole is in close connection with the pump, by which foul water may find its way into the well. There is an evil of considerable magnitude likely to result from the practice of having public pumps or stand-cocks to supply a neighbourhood with water. It is, that as children and females have to go and wait their turn, they may come in contact with persons of the worst character, hear bad language, have their sense of delicacy impaired, and at last become regardless of decency."

In many localities, again, water has been laid on to houses which have not been provided with drains; the consequence of this is, that the waste water sinks into the soil about the house, rendering it damp and unhealthy.

It is not man only who suffers from defective supply of water, but the poor beast also; thus no adequate accommodation has hitherto been provided for the supply of cattle of all descriptions with that necessary, water; this want is particularly manifest on the various roads leading to the metropolis, on which may constantly be seen droves of sheep and oxen making their weary way to the great city.

How often have we not been pained to see the poor, over-driven beast, foaming and panting, lying down in the road, ready to expire with fatigue and thirst, without the possibility of a drop of water being procured. The only source of supply on these occasions is the pump or tank of the publican, and he of course expects those who use his water to pay for the accommodation, usually in libations of beer.

The great evil of which we now complain will of course be much lessened when that gigantic nuisance, Smithfield, is done away with, as there is now good reason to believe that it will be speedily; but even in that case a public and untaxed supply of water on our great thoroughfares will be required for dogs and horses.

Our attention has been particularly directed to this subject by certain benevolent ladies, whose sympathies are always readily enlisted in favour of suffering in any form; and in accordance with a promise given, we now raise our voice on behalf of the poor dumb beast, which has no power to make known or to enforce its own necessities.

The following are the experiments previously referred to, showing the action on lead of some of the waters now in use.

Experiments showing the Action of certain Waters now in use in this Metropolis on Lead, as Thames, Hampstead Well and Pond Waters, and the Water of the Artesian Well at Trafalgar-square.

The results obtained from these and the other experiments already detailed are of the highest importance, and not merely sufficient to set at rest for ever the question of the comparative action of soft and hard water on lead, but they also clearly show how dangerous is the employment of that metal in any form in connexion with the present water supplies of this metropolis.

Considerable as was the quantity of lead taken up and dissolved by each of the hard waters experimented with, the amount would, no doubt, have been much greater had pieces of lead presenting a larger surface been employed, and had the waters, in place of being included in sealed vessels, been freely exposed to the atmosphere, as in the majority of cisterns they constantly are.

1*st Experiment.*

A thin piece of lead, about an inch long and half an inch wide, was placed in a bottle containing ten ounces of Thames water, procured at Waterloo-bridge, and which exhibited an alkaline reaction.

Results.—At the end of a fortnight the lead appeared but little acted upon, the upper surface only presenting a slightly dullish aspect.

Tested.—At the expiration of the time above referred to, sulphuretted hydrogen being passed through a wine-glass of the water, the liquid became *decidedly discoloured*, and exhibited the brownish hue characteristic of the presence of lead.

2*nd Experiment.*

A similar piece of lead was placed in contact with the same quantity of water, obtained from the Artesian well at Trafalgar-square; reaction alkaline.

Results.—The metal at the end of a fortnight appeared somewhat dulled.

Tested.—On the application of the sulphuretted-hydrogen test, the water became *quickly* and *more decidedly discoloured* than in the previous experiment, it being turned quite brown.

Remarks.—The water of this, and, indeed, of most Artesian wells, contains a large proportion of alkaline carbonates and chlorides, both of which, by previous experiments, have been shown to act strongly on lead.

3*rd Experiment.*

In this experiment the lead was placed in contact with water obtained from the deep well at Hampstead, from which the Hampstead Water Company procures a part of its supplies. Reaction slightly alkaline.

Results.—Metal a good deal dulled, with a small quantity of the oxide adhering to the bottle.

Tested.—The effect of the application of the sulphuretted-hydrogen test was *still more decided*, the liquid assuming a blackish tint.

Remarks.—Mr. Squire, her Majesty's chemist, who has paid much attention to the subject of water, and who has analysed a considerable number of the Hampstead well-waters, informs me that the water of the company's well is constituted very much like the Trafalgar-square water, and is, indeed, rather softer of the two — a fact which satisfactorily explains its powerful action on lead.

4th Experiment.

In this case water from one of the Hampstead ponds, from which, also, the Hampstead Company derives part of its supplies, was employed. No reaction with test-paper.

Results. — Metal at the end of a fortnight slightly dulled only.

Tested. — The water on the application of the test became *less deeply coloured* than in the former case, but still very decidedly so, indeed, to nearly *an equal extent with the water of the Trafalgar well.*

Remarks. — The results of Experiments 3. and 4. are in accordance with common observation: the strong action of the water of the Hampstead Company on lead has long been known to plumbers. The effects produced by the pond water, which is very hard, are principally due to the earthy carbonates.

Experiment showing the Action of the Soft Bagshot Water on Lead.

5th Experiment.

A piece of lead of the same size as that employed in the previous experiments, was placed in a bottle containing twelve ounces of the Bagshot water, of one degree of hardness, and neutral to test paper.

Results. — Metal at the end of a fortnight considerably dulled, the bottle near which it had rested being slightly coated with oxide.

Tested. — *No perceptible effect* on the application of the test, which was frequently and carefully repeated.

Remarks. — The effect produced by this water on the lead was very similar to that occasioned by distilled water, although less considerable.

From these experiments we deduce the following highly important conclusions: —

1st. That Thames water, by which the greater part of London and its suburbs is supplied, acts very decidedly on lead. From the similarity in chemical composition of Thames water with that of the New River, Lea, and Ravensbourne, there is good reason to believe that these would affect that metal to nearly an equal extent.

2nd. That the water supplied by the Hampstead Company, both pond and well, acts energetically on lead, much more so than Thames water.

3rd. That the water of the Artesian well in Trafalgar-square likewise acts strongly on lead, rather less so than the Hampstead well water, but still more energetically than Thames water. Buckingham Palace and one or two of our public buildings are supplied with this water.

4th. That the pure and soft water of the Bagshot springs exerts only a very slight action on lead, a small quantity of insoluble oxide, after contact with that metal for a fortnight, alone being formed. The results of experiment on this water offer conclusive refutation of the evidence to which certain gentlemen have, unfortunately, become committed.

SECTION IV.

PROPOSAL OF THE BOARD OF HEALTH FOR THE SUPPLY OF THE METROPOLIS WITH WATER.

When the various facts referred to in the course of this Report are called to mind, showing the many advantages attending the use of *soft water*, as well as the numerous and serious evils connected with the employment of *hard water*, few persons will be disposed to question the propriety of the condition which requires, that whatever water be selected for the future supply of the metropolis should be of the kind denominated soft, and, above all, should be free from organic contamination of every description. By these tests must all propositions for the water-supply of towns and cities be tried, those, where a choice exists, being unhesitatingly rejected, which are found wanting, either with respect to the quality of softness, or *more especially freedom from organic impurity, the most dangerous species of impurity to which water is liable.*

Two propositions have been made by the General Board of Health for the supply of the metropolis with water. As these, however, are rather modifications of each other than distinct proposals, the consideration of the one is intimately connected with that of the other.

The first proposition had for its object the collection of the "rainfall" of an extensive district known as the "Bagshot sands."

Of the extent and character of these sands, the following concise and very clear description is given by Mr. Robert Austen: —

"The Bagshot sands, as a continuous series of beds, extend from Esher to Strathfieldsaye, east and west, about thirty miles. Their width is variable; they occur north of Virginia Water, and their most southern point is on the summit of the high ground above Farnham. If we estimate them to have a mean breadth of ten miles, they will cover an area of 300 square miles.

"The composition of the beds of this series is remarkably uniform.

"*a.* The upper portion consists of pure siliceous sands. This division attains its greatest thickness about the north and east portion of the mass, as at Bagshot Heath, Chobham Ridges, Romping Downs, Finchhampstead Ridges, Hartfordbridge Flats. These sands are from 200 to 300 feet in thickness.

"*b.* Beneath these sands is a retentive stratum of marl and clay, varying from five to fifteen or twenty feet in thickness.

"*c.* The lowest portion consists of white and pale yellow sands, purely siliceous for the most part, the subordinate argillaceous strata being at the eastern portion of the map.

"Over the areas of the upper and lower sands much rain-water is absorbed as fast as it falls. That of the upper sands is thrown out, and collected over the surface of the retentive stratum, No. 2. At the junction of the two all the streams and streamlets take their rise, and this same retentive stratum, when denuded, supports the watercourses and ponds of the district."

In a second communication from the same gentleman, addressed to the Commissioners of the General Board of Health, the following additional observations on the district are made: —

"It will be seen that the water supply is proposed to be taken exclusively from the elevated ground north of Farnham, from the Chobham Ridges, from the Romping Downs, as well as from the high land extending from Bagshot Heath to the Fox-hills, near Chertsey, the whole of which districts belong to that division of the Bagshot sands which constitutes their upper portion, and whose composition was explained in the memorandum above alluded to.

"The peculiar advantages which this area presents consist, first, in the circumstance that great quantities of water can be collected at once from streams of considerable volume, and before they have been rendered impure by the influx of the sewage of inhabited districts; secondly, that the surface-drainage may be accelerated, whereby loss by evaporation will be diminished; and lastly, that it affords considerable facilities for its collection.

"The elevation of the whole of the district I have indicated is a most important physical feature, with reference to the supply of London."

Professor Ramsay, of the Geological Survey, gives a description of the district very similar to that of Mr. Austen.

The Bagshot sands, since they consist of nearly pure silex, are exceedingly well adapted for collecting the rainfall; for, being insoluble, they impart little or nothing of an impure nature to the water which percolates through them.

Having thus given a general idea of the character of the "gathering grounds," we will proceed to ascertain the quality of the water, and to determine how far it agrees with the conditions laid down as essential to every water destined for the supply of large populations.

In reference to its softness or freedom from saline impurity, we have the following satisfactory evidence: —

Dr. Robert Angus Smith, in reply to questions by the Board of Health, gives the following testimony: —

"Allowing the average of the Farnham water to be about two and a half degrees, it will represent the quality of the water derivable from the whole of the eastern part — that is, from twenty to thirty square miles of gathering ground, as far as I have seen, nearly all waste. In respect to quality, the Farnham water is equal to the mass of any Lancashire or Cheshire water derived from gathering grounds which I have examined. In softness it is equal, in some places superior, to the Bala-Lake water, from the proposed collecting point above Llangollen."

The evidence of Professor Way, of the Royal Agricultural Society, is to the following effect:—

"Have you analysed the specimens of water given to you by Mr. Paine, of Farnham?—I have examined them to a certain extent.

"Will you state the result of that examination?—The specimen which I operated upon was obtained by Mr. Paine and myself from the commons, near Farnham, being collected from a small well near its source, through which the water flows on its way to the town. I found it bright and sparkling, and quite different to what we are in the habit of recognising in rain-water, which is usually collected in a manner very unfavourable to its qualities for domestic or other purposes. The total quantity of salts of any kind in a gallon of this water, proved to be 1·5 grains, which, so far as I am aware, is as small a proportion as is found in any considerable body of natural water from any source. The proportion of lime I found to be ·168 grains in a gallon, which is equivalent to exactly three-tenths of a grain of carbonate of lime in the gallon, or three-tenths of a degree of hardness of Dr. Clark's test."

Other testimony of a like character has been given by Dr. Lyon Playfair, Mr. Napier, and many others.

It is therefore evident that the Bagshot or Farnham water is possessed of at least one of the qualities necessary—viz., unusual softness.

We have next to inquire into the condition of the Bagshot water, as respects contamination by organic matter, and on this point we will quote the evidence of Dr. R. A. Smith, who was employed by the Board to make a particular examination of the district in question.

"Are you aware whether in any of the towns now supplied, or to be supplied, with soft water from gathering grounds, as at Bolton or Manchester, under-drainage has yet been thought of?—No, in none of them.

"Even if the surface water were taken, as for the northern towns, from the surface of the district, crudely as at present, and without any further improvement, would not the general supply from the entire district you have examined be superior to most river-waters, not to speak of the Thames?—Yes, certainly. It would have the greatest superiority in respect to softness; it would have less mineral, and would be nearly pure from animal matter; and it would have less vegetable matter. The only matter in it is peat, and that is not visible to the eye. I except some portions of the district which might be separated or improved.

"What are the chief causes of the variations in the quality of water which you find in this district?—Variations arising from peat chiefly.

"Is not the peat very thinly spread over the whole district?—It is not thick anywhere; but the variations in the quality of the water are caused by the state and inclination of the surface, which occasions the rain to wash the peat surface alone before it is discharged into the brooks.

"We understand, then, that by the shallow drainage which you contemplate, you have in view the instance of the derivation of the water for the supply of the town of Farnham, by which the water falling on the surface of peat passes through the peat, and thence through the sand into the tile-drain, cleared of the peaty infusion?—Yes, that describes the process.

"What is the depth of the peat on the gathering grounds for Manchester?—Some of it about six feet deep; a great part of it about four feet deep.

"What was the depth of the peat on the gathering grounds for the new supply of water for Liverpool?—That which I saw was from two to three feet deep.

"Mr. Donaldson, the agricultural surveyor, reports to the Board, that the surface peat on the Surrey wastes is so thin, much of it some six or eight inches thick, that it might be taken off at a cheap rate?—Yes; but from the instances which I observed, it would suffice to take off two or three inches of peat from the surface.

"You do not, then, think that the infusion of peat, even if the water were taken as it is, would be highly objectionable?—No, it is not thought so; peat itself is highly antiseptic; it is not considered favourable to the production of animalcules; it is not directly convertible into animal life like the organic matter in the Thames, and most river water. The only objections I know to it are the taste and the colour, which are disagreeable when the infusion is considerable."

It thus appears that the only description of organic matter present in any quantity is derived from the peat, which forms a thin layer over portions only of the district, and which there would be no difficulty whatever in removing altogether.

Now of all organic matter, that from peat is the least hurtful; it partakes of the nature of charcoal, and as contained in water, it consists of little else than colouring matter, removable by natural filtration through sand.

The Bagshot water, therefore, fulfils to a great extent the second condition laid down as necessary — viz., freedom from contamination by organic matter.

In the description of the upper stratum of the Bagshot sands, Professor Ramsay states that it appeared to be slightly coloured with oxide of iron.

The traces of iron observed in some of the samples of water examined, were derived, chiefly, no doubt, from this oxide, which, however, is present only in certain parts of the district.

At the termination of the examination of Dr. Smith by the Board, we notice the following questions, with the replies thereto: —

"Do you see your way of obtaining any supplies of equal purity for the metropolis? — I know of no other siliceous district near London, and I take it for granted that there is none producing soft water, or geologists would have pointed it out.

"Even if little or nothing were done either on the surface or with the mode of collection, we are to understand, then, that the supplies derivable from the greater portion of these Surrey sandy districts would be on an equality with the soft water supplies of the northern towns you know of, as at present collected and distributed to them? — Yes, certainly."

We find, too, Professor Way giving testimony equally strong in favour of the Bagshot water.

"In both a sanitary and an economical point of view you would, then, consider such water of proper quality for the supply of the metropolis or of any large town? — Undeniably; I have before stated my belief that rain-water collected in a pure atmosphere, and on surfaces uncontaminated with decaying animal or vegetable matter, or with soot, &c., is the most perfect form of water. It is, in fact, the nearest approach to *distilled* water; but having the advantage over artificially distilled water of being well aërated, and therefore agreeable to drink. I consider the water of Farnham, of which we are speaking, to be *rain-water*, collected in the most unexceptionable manner that is practicable on the large scale."

As the result, then, of what has now been stated and ascertained, in reference to the water procured from the Bagshot sands, we deduce the general conclusion, that that water is in every respect admirably adapted for the supply of the metropolis: it is soft, and therefore possesses all the advantages of soft water; it contains but little carbonic acid, alkaline, or earthy carbonates, and therefore its action on lead would be infinitely less than that of every hard water now in use; it is almost free from organic matter, and as the little it does contain is of a harmless description, capable of separation by filtration, not the slightest cause of apprehension would exist of the production of disease from its use.

But another very important circumstance relating to the Bagshot water remains to be stated — viz., that for some years past the town of Farnham has been supplied by this very water; its properties have thus been put to the very best test possible — viz., that of practice, with the most satisfactory results.

Mr. Paine, of Farnham, gives the following information in reply to questions by the Board: —

"For how many houses does this drainage of two acres give you a supply? — For 116 houses, night and day; and they do not use half the supply that is obtained; and the addition of a drain from one point might, for an outlay of 10*l*., give double the quantity we now have, if necessary.

"Then the supply to the Bishop's Palace is constant?—Yes; but it has no connection with the town supply. It is derived from another "tapping" of the hill.

"Is the water conveyed there through lead pipes?—Yes.

"Your supply also is through many leaden pipes in the town?—The mains are of iron, but the pipes which convey the water into the houses are of lead.

"Have you heard of any casualties from the effect of the soft water upon these leaden pipes?—I am not aware of any having happened; the supply is constant, and consequently there is no need of cisterns.

"How long has the supply been in existence at the Bishop's palace?—I should say 200 years, or perhaps more.

"How long has your own supply been in operation?—Since 1837.

"You are, I believe, a native of Farnham, and acquainted as an agriculturist with all the country around?—Yes.

"From how many miles of surface, as far as you have observed, can a similar supply to that of Farnham be obtained?—I should say from a district of fifteen miles in length, and varying from three to six miles in breadth, lying between Farnham and Wokingham.

"Then you see nothing to affect the conclusion that by like care being extended over the whole district, some fifteen miles long, to from three to six or seven miles wide (thus making some eighty square miles of gathering ground), water of a similar quality to that delivered in Farnham would be obtainable?—I think so; but I should not drain the whole surface of the district, but only those spots where water is found to ooze out at the sides of elevations."

From this evidence alone it is plain that the action of the Farnham water on lead is not considerable, and from it also some idea of the *quantity* of water available may be formed.

It has been stated that two propositions have been entertained by the Board of Health for the supply of the metropolis with water from the Bagshot district: the second and more recent proposition contemplates, not the use of the whole rain-fall, but of *that only which re-issues from the earth in the form of springs*, and this we will next consider.

A careful and extended examination of the proposed "gathering grounds" has brought to light the important fact, that in and around the space which these describe, a considerable number of springs exist, the united yield of which is alleged to be fully sufficient to supply the demands of the entire metropolis.

We now quote the following remarks from the report of Mr. Napier, in reference to the Bagshot springs:—

"Guided by what I had seen at Farnham-hill, I turned my attention to look for springs, and, after much and close examination, came to the conclusion that the origin of many little silver threads of water, silently stealing down the hill-sides under the grass, arose also from such sources. A diligent search showed me that the quantity of water to be derived in this manner within the original area of the gathering grounds is so great, that if the neighbouring ranges of mountains and hills on the south side—namely, Hindhead, Blackdown, Hascombe-hills, Leith-hill, &c.—presented the same feature, I might probably hope to collect a stream nine feet wide and three feet deep, of the desired softness and purity.

"I am now happy to inform the Board, that a month's researches into every hill and glen, every copse and crevice, has produced this result. Having tested the waters as they issue from their sources, I can announce that I have gauged a sufficient number of springs and rivulets to enable me to form an opinion both as to quantity and quality; the water being of its primitive purity; perfect as to aëration; brilliant in colour; soft almost as distilled water; of a grateful temperature, about 50°; and almost free from all mineral, animal, and vegetable impregnation."

The stream referred to by Mr. Napier, nine feet wide and three feet deep, represents the quantity now brought into London by the different water-companies, flowing at the rate of two miles an hour, a supply double the actual cosumption.

The advantages of the supply from springs over that from the rainfall are, first, greater certainty, the supply being less immediately dependent upon the rainfall; second, superior quality, the water being softer, under 1° of hardness;

third, entire freedom from animal or vegetable matter, peat, or iron; fourth, greater economy, the outlay necessary for pipage and reservoirs for storage and filtration being much reduced.

The yield of the springs, according to Mr. Napier's gaugings and calculations, is given at 40,000,000 gallons of and under 1°, and 10,000,000 of and under 2° of hardness, a quantity sufficient for the supply, at the estimate of seventy-five gallons per house, of 523,126 houses, nearly double the present number in the metropolis.

The gaugings of a second engineer (Mr. Rammell) tend to show that Mr. Napier's calculations are much under rather than over the actual yield. Mr. Rammell estimates the supply to amount to upwards of 51,000,000 gallons.

Having now considered the *quality* and *quantity* of the Bagshot water, and having shown that, as respects the former, there is nothing further to be desired, and that there is every reason to believe that the latter is amply sufficient for the wants of the metropolis, we will, in the next place proceed to describe the measures proposed for the collection, conveyance, storage, and distribution of the water.

First, then, it is intended that the pipes, which are to be of earthenware, should be laid up to *the very sources of the springs*, and so arranged as to receive only the least flow; that they should be placed four or five feet deep in the earth, whereby the coolness of the water will be preserved; that they should follow the natural slopes of the country, and converging, that they should be brought down to the pass in the range of the Hog's Back at Guildford.

Collected at this point, it is arranged that the pipes discharge themselves into a double culvert of brick, which is of course *covered:* the line of direction of this culvert, as proposed by the Board, "is an inclination from the contour at Guildford to that at Wimbledon Common, thus saving expensive foundations by keeping under the surface, the deviation from the straight line not being considerable."

At Wimbledon Common it is proposed that there should be a reservoir, also *covered*, "the depth to be 20 feet, the width 100 feet, spanned in three flat hollow brick arches, and the capacity made good in length on the line of direction to London; the sides and bottom to be puddled and lined with tiles laid in cement. The entering water *should be introduced in several places* at the bottom, and not opposite the channels of delivery; thus compelling a thorough mixture, and avoiding all stagnation."

The position of Wimbledon is sufficiently elevated to afford high pressure service to more than one-half of London.

We believe we are correct in stating that we were the first to bring prominently under the notice of the Board of Health the injurious effects, especially those relating to the development of vegetable and animal productions, resulting from the exposure of water to air and light, as well as from a state of rest or stagnation, and we are glad to perceive that the reasons urged have been appreciated, and that it is proposed to carry out the principles laid down, that water, as far as practicable, should be kept in motion, and excluded from the light, in a manner so satisfactory and efficient.

Mr. Napier adduces the following testimony, showing the effects of stagnation on water:—

"A fact which strongly corroborates the evil influence of reservoirs in allowing the water to stagnate, has been exemplified at Dublin, the north side of which city is partly supplied by the Portobello reservoir, about 100 yards long, 70 yards wide, and of a considerable depth; the reservoir is supplied from a canal close by, through which a current is constantly flowing. A few years ago, this reservoir was exceedingly dirty, and while being cleaned, the supply was drafted direct from the canal, when a considerable improvement was remarked in the quality of the water. The reservoir being cleaned, the water was again turned in, and although passed through a new filter, there was an immediate change for the worse, being in fact little better than before the reservoir was cleaned, thus corroborating the assertion of Dr. Hassall, that water not kept thoroughly in mixture and motion must deteriorate."

The existing apparatus of street and home distribution is to be retained for the present, earthernware mains ultimately being substituted for the iron ones now in use.

Lastly, the proposal of the Board of Health contemplates the substitution of the *continuous* for the *intermittent* system.

The *disadvantages of the intermittent system* are, that it necessitates the use of cisterns, whereby the quality of the water is seriously affected; that it leads to great waste, the surplus water frequently overflowing the butt, or cistern, rendering the house, yard, soil, &c., damp, and so giving rise to disease; and, lastly, that it is attended with much expense.

Few persons have formed any correct idea of the expense and waste resulting from the intermittent system, and the consequent use of cisterns: we have been shown plumbers' bills, in which the annual charge for cleansing the cisterns, and repairs of the ball and tap, have amounted sometimes to more than the entire water-rate, an expense which not unfrequently leads some not over-scrupulous persons to dispense as far as they are able with these costly pieces of machinery. One individual informed me that so constantly was he annoyed by the ball-tap getting out of order, and with the expenses for its repairs, that he removed it entirely, first satisfying himself that the orifice of the waste-pipe was fully as large as that of the service-pipe. The tap in this case has now been removed just ten years, and although the former occupant of the house has been succeeded by a new tenant, its use is still dispensed with. This, we are convinced, is no solitary instance, but that there are hundreds, if not thousands, of similar cases in this metropolis.

A cistern, to be in a condition approaching even cleanliness, should be washed out at least once a fortnight; the plumber's charge for this varies, we believe, from 2*s.* 6*d.* to 4*s.* 6*d.*, and no labourer would consider himself sufficiently paid with less than 1*s.*: the expenses connected with the cleansing of the cistern, independent of repairs, is no light tax upon the housekeeper.

For further remarks exposing fully the evils resulting from the use of cisterns the reader is referred to the work on water, by the author, more than once mentioned in the preceding pages. Other evils attending the use of cisterns in addition to those already mentioned, are, the difficulty of getting at them to clean them; their exposure to light and air, whereby the quality of the water is deteriorated; and the objectionable position in which they are often placed, frequently immediately over the water-closet.

The *advantages of the continuous system* are, that it entails the abolition of cisterns, with their concomitant evils and expenses: the water as delivered is purer, cooler, and not subject to waste, and so saturate the soil; and though last, not least, the mains being fully charged, will at all times yield an abundant supply with great pressure, for the cleansing of streets and houses, for watering roads, the extinction of fires, &c., whereby the saving of many thousands of pounds and much valuable property would be annually effected.

The expense of the execution of the works proposed by the Board of Health for the supply of the whole metropolis, is not expected to exceed 700,000*l.*—a sum less by some thousands than has been expended by the New River Company alone.

The amount of the water-rate which would have to be levied is estimated on small tenements at 1*d.*, and, on the larger, at 2*d.* per week.

We cannot more appropriately conclude our brief sketch of the proposal of the General Board of Health for the supply of the metropolis with water, than in the words of its own Report.

"Various detailed estimates have been made, at our instance, of the expense of distributory apparatus, including service-pipes for carrying constant supplies of water into tenements of the poorest classes, as part of works for sanitary improvement requisite for the worst conditioned places; estimates have also been made of the expense of distributory apparatus for the supply of houses of all classes above the poorest. The result is, the confident assurance of all our engineering inspectors, supported by other concurrent practical testimony, that an entirely new supply of the softest water may be brought to the metropolis, pure, and well aërated, and may be delivered into every house in the metropolis in a constant supply, unlimited in quantity, for drinking, for culinary and other domestic purposes, for baths and for washing, at an average original rent-charge, inclusive of the expense of the tenant's supply-pipe and tap, of 2*d.* per week per tenement.

"With these results, which, with adequate powers, could unquestionably be obtained, the metropolis would be placed in a condition equal in respect to the quality of its supplies of water, and superior in respect to their distribution, to any metropolis or city in the ancient or the modern world."

With a few brief observations of a general nature we will bring our article on water to a conclusion.

We would now observe, that in the remarks which we have felt it our duty to make, in reference to the proposal of the Board of Health for the supply of the metropolis with water, we have been animated solely with an earnest desire to ascertain the truth, and to proclaim it.

The proposition of the General Board of Health appears to us to be so immeasurably superior to every other that has yet been suggested, that, in the interest and for the welfare of our fellow citizens, we have done our best to elucidate its chief features, and now give it our strenuous support.

The Board of Health has set to work in the right way, and in the right spirit. It first laboured diligently to get at the facts, and after having studied the subject, and mastered it, the Board now comes forward, and submits its proposition to the public in all its details—a proposition based on well-ascertained facts.

How different has been the course pursued by the Board, and that of the directors of the water-companies, the great majority of whom, although holding the responsible position of supplying the public with so prime a necessary as water, really knew nothing about water, or of the qualities necessary to it as a pure and wholesome beverage, until the Board of Health supplied them with correct information on the subject. And now that they are a little more enlightened, what has been their conduct?—how have they been occupied? In the endeavour to get together a little trashy evidence intended to damage the proposition of the Board. This evidence, regarded in a scientific point of view, is so worthless, that we will not condescend to notice it; it is abundantly refuted by the ascertained facts of the case.

We recommend the directors to follow a more judicious course; not to spend their money in useless litigation, but to acquaint themselves with the facts as stated, and if they find them to be correct, as honourable and conscientious men, not to stand in the way of a great public benefit, but to accept with the best grace they can the fair and liberal compensation which will doubtless be awarded them.

Opposition, we affirm, will in the end, although this may be deferred for a time, be completely thrown away.

We are sorry, however, to find that the very meagre conflicting testimony which the directors, by means of their cash, have been able to get together, has induced the Ministry to appoint three "commissioners" to report to it on the water supply of the metropolis, these newly appointed "commissioners" being altogether independent of the Board of Health.

We object to this course on more grounds than one. In the first place, the whole matter is clearly proved and settled; no additional testimony is required, and we very much doubt whether further information on the subject will be forthcoming. In the second, we deem this nomination of independent commissioners most unbecoming to the Board itself; it has the effect of casting an unmerited doubt as to the character and sufficiency of the evidence obtained by it; and if the government show its want of confidence, by what reason is it expected that the public is to retain its faith?

The report of these commissioners will, we can scarcely doubt, confirm the conclusions of the Board; indeed, there is but little room for any other result, and the government, we trust, will find its hands strengthened by the "commissioners." The conduct of the Ministry in this matter may therefore have been such as to help them over a difficulty; the stratagem may have been very politic; but we prefer straightforward dealing to strategy, and therefore we condemn this very unhandsome treatment.

If it was considered desirable that additional evidence on any point of the inquiry should be obtained, the Board itself should have been instructed and empowered to procure this; the only particular in which the evidence is at all weak is in reference to the comparative action of hard and soft water on lead—a point completely set at rest by the experiments adduced in this Report.

The three commissioners are, Professors Graham, Miller, and Hofmann; they were selected because they had not become identified in any way with the Board of Health by giving evidence, and therefore it was considered their testimony would be impartial—a very bad compliment to those gentlemen who have supplied the Board with information, much of it of a valuable character.

We have no desire to speak disparagingly of the three gentlemen named, who are men of high chemical attainments and of good reputation; our concern is with the circumstances relating to their appointment, and with the facts of the case. We would now observe that these gentlemen, although very good chemists, are not known (with the exception of Professor Hofmann, of whose testimony the Board has already had the advantage) to have devoted any special attention to the subject of water, upon which they are now called suddenly to give a weighty opinion; while, on the contrary, the evidence adduced by the Board has been furnished by men of not less standing and reputation than themselves, and who have devoted years to the study of the subject, and who were qualified to give, not merely chemical opinions, but to enter into the medical, physiological, and other bearings of the inquiry.

It now only remains that we give expression to the great satisfaction which we have derived from the fact, that a very large portion of the scientific evidence procured by the Board has been supplied by members of the medical profession —a circumstance highly creditable to their knowledge and intelligence. When will governments learn to treat our ill-requited but meritorious profession with justice and liberality?

Since the date at which the above Report was published the entire subject of the water supply of the metropolis has been submitted to the consideration of a Commtttee of the House of Commons, of which Sir James Graham was chairman. The results of all the evidence given before this committee, and of its deliberations, have ended as most other questions, in which on the one hand the rights and interests of the public are opposed by interested and powerful monopolists on the other, do end in this country, in a compromise, probably but little satisfactory to the water companies themselves, and certainly still less so to the public at large. The metropolis and its suburbs are still to be supplied with water from the Thames, although this is not to be taken below Kingston; the water is to undergo a process of filtration; and the reservoirs in which it is to be stored are, we believe, to be covered; these provisions to come into operation in 1856. These changes, as far as they go, are no doubt in the right direction, but the evil is that they do not go half far enough. The public will still be supplied with *hard water contaminated to a considerable extent with organic and other impurities;* and, further, the supply is to be distributed on the intermittent system, which entails the use of cisterns, to which there exists so many strong objections. At the various sittings of the committee above referred to the interests of each of the metropolitan water companies were represented by one or more Old Bailey barristers, some of whom thought that they could not properly or sufficiently discharge their duty to their clients, except by bullying and insulting every adverse witness who had the courage to appear on behalf of the public. We ourselves had the honour on this occasion to advocate the interests of the public in this important sanitary question, and of course did not fail to get grossly abused by more than one of the "big wigs," but as the cause was a good one we did not very much care. Each sitting of this committee, it is alleged, cost, chiefly in fees to the lawyers, upwards of 1000*l.*; and, as there were many sittings, so of course many thousands were thus expended, which will have to be refunded through the instrumentality of the water-rates. For the improvments above referred to, imperfect and incomplete as they are, we may conscientiously affirm that the public are largely indebted to ourselves, for we have not ceased, for years past, on every favourable occasion and by every means in our power, to agitate this great social and sanitary question.

CHICORY, ITS PROPERTIES AND ADULTERATIONS.

Chicory, succory, or wild endive, belongs to the same natural family of plants as the dandelion, a very characteristic and familiar cognomen of which we refrain from mentioning. Like the dandelion, chicory is indigenous, and may be seen growing in various parts of the country, by the road or hedge side; it may be recognised by the compound character of its flowers, and their bright and beautiful blue colour. It blossoms in the months of August and September, and any person desiring to get a sight of this very notorious vegetable, may gratify his or her curiosity by a walk along the banks of the Thames, from Kew for about a mile or so in the direction of Richmond.

"This plant," says M'Culloch, "is found growing wild on calcarious soils of England, and in most countries of Europe. In its natural state the stem rises from one to three feet high, but when cultivated it shoots to the height of five or six feet. The root runs deep into the ground, and is white, and fleshy, and yields a milky juice. It is cultivated to some extent in this country as an herbage plant, its excellence in this respect having been strongly insisted upon by the late Arthur Young.

"But in Germany, and in some parts of the Netherlands and France, it is extensively cultivated for the sake of its root, which is used as a substitute for coffee.

"When prepared on a large scale, the roots are partially dried, and sold to the manufacturers of the article, who wash them, cut them in pieces, kiln-dry them, and grind them between fluted rollers into a powder.

"The powder has a striking resemblance to dark ground coffee, and a strong odour of liqourice. It has been extensively used in Prussia, Brunswick, and other parts of Germany, for several years, but as it wants the essentail oil, and the rich aromatic flavour of coffee, it has little in common with the latter, except its colour, and has nothing to recommend it except its cheapness."

Notwithstanding that chicory "has nothing to recommend it except its cheapness," and that it is used exclusively to adulterate coffee, it has of late years been raised in great quantity in this country, owing to the very improper encouragement given by Government.

Large crops of chicory are grown in Yorkshire, in the neighbourhood, it is stated, of property belonging to the Chancellor of the Exchequer, and it was this circumstance which led to the assertion recently made, that Sir Charles Wood was himself an extensive grower of the plant.

This statement, we are happy to say, has just been distinctly contradicted by the Chancellor, who, however, in making known the denial, refrained from any allusion to the circumstance which explains the origin of the report. We are not surprised that the charge should have been made, for it is only natural that when an individual pertinaciously follows a course opposed to reason and correct principles, as Sir Charles Wood has done in the case of chicory, that an endeavour should be made to account for conduct so singular, and that it should be imagined that some strong personal interest existed, whereby the course of proceeding adopted might be explained.

The following Analyses of Chicory in its different states, with Report on the properties of that root, particularly as contrasted with coffee, are by Dr. Letheby and ourselves:—

"No one who is acquainted with the respective properties of chicory and coffee can for a moment entertain the opinion that the former can be effectively substituted for the latter; but inasmuch as great misapprehension prevails with the public respecting the supposed virtues of chicory, we have instituted the following analyses for the purpose of determining its nature and composition.

"In the first place, it will be noticed that coffee and chicory differ very essentially from each other in their botanical nature; for the one is the fruit or seed of a tree, while the other is the succulent root of a herbaceous plant. Now it is a well-ascertained fact, that of all parts of vegetables, the fruit and seeds usually possess the most active properties—this is no doubt due to the circumstance of their being freely exposed to the influence of light and air—agencies which promote chemical changes in the plant, and so effect the elaboration of those complex organic substances on which the activity of vegetables depends. On the other hand, it must be manifest, that, as the roots are removed from the influence of these powerful agencies, they cannot be so richly endowed with active properties; and, indeed, there are but few roots, which contain either alkaloids or volatile oils—the two classes of constituents which give to coffee its peculiar virtues. The distinction, therefore, between the properties of the seeds and roots of plants is very important, and it is especially so in the case before us.

"In the preparation of chicory the older roots are selected: they are first cleansed in a very imperfect manner by washing, then cut into slices, and dried in a kiln: in this state they are furnished to the chicory-roaster, who submits them to a rough kind of roasting process, somewhat similar to that employed for the torrefaction of coffee; after which they are powdered, the powder itself being frequently extensively adulterated.

"The root has been examined by us in three conditions, namely:—

"1st. In its recent, or raw state.

"2nd. In the kiln-dried condition.

"3rd. In the roasted and powdered form, as it is used for the adulteration of coffee.

"The *raw root* furnishes a milky juice, which owes its opacity to the presence of an inert vegetable substance named Inuline. The juice is very bitter, and, when filtered and heated, it shows, by its turbidity, that it contains a small quantity of albumen.

"When macerated in cold water, it yields about 13 per cent. of solid matter or extractive, which gives to the solution a very bitter taste; alcohol also extracts this bitter constituent, and on evaporation it furnishes a gummy product, which is very similar in its properties to the bitter material of the dandelion root. Acetate of lead produces a copious precipitate in the liquid from the deposition of gum, vegetable acid, and colouring matter. By means of Fehling's test, it was found that the raw root contained 1·1 per cent. of grape-sugar or glucose.

"The *kiln-dried root* possesses all the characters of the preceding, but in a higher degree, for water extracts about 50 per cent. of solid matter; and the solution furnished to Fehling's test as much as 10·5 per cent. of sugar.

"Neither of these specimens exhibited the least trace of starch, but by boiling in water, filtering, and cooling, they yielded a small quantity of a white powder, which had all the characters of Inuline.

"The absence of starch in the state in which the root is ordinarily used is also conclusively shown by means of the microscope, and we find that the tissue contains abundance of cellulose, which, by the action of strong sulphuric acid, gives a product that renders iodine blue.

"The *roasted Chicory root* yields from 45 to 65 per cent. of soluble extractive. Its solution in water is acid, and it does not possess the peculiar bitter taste of the raw root; but the taste of the liquid is more like that of burnt sugar. The copper test shows the presence of from 10 to 13 per cent. of sugar.

"The following analyses represent the per-centage composition of the root in its different conditions:—

	Raw Root.	Kiln-dried.
Hygroscopic moisture	77·0	15·0
Gummy matter (like pectine)	7·5	20·8
Glucose, or grape sugar	1·1	10·5
Bitter extractive	4·0	19·3
Fatty matter	0·6	1·9
Cellulose, inuline, and woody matter	9·0	29·5
Ash	0·8	3·0
	100·0	100·0

"The composition of the roasted root was as follows:—

	1st Specimen.	2nd Specimen.
Hygroscopic moisture	14·5	12·8
Gummy matter	9·5	14·9
Glucose	12·2	10·4
Matter like burnt sugar	29·1	24·4
Fatty matter	2·0	2·2
Brown or burnt woody matter	28·4	28·5
Ash	4·3	6·8
	100·0	100·0

"The ash of these had the following composition: —

	1st Specimen.	2nd Specimen.
Chloride of potassium	0·22	0·45
Sulphate of potash	0·97	0·98
Phosphate of potash	1·41	1·37
Ditto of magnesia	0·30	0·53
Ditto of lime	0·40	0·81
Carbonate of lime	0·10	0·26
Alumina and oxide of iron	0·20	0·20
Sand	0·70	2·20
	4·30	6·80

"By an examination of the foregoing analyses it will be seen that the root does not contain anything which can possibly be regarded as a substitute for coffee. It will be also manifest that in the process of roasting, the bitter principle is entirely destroyed, and that by the torrefaction of the saccharine and other constituents a quantity of caramel is produced, which has no virtue beyond that of burnt sugar. It is likewise evident that the kiln-dried root has undergone a sort of fermentation, whereby the amount of sugar has become greatly increased.

"We will now compare the preceding results of our examination of chicory root with the analyses that have been made of coffee berries.

"In a memoir published by M. Payen in the 'Journal de Pharmacie,' of Paris, in the year 1846, it is shown that the unroasted coffee berry has the following composition: —

Hygroscopic moisture	12·000
Sugar, gum, and acid	15·500
Nitrogenous matter (Legumine, Casein, &c.)	13·000
Free caffeine	0·800
Chlorogenate of caffeine, &c.	3·5 to 5·000
Fatty substances	10·0 to 13·000
Concrete essential oil	0·001
Aromatic fluid essential oil	0·002
Cellulose and woody fibre	34·000
Mineral substances in ash	6·697
	100·000

"The composition of the ash is —

Alkaline phosphates	2·64
Sulphate of potash	0·03
Chloride of sodium	0·04
Carbonate of lime	0·26
Carbonate of magnesia	0·78
Sulphate of lime	0·10
Phosphate of lime	2·82
Silica	0·02
	6·69

"The composition of the coffee berry, after it has been roasted, will depend on the degree of heat to which it has been subjected. If the temperature have not been raised above 500° Fahr., the berries will not have lost any of their active principles, and but little of their aromatic volatile oil; but they will have given off about 18 per cent. of water, and have acquired a small proportion of empyreumatic matter.

"In the act of roasting, the organic salt of caffeine is partially decomposed: it becomes red, and a portion of the active principle caffeine is set free. The cellulose, and those substances which are allied to it, become, to some extent, carbonised, and yield coloured and empyreumatic products. The fatty oils become diffused throughout the mass thus rendered porous, and carry with them the slightly modified essential oils. The fixed and volatile oils readily yield to the action of water, especially when hot, as in the making of coffee.

"If the roasting be discontinued at this period, the berries acquire a light chestnut colour, and become so friable that they are easily reduced to powder; but if the roasting be continued further, carbonisation of the nitrogenised ingredients occurs, and an empyreumatic oil is generated, which takes the place of the volatile aromatic principles: the caffeine is likewise dissipated and even destroyed to a great extent. By this treatment the coffee loses a considerable amount of its soluble active principles; and, as may be supposed, the loss is still greater with further torrefaction. The best temperature for the operation is about 482° Fahr., which does not dissipate the volatile aromatic oil, or decompose the caffeine; at this temperature the berry acquires a light red-brown, or chesnut-colour.

"Well-roasted coffee yields about 37 per cent. of extractive to boiling water, of which about one-fourth consists of nitrogenised matters, which Payen regards as being highly nutritious; in addition to which, he considers the aromatic essential oils, which are also contained in the infusion, as valuable dietetical agents, and as having the power of acting as agreeable stimulants to the digestive organs. Many chemists have remarked the curious relations which exist between the composition of the caffeine of coffee and some of the products of the human system. This relation, coupled with the fact, that coffee and its allies — tea and cocoa (both of which contain a similar active principle) — are instinctively used by all the nations of the earth, indicate that it serves some important purpose in the animal economy. No one has commented on this fact with greater force than Liebig, who, in alluding to it, says, 'it is impossible to admit the assertion that the use of coffee and tea is a matter of mere habit.' We think it, on the contrary, highly probable, not to say certain, that the instinct of man — feeling certain blanks, certain wants of the intensified life of our times, which cannot be satisfied or filled up by mere quantity — has discovered in these products of vegetable life, the true means of giving to his food the desired and necessary quality.' Now it happens, that chicory does not contain a particle of any constituent or principle which can be regarded as having the remotest analogy with the vegetable principles of coffee; how, therefore, can it be said to act as a substitute for it? Payen has compared the infusion of the two substances, and he says, 'that when they are of an equal colour and density, the solution of chicory contains only half as much of nitrogenised substances as the infusion of coffee. This is a real cause of inferiority, but it is unworthy of notice when compared with the enormous difference that separates this liquid, without either a pleasant smell or taste, from an infusion, whose stimulating qualities and exquisite perfume are so remarkable.

"But, setting aside the results of actual experience as to the effects of chicory and coffee on the animal frame, and looking only to the positive results of the present analyses, we are in a position to arrive at certain definite conclusions with regard to the comparative properties and activity of chicory and coffee.

"Chicory belongs to the same natural family of plants as the dandelion, and resembles it very closely in its properties; for the extract obtained from both is bitter, and according to the best authorities, possesses diuretic and aperient qualities. Five ounces or 2187 grains of recent chicory-root, yielded 298 grains of extract, dried at a temperature of about 200° Fahr. This extract was of a light fawn colour, of a bitter taste, and of a pasty consistence: after having been kept for some days, it lost a considerable part of its bitterness. Forty, and even eighty grains, taken at one dose, failed in our case to produce any very marked or obvious symptoms.

"The properties of *kiln-dried* chicory differ but little from those of the recent root; the chief difference consisting in the loss of a very large quantity of water, which is expelled during the process of drying, in a diminution of bitterness, as well as an augmentation in the amount of sugar.

"The *roasted root* contains less gum, more sugar, a good deal of carbon arising from the partial charring of its tissues, and the bitterness has almost completely disappeared, that which remains being principally due to the burnt sugar. The absence of bitterness would lead to the inference, that the active properties of chicory are nearly, if not entirely, destroyed by the process of roasting; but opposed to this, is the fact, proved by observation and experience, that chicory, in some cases, produces diarrhœa.

"Looking to the results of the analyses of coffee, we perceive that it contains at least two principles which are possessed of undoubted virtue and activity. In fact, the essential oils, and the caffeine, act as powerful stimulants on the nervous system; and it is worthy of notice that the stimulation is not followed by any considerable amount of subsequent depression. Add to this, that, while the infusion made from the one is light, transparent, and aromatic — that from the other is thick, viscid, heavy, and almost inodorous.

"We would say then, that while chicory exhibits no analogy whatever in its composition with coffee, neither does it possess any properties in itself which render it valuable; and it is questionable whether the qualities which it does retain are not positively hurtful."

The above Report was written some time subsequently to the publication of the following brief remarks on the properties of chicory.

Sir Charles Wood having stated, whether on his own authority or that of some other person does not very clearly appear, that chicory is both "wholesome" and "nutritive," we propose to ascertain how far these statements are well founded.

Chicory is possessed of active medicinal properties, in consequence of which it has long been included in the "materia medica."

These properties resemble closely those of the allied plant, the dandelion, in reference to which we find, in the work of Dr. Pereira, the following observations: —

"Its obvious effects are those of a stomachic and tonic. In large doses it acts as a mild aperient. Its diuretic operation is less obvious and constant. In various chronic diseases, its continued use is attended with alterative and resolvent effects; but where the digestive organs are weak, and readily disordered, taraxacum is very apt to occasion dyspepsia, flatulency, pain, and diarrhœa."

These remarks of course apply to the recent root, and it therefore now becomes necessary that we ascertain what are the effects produced on the human frame by chicory, when roasted. In order to determine this point, we have instituted certain experiments or trials, the details of which we will now make known.

Three persons partook of a chicory breakfast. The infusion was dark-coloured, thick, destitute of the agreeable and refreshing aroma so characteristic of coffee, and was of a bitter taste.

Each individual experienced, for some time after drinking the infusion, a sensation of heaviness, drowsiness, a feeling of weight at the stomach, and great indisposition to exertion; in two, headache set in; and in the third, the bowels were relaxed.

In second and third trials of the chicory breakfast, the same feelings of drowsiness, weight at the stomach, and want of energy, were experienced, but no headache or diarrhœa.

Several other trials were subsequently made, with nearly similar results.

But chicory, it will be said, is seldom taken alone in this country, and when mixed with coffee these effects are not produced.

Two persons partook, for a considerable period, twice a day, of an article denominated coffee, costing one shilling and sixpence a pound, and largely adulterated with chicory: during nearly the whole of this time they both suffered more or less from diarrhœa.

From the result of these trials, therefore, we are warranted in concluding that at least some doubt is attached to the assertion of the "wholesome" properties of chicory root as an article of diet.

Of the "nutritive" properties of chicory we shall say but little, feeling assured that the reader will scarcely be disposed to question the accuracy of the assertion, that a mouthful of good wheaten bread contains more nourishment than a cup of infusion of chicory.

Lastly, chicory root is entirely destitute of the essential oil of coffee, as well as of "caffeine," the active principle upon which most of the virtues of that invaluable berry depend; and these deficiencies explain in a great measure the feeling of lassitude and want of energy experienced after drinking infusion of chicory.

It must be clearly borne in mind, however, that the mixing or adulteration of coffee with chicory is not objected to by us on account of the medicinal properties of chicory merely, but because we hold this practice to be prohibited by considerations of money, justice, and public morality.

Structure of Chicory Root.

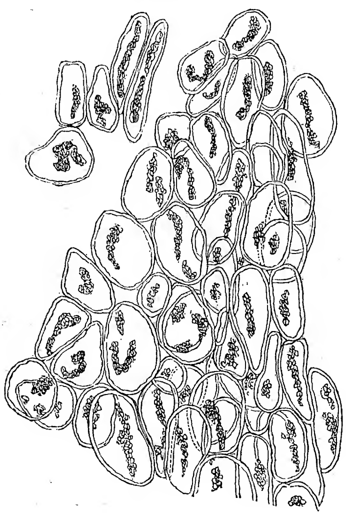
In the raw chicory root three parts or structures may be distinguished with facility, cells, dotted vessels, and vessels of the latex.

When the adulterating merchant or grocer, in the secrecy of his own warehouse, first reduced chicory root, parsnips, corn, beans, &c., to charred and shapeless masses, the idea probably never entered his mind that enough of the distinctive structural characters of each of these substances still remained undestroyed, to enable the man of science to drag to light his guilty deeds, and to trace the presence of these substances in every parcel of adulterated coffee sent out from his premises.

In the roasted and charred chicory root the same structures may be detected as are distinguishable in the raw or unroasted root.

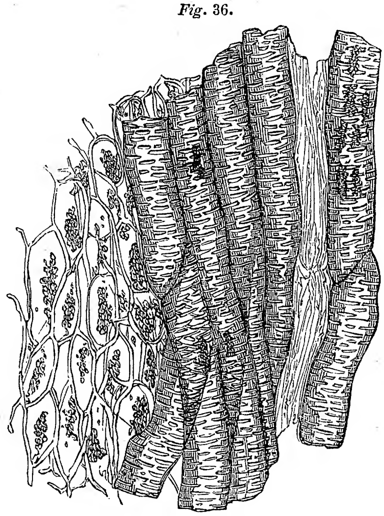
The chief part of the root is made up of little utricles or *cells*. These are generally of a rounded form, but sometimes they are narrow and elongated. The former occur where the pressure is least and the root soft; the latter in the neighbourhood of the vessels.

Fig 35.



Fragment of *roasted* Chicory Root, taken from a sample of adulterated coffee, showing the *cells* of which it is principally constituted. Drawn with the Camera Lucida, and magnified 140 diameters.

Fig. 36.



Fragment of *roasted* Chicory Root, taken from a sample of adulterated coffee, showing the *dotted* or *interrupted spiral vessels*, which pass in bundles through the central parts of the root. Drawn with the Camera Lucida, and magnified 140 diameters.

The *dotted vessels* are particularly abundant in the central and harder parts of the root, which they traverse in bundles: they are cylindrical unbranched tubes, tapering to a point at either extremity, and elegantly marked on the surface with short fibres, describing an interrupted spiral course.

In studying the structure of chicory root, we have clearly made out the origin of the dotted vessels in narrow elongated cells tapering to a sharp point at either end, at first smooth, but subsequently exhibiting faint oblique markings.

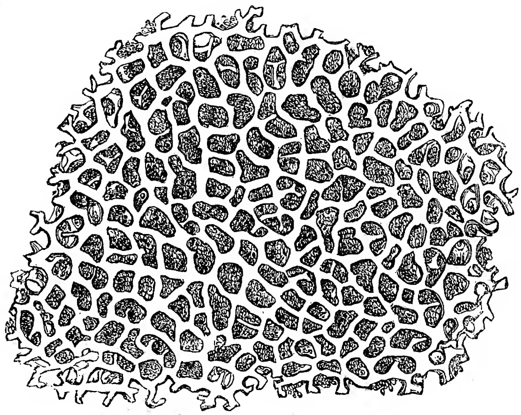
The vessels of the latex, *vasa lacticescia*, are present in most plants, having a milky juice or sap; they form branched and frequently anastomosing tubes, of less diameter than the dotted vessels, and with smooth membranous parietes.

These vessels afford a useful means of distinguishing chicory from some other roots employed in the adulteration of coffee.

Structure of the Coffee Berry.—In our report on coffee, we entered minutely into the structure of the raw and roasted coffee berry; on the present occasion, therefore, we shall refer to it only very shortly.

The Chancellor of the Exchequer, in May of the past year (1850), stated to the House of Commons, that "having desired the Board of Inland Revenue to state whether there was any ready and available proof of the mixture of chicory with coffee, he had received a reply to the effect, that four experienced persons having been employed in making experiments, the result of the inquiry was, that neither by chemical tests, nor in any other way, could they ascertain with any degree of certainty, whether the mixture contained chicory or not."

Fig. 37.



A fragment of *roasted* Coffee Berry. Drawn with the Camera Lucida, and magnified 140 diameters.

It does certainly appear to us as very remarkable "that four experienced persons" should, after special investigation, have deliberately reported that "neither by chemical tests, *nor in any other way*," could they ascertain whether the mixture contained chicory or not, although, at the same time, the means of discrimination were so obvious and simple.

The coffee berry is in every respect unlike chicory in its structure, and consists chiefly of angular and coherent cells.

Adulterations of Chicory.

What! chicory adulterated? A substance used to adulterate another article, itself adulterated? Impossible! we fancy we hear the inquirer exclaim. Improbable as the thing appears, it is nevertheless true.

When it is remembered that all the vegetable substances employed in the adulteration of coffee require to be charred or roasted, and that to effect this a suitable apparatus is required, such as but few retail grocers possess, it at once becomes at least probable that these substances are prepared for them by other parties.

This impression acquires increased force when it becomes known that the majority of grocers buy their chicory, not in nibs, but *in powder*, and that this is supplied to them by certain wholesale chicory houses, which charge for it, in general, a less price than for the nibs, or unground root itself, or than genuine chicory powder can be fairly sold at.

The substances which are either substituted for chicory, or mixed with it, are very numerous; several of these we have ourselves detected, while others have been discovered from time to time by different parties.

Adulteration with Carrot.—The carrot resembles very closely chicory root in its structure; the cells and dotted vessels it is impossible to distinguish from those of chicory, the chief difference is in the absence from the carrot of the vessels of the latex.

This difference, although sufficient on a prolonged examination to enable the observer to distinguish a sample of carrot from one of chicory, would not allow of his detecting fragments of carrot when mixed with chicory, because minute pieces of the latter vegetable frequently do not contain lactiferous vessels.

Adulteration with Parsnip.—The parsnip also resembles chicory root very closely in its structure; the cells are nearly of the same size and form, the dotted vessels are similar, but there are no lactiferous vessels, and the cells, moreover, contain starch-granules of small size.

Some of the starch-granules in the process of roasting always escape destruction, and thus the substitution of parsnip for chicory, or its admixture with that root, may with care always be discovered by means of the microscope.

Adulteration with Mangel-wurzel.—The cells forming the root or tubers of this plant are three or four times larger than those of any of the previously described substances, from which, therefore, it may easily be distinguished.

Various statements have appeared respecting the employment of this root in the adulteration of chicory and coffee.

Adulteration with Beans.—This is a favourite adulteration of both coffee and chicory, of which we have met with several instances.

The means of distinguishing it have been pointed out in a previous Report; they relate principally to the size and form of the starch-granules which enter into the structure of the bean.

Adulteration with "COFFINA."—An article has lately been introduced into the market under the attractive title of "Coffina," said to be a "Turkish plant," and to have been found "highly nutritious" on analysation.

It is in the state of powder, has very much the appearance of coffee in colour, a very bitter taste, and possesses the odour of lentils.

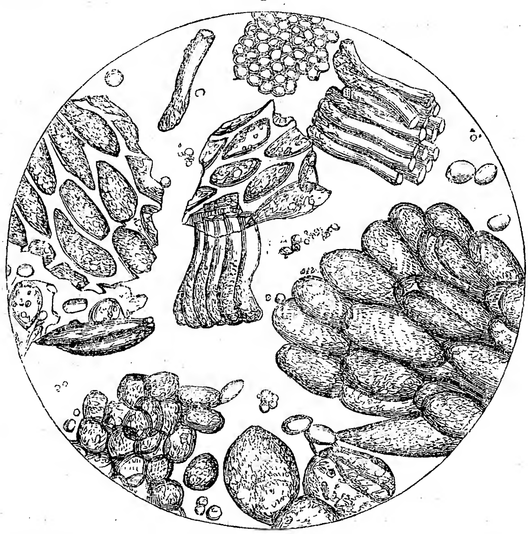
On an examination of this powder with the microscope, we find it to consist entirely of a seed, including even the husk, belonging to some plant of the natural family *Leguminosæ*.

Of this worthless, if not pernicious article, no less than *eighty tons* were offered, within the last few days, for sale by a Scotch house, at about 12*l.* per ton, that is, at less than 1½*d.* per pound.

On this single transaction, therefore, the revenue would be defrauded of no less a sum than 4,480*l.*; and the public of at least four times that amount—viz., nearly 18,000*l.*

This article, the name of which is borrowed from another substance, of which it does not contain a particle, is not recommended as a substitute for chicory, but to be used with chicory *in place of coffee.*

Fig. 38.



This engraving exhibits the several structures detected in a sample of "COFFINA." Drawn with the Camera Lucida, and magnified 140 diameters.

A recent importation of about *one hundred tons* of lupine-seed from Egypt into Glasgow, has led, a correspondent writes, to the conjecture that this "coffina" is made from them. From a careful comparison of the structures found in "coffina" with those of lupine-seed, we are of opinion that this conjecture is well founded.

The same firm to which a sample of "coffina" was sent, has recently been offered *five hundred tons* of foreign ACORNS, at 5*l.* per ton, or less than three-farthings a pound. Should these find a purchaser, as they will doubtless do, if they have not already been bought up, the revenue will be cheated to the extent of 28,000*l.*, and the public to about 112,000*l.* These also were intended to be used in the adulteration of coffee.

Adulteration with Roasted Corn.—This adulteration is the one most frequently practised of all; sometimes whole wheat or rye is roasted, at others, an inferior or damaged description of the ground farina of these is employed, which is usually first made up into buscuits and then charred.

Adulteration with Biscuit-Powder.—We have been informed, on good authority, that in Whitechapel there exists a manufactory for the express purpose of preparing, on a large scale, from an inferior description of flour, a biscuit, to be burnt, ground, and exclusively employed in the adulteration of chicory and coffee.

We have evidence also that "dog-biscuits" even are used for the same purpose.

Adulteration with Burnt Sugar.—Burnt sugar, familiarly known in the grocery trade as "black Jack," is also prepared wholesale for the adulteration of chicory and coffee.

It is sold mostly in tin canisters, at 1*s*. per lb., and as usually met with, is in lumps of about the size of a bean; these are quite black, exhibit a shining fracture, and have the bitter and peculiar taste characteristic of burnt sugar.

It is sometimes denominated the "coffee refiner;" it is really, however, rather a "coffee colourer," and is employed to impart colour and bitterness to infusions or decoctions made from inferior and largely adulterated articles vended under the name of coffee.

Some grocers make a practice of grinding the coffee while the purchaser waits for it; this is done to inspire confidence, and no doubt it frequently has this effect, the customer leaving the shop with the full impression that he has secured a genuine article. This, however, is often a mistake, for, frequently, near to the mill are boxes containing nibs of chicory broken up into the size of coffee berries, and lumps of "black Jack:" now, a certain quantity of each of these, a handful or so of chicory nibs, and a few pieces of "black Jack," find their way into the mill as well as the coffee berries.

Adulteration with Red Earth.—If a little chicory powder, as purchased from a retail grocer, be placed between the teeth, it almost constantly feels very gritty, and the experimenter will most probably be disposed to spit it out as soon as possible, under the impression that he has got so much earth or dirt in his mouth.

So considerable is the quantity of grit present in many samples of powdered chicory, that the first idea which occurs is, that they are adulterated with some earthy substance: this, however, in general, is not the case, and we believe that the grit or sand contained in them is often derived from the very imperfectly cleansed chicory roots themselves.

There is too much reason to apprehend, however, that earthy and mineral substances are not unfrequently employed in the adulteration of chicory.

We will now proceed to detail the results obtained by the examination of numerous samples of chicory in powder.

Results of the Microscopical Examination of Twenty-two Samples of Chicory in Powder, purchased at the Establishments of different Metropolitan Grocers.

Chicory root is reduced to powder, not by grinding in a mill, but by friction between rollers: this mode of preparation, we believe, gives increased facilities to adulteration, because in this way burned vegetable tissues may be so comminuted as to render their recognition almost impossible.

We make this observation, because we have noticed that of several of the following samples, more than one half was made up of vegetable matter, reduced to such a state of division that but little trace of structure was visible.

It has been repeatedly stated that ground chicory root when placed on the surface of water, quickly sinks, and that by this means the adulteration of coffee with chicory may always be detected. This test in the case of the majority of the samples of chicory examined, completely failed, as the powder did not sink, but rested on the surface for a considerable time, and continued perfectly dry.

1*st Sample.*—Purchased in Oxford-street, south side.
Adulterated—with *roasted beans*, and containing a considerable quantity of *sand or grit.*
2*nd Sample.*—Purchased in Oxford-street, south side.
Contains *much grit; no adulteration* detected.
3*rd Sample.*—Purchased in Oxford-street, south side.
Contains *sand; no adulteration* detected.
4*th Sample.*—Purchased in Oxford-street, south side.
Contains *sand; no adulteration* detected.
5*th Sample.*—Purchased in Oxford-street, south side.
Contains *much sand; no adulteration* detected.
6*th Sample.*—Purchased in Oxford-street, north side.
Adulterated—with a considerable quantity of *roasted beans.*
7*th Sample.*—Purchased in Little Newport-street.
Contains *sand; no adulteration* detected.
8*th Sample.*—Purchased in Brewer-street, Golden-square.
Contains *sand*, and a small quantity of *coffee.*
9*th Sample.*—Purchased in Silver-street.
Contains much *sand; no adulteration* detected.
10*th Sample.*—Purchased in Tyler-street.
Contains *sand; no adulteration* detected.
11*th Sample.*—Purchased in Walker's-court.
Adulterated—with *much burnt corn*, and contains *sand.*
12*th Sample.*—Purchased in Seven-dials.
Contains much *sand; no adulteration* detected.
13*th Sample.*—Purchased in Ryder's-court.
Adulterated—with *roasted corn*, and containing very much *sand.*
14*th Sample.*—Purchased in Oxford-street.
Adulterated—with a *considerable quantity of roasted beans*, and containing much *sand.*
15*th Sample.*—Purchased in Pulteney-street.
Contains a small quantity of *sand; no adulteration* detected.
16*th Sample.*—Purchased in Little Earl-street.
Adulterated—with *roasted corn.*
17*th Sample.*—Purchased in Little Windmill-street.
Adulterated—with an *immense quantity of roasted beans* and much *sand.*
18*th Sample.*—Purchased in Panton-street.
Contained a small quantity of *sand; no adulteration* detected.
19*th Sample.*—Purchased in Tottenham-court-road.
Adulterated—with a *small quantity of roasted corn*, and containing a little *sand.*
20*th Sample.*—Purchased in Newport-market.
Containing a *small quantity of roasted farina*, and much *sand.*
21*st Sample.*—Purchased in Marshall-street.
Contains a small quantity of *coffee; no adulteration* detected.
22*nd Sample.*—Purchased in Grafton-street.
No adulteration detected; contains much *sand.*

From an examination of the above *Twenty-two* analyses, it appears that no less than *nine*, or *nearly half* of the samples examined, were adulterated.

The prices demanded for the several samples varied from 5*d.* to 1*s.* per lb.; the ordinary charge being 8*d.* The price of chicory in powder to the trade ranges in general from 20*s.* to 32*s.* per cwt.; thus the profit of the retail grocer on the sale of chicory powder is seldom under cent. per cent., and often much above it.

Results of the Microscopic Examination of Samples of Chicory in Powder obtained from Wholesale Dealers.

The following samples, with two exceptions, were forwarded to an extensive firm in the City, which hitherto has never made use of chicory in its business; it may therefore fairly be inferred that they were superior in quality and condition to those usually offered; indeed, this remark applies to *samples* in general, which in most cases are better than the articles subsequently supplied.

23*rd Sample.* — Price 26*s.* per cwt.; contains a considerable quantity of *sand; no adulteration* detected.

24*th Sample.* — Foreign chicory, price 52*s.* per cwt.; contains much *sand; no adulteration* detected.

25*th Sample.* — Price 32*s.* per cwt.; *adulterated* with *roasted corn*, and contains *sand.*

26*th Sample.* — English chicory, price 30*s.* per cwt.; so highly burnt as to be almost black, and reduced to charcoal; mere rubbish.

27*th Sample.* — English chicory, price 30*s.* per cwt.; contained much *sand; no adulteration* detected.

28*th Sample.* — Price 24*s.* 6*d.* per cwt.; *adulterated* with *roasted corn*, and contains *sand.*

29*th Sample.* — Guernsey chicory, price 30*s.* per cwt.; containing much *sand; no adulteration* detected.

30*th Sample.* — Price 26*s.* per cwt.; containing a little *sand; no adulteration* detected.

31*st Sample.* — English chicory, price 26*s.* per cwt.; *adulterated* with *much roasted corn*, and containing very much *sand.*

32*nd Sample.* — Foreign chicory, price 42*s.* per cwt.; containing much *sand; no adulteration* detected.

33*rd Sample.* — This sample was supplied to a coffee-house keeper by a wholesale and retail dealer in the City.

Adulterated — with *ground acorns.*

34*th Sample.* — We publish the name in the following case, for the same reasons which have induced us to make known the names of other parties vending articles in sealed packages, the wrappers of which are made the vehicle of advertisements.

"An Improvement to Coffee.
Genuine Chicory Powder,
manufactured by
J. S. Fry & Sons, Bristol,
From the finest root.
Use it in proportion of one tea-spoonful to three of coffee."

Adulterated — with *much roasted corn.*

The publication of the above analysis led to some correspondence between the Messrs. Fry and ourselves; this was brought to a termination satisfactory to both parties by the publication in "The Lancet" of the following observations: —

"Of the full and complete accuracy of the statements and analyses of the Commission not a reasonable doubt can now be entertained. It will, we think, be universally admitted that nothing could exceed the care and scientific accuracy by which the Reports on Food and its Adulterations have been characterised throughout. Of the truth of this remark, we have received abundant and conclusive evidence on all sides; but we need only refer to one fact to demonstrate its perfect correctness. The reports in question have now been published with considerable regularity for upwards of two years; during this period many hundreds of analyses have been made, and names and addresses published, yet in one instance only have our results been seriously called in question. We allude to the case of Messrs. Fry, which occurred nearly two years since. On that occasion we felt ourselves bound to publish the result of a careful analysis of a packet of chicory which came to our hands, bearing the address of Messrs. Fry. It was of an unfavourable nature. On the other hand, those gentlemen laid before us the reports of a chemical and microscopical inquiry respecting it, conducted by persons of much scientific reputation, certifying the absence of any admixture. Whatever may have been the cause of the discrepancy, enough has transpired to satisfy us that Messrs. Fry themselves were entirely free from blame. Other packages of their manufacture have since been procured, which, on examination, have been found quite free from adulteration or admixture of any kind. We refer to this matter, because, knowing the high character of the Messrs. Fry, we consider this explanation due both to them and to ourselves. We have, then, great reason to look back upon the past career of the Analytical Sanitary Commission with the highest satisfaction. The analyses, having been no less accurate than the results of the labours of the Commission, have been important to the public and the profession."

We have now shown,

1st. That chicory, an article used to adulterate another article, is itself largely adulterated.

2nd. That the dealers in or manufacturers of chicory are in many cases the parties who practise this adulteration.

We are sorry, however, to say, that in those instances in which the retail grocers do not themselves adulterate the chicory they vend, we are unable to acquit them of guilty knowledge of and participation in the fraud: this knowledge is displayed in the fact that the fraudulent grocer frequently purchases chicory in powder, at a price at which it is not possible to procure genuine chicory.

Review of Reasons urged both For and Against the Admixture of Chicory with Coffee.

Various reasons have been urged both in favour of and against the "adulteration," or, as the Chancellor more gently phrases it, the "mixing" of chicory with coffee: these we will next proceed to consider.

In *favour of the adulteration* it is alleged,—

First, that the *admixture of chicory with coffee improves coffee*, and that *such addition is approved of by the public.*

In order to ascertain whether the addition of chicory to coffee be really an improvement, we prepared three infusions, one of coffee, another of chicory, and the third of both these mixed in the proportion of three-fourths coffee and one-fourth chicory.

The *infusion of coffee* was perfectly transparent, and of a dark and rich brown colour; it emitted an odour in a high degree penetrating and refreshing, and to the taste it was agreeable, and rather bitter.

Having been taken for a few minutes, it produced a feeling of general warmth, and a state of bodily and mental activity and invigoration.

The *infusion of chicory* was opaque, staining the sides of the vessel containing it; it possessed a heavy, though perhaps some persons might be of opinion not a disagreeable smell, wholly unlike, however, the volatile and diffusive odour of coffee; in taste it was more bitter than the coffee, with a certain degree of sweetness.

Having been swallowed for a few minutes, it occasioned a feeling of weight at the stomach, and a general heaviness and indisposition to bodily and mental exertion.

The combined infusion of chicory and coffee partook, to a great extent, of the characters of the infusion of genuine coffee, as might be anticipated from the large quantity of coffee it contained.

Altogether, we were unable to bring ourselves to believe that the addition of chicory to coffee in the proportion of twenty-five per cent. of the former was any improvement; on the contrary, we were satisfied that the quality of the beverage was greatly impaired by the addition.

Persons who are foolish enough to regard a slight sensation of weight and fulness in the region of the stomach—symptoms really of incipient indigestion—as evidences of the beverage being possessed of increased "strength" and "body," might possibly be brought to consider the addition an improvement.

In contrasting the properties of chicory and coffee together, we would once more observe it must not be forgotten that the former article is wholly destitute of that peculiar principle "*caffeine*," upon which the virtues of coffee depend, and that therefore for every ounce of chicory in a pound of coffee there is so much the less of that stimulating and invigorating nitrogenised product.

Allowing, however, for the sake of argument, that the admixture of chicory in moderate proportions is in the opinion of some persons an improvement, it is very certain that by others it is not considered to be so; and such, therefore, ought surely *to be allowed a choice*, and not be compelled, as at present they frequently are, to drink chicory although they dislike it.

But the admixture of chicory with coffee in the proportion of twenty-five per cent., the utmost that can be allowed by any person to constitute an improvement, does not in general satisfy the desire for profit on the part of the grocer; he uses, in most cases, a very much larger proportion of chicory than this, and the shilling coffee, "*the poor man's beverage*," contains one-half or three-fourths chicory, and in some instances consists entirely of it. Now no truthful person will assert that chicory in these, the more common proportions, is an improvement to coffee.

Second, that *the use of chicory increases the consumption of coffee.*

This statement, although recently put forth by no less an authority than the Chancellor of the Exchequer, is just the very reverse of the truth, which is, that the use of chicory diminishes the consumption of coffee. This we have already clearly proved, and it is not necessary that we discuss this point again. It is settled.

Third, that *the poor man, by the employment of chicory, has an article placed within his reach which otherwise he could not obtain.*

This argument, although specious, is utterly fallacious.

Genuine coffee, ground, or in the berry, may now be obtained at numerous respectable establishments, at 1*s.* 2*d.* and 1*s.* 4*d.* the pound, this article costing the grocer more than three-fourths of the sum he demands for it.

The mixture of chicory and coffee is never sold under 1*s.* per lb., and the cost of this to the grocer very frequently does not exceed 3*d.* a pound.

Which of these two articles, therefore, we ask, is the *best poor man's bargain?*

Shilling coffee, as vended at the present, is vile and often deleterious rubbish, and we recommend the poor man never to purchase it.

We say, therefore, that so far from the poor man being benefited by the use of chicory, that out of every shilling he spends in what is falsely denominated coffee, he is frequently robbed of 9*d.*

We can well understand how the poor man or the poor man's wife, having, on a Saturday night, only a few shillings to spend, and desiring to make this go as far as possible, is induced to purchase the cheapest articles he or she can procure, overlooking the fact, that what professes to be the cheapest is often in reality the dearest in the end.

We wish the poor man, therefore, clearly to understand, that chicory is not to be compared to coffee in any respect, and we would have him avoid the "cheap and cutting shops," distinguished by large placards and huge piles of damaged goods, and buy his coffee at some house of known and acknowledged reputation and respectability.

Apprehensive that Government will be forced to take notice of the scandalous practices now so rife in the article of coffee, the adulterating grocers have already begun to raise the cry of "dear coffee," and they tell us, that if the admixture of chicory with coffee be prohibited, the price of the latter article will be 2*s.* the pound.

The answer to this statement is, that excellent *genuine coffee* may now be obtained at establishments which do not use chicory in their business at all, at prices varying from 1*s.* 2*d.* to 1*s.* 6*d.* per pound.

Fourth, that *the law sanctions the adulteration of coffee with chicory*, and therefore that the grocer, in mixing chicory with coffee, is guilty of no fraud.

As the law at present stands, it must be conceded, we are sorry to say, that in mixing chicory with coffee the grocer does not violate the law, but only does that which the executive and its officers, to their shame be it said, not alone sanction, but actually recommend.

We hold, however, that in vending an article as coffee which is not coffee, the grocer is guilty of a moral fraud, and that which is morally wrong no act of parliament and no ministers can make morally right.

Fifth, and lastly, it is alleged that there is no necessity for legislative interference, since, *by buying the coffee-berries in the whole state, the public can protect itself.*

Those who use this argument cannot but be aware how inefficient, practically, is the protection here referred to.

The poor man has not the money wherewith to purchase a mill; and if he had, working early and late, rising at six in the morning, and going to bed late at night, what time or spirit has he to attend to such matters?

Again: others not so poor, and who are in a position to make the necessary purchase, are perhaps equally engaged, or ignorant of the extent to which they are cheated.

Even of those who have both money and leisure we affirm that not one in twenty avails himself of the protection which the purchase of the whole berry affords; nor, since he pays a fair price for an article which he specifies, ought he to be called upon to adopt measures of extraordinary precaution against fraud.

We are not disposed, however, to underrate the value of this means of protection, and we hope shortly to be able to announce where efficient coffee-mills may be procured at a reasonable cost.

We put it to coffee-merchants and respectable dealers whether it be not advisable that they should themselves take some steps to supply the public with cheap and effective coffee-mills.

We have now to consider the chief arguments which have been or may be advanced against the adulteration of coffee with chicory.

Against this practice we allege,

First: that such adulteration *necessitates the commission of a moral fraud*, and further, that it is frequently made the cloak for pecuniary fraud and extortion.

When a purchaser enters a shop, asks for an article, pays the price demanded for it, he has a right to expect that he obtains that for which he asks, and not a mixture of two different things, one of which he probably positively objects to, and the relative proportions of which are regulated by the will and conscience of the vendor. The grocer who, under such circumstances, places in the hands of the purchaser an adulterated commodity, commits a moral, and frequently a pecuniary fraud.

We will suppose the following case of poisoning, not an improbable or unfrequent one:— An infant has been given an overdose of Godfrey's cordial; the proper remedy is a strong infusion of coffee—the coffee already in the house, inasmuch as it is the most readily obtained, is used, and consists principally or perhaps entirely of chicory. *The child dies.* Who is the party morally responsible in this case?

Second: that *it is unjust to the producer* of coffee.

The grower of coffee has at least a right to demand, in consideration of the heavy tax which he pays for the privilege of being permitted to import his coffee into England for disposal, that the sale of the article, and its estimation with the public, be not injured by the practice of adulteration, carried on under the sanction, and with the connivance, of the legislature.

The payers of duty on other excisable articles are protected against adulteration by law, and the coffee-grower has a full right to demand, in common honesty, the same amount of protection.

Third: that *the revenue is injured.*

Whatever lessens the consumption of an excisable article, of course injures the revenue. It has been proved that the mixing of chicory with coffee lessens the consumption of coffee, and therefore, by so much is the revenue diminished and injured.

If the loss in the revenue were so much gain to the public, there would be less reason to complain, but this is not the case; the advantage is pocketed by unprincipled grocers.

Fourth: that *the public is defrauded.*

That the public, and especially that large section of it, the poor, is extensively defrauded by the adulteration of coffee with chicory, to say nothing of roasted corn, beans, dog biscuits, &c., has already been clearly proved. Let those who entertain any doubts upon the subject, consult the Table of Analyses which we gave in our Report on Coffee.

We have now clearly shown that the disadvantages and evils resulting from the mixture of chicory with coffee, in the manner and to the extent now practised, are great and manifold, and that they demand the application of a suitable remedy.

The remedy which we propose is simple, moderate, and just: it is, that the "Treasury minute," authorising the mixture of chicory with coffee, be rescinded. The effect of this would be, to place coffee upon the same footing with all other excisable articles, as tea, pepper, &c., and that penalties would attach to its adulteration.

Chicory would of course still be sold; but in place of being so clandestinely, it would be vended openly, and under its proper name, and at its fair value.

Public morality, the interests of the revenue, of the grower, the consumer of coffee, and the honest tradesman alike require the adoption of the remedy here pointed out.

MUSTARD, AND ITS ADULTERATIONS.

The plants from which mustard is obtained are, *Sinapis nigra*, or black, and *Sinapis alba*, or white mustard; they belong to the natural family *Cruciferæ.*

The black mustard-plant is distinguished by its seed vessels, which are smooth, and the colour of the seeds themselves, which are reddish, or blackish brown.

In the white mustard-plant the seed vessels or pods are clothed with hairs, which render them rough, and the seeds are yellow.

The two species of mustard differ in properties as well as in botanical characters.

The seeds of *S. nigra* are more pungent than those of *S. alba*, but there are other differences.

Analysis has detected in black mustard-seed several distinct chemical compounds—*Myronic acid, Myrocyne, a volatile oil*, and *a fixed oil of mustard.*

Myronic acid is an inodorous, non-volatile, bitter, and non-crystallisable substance, containing nitrogen and sulphur, and forming salts with bases. The characteristic property of this substance is, that it yields, with myrocyne, the volatile oil of mustard.

Myrocyne, the *emulsin* of black mustard, yields, as already noticed, with myronic acid, the volatile oil of mustard. "It has considerable resemblance to vegetable albumen and emulsin, but as it cannot be replaced by either of these substances in the development of the volatile oil, it must be regarded as a substance *sui generis*. It is soluble in water; but is coagulated by heat, alcohol, and acids, and in this state it loses the power of acting on the myronates, and of yielding the volatile oil."—*Pereira.*

The *volatile oil of mustard* does not pre-exist in black mustard-seeds, but is formed, as already observed, by the mutual action of myronic acid and myrocyne in cold or warm water; it is this oil which gives to mustard its penetrating odour, sharp burning taste, and its acrid, rubefacient, and vesicant properties: it contains nitrogen and sulphur in its composition.

The above details are of practical interest and importance, for since heat coagulates myrocyne, and this substance is necessary to the formation of the volatile oil upon which the greater part of the active properties of mustard depends, it is clear that water either cold or warm only, should be employed in the mixing of mustard.

The *fixed oil of mustard* is usually procured from the siftings or dressings of mustard, which consist mainly of husk: it is stated to constitute about twenty-eight per cent. of the seeds.

Of the composition of white mustard we find the following account in Pereira's "Materia Medica."

"Robiquet and Boutron (*Journ. de Pharm.*, xvii. p. 279.), however, have proved, that white mustard contains neither volatile oil, nor any substance capable of producing it, but owes its activity to a *non-volatile acrid substance*, which does not pre-exist in the seeds, but is readily formed in them under certain conditions. Another chemical peculiarity of white mustard is, that it contains *sulpho-sinapisin.* (Henry and Garrot, *Journ. de Chim. Méd.*, i. 441.) Hence, while sesquichloride of iron strikes a deep red colour in an infusion of white mustard, it merely communicates an orange tint to the infusion of black mustard. Moreover, the thick mucilaginous liquor obtained by digesting the seeds of white mustard in cold water is peculiar to them. (Cadet, *Journ. de Pharm.*, xiii. 191.) Simon (*Journ. de Pharm.*, xxv. 370.) has announced the existence of a new principle, which he calls *erucin.*"

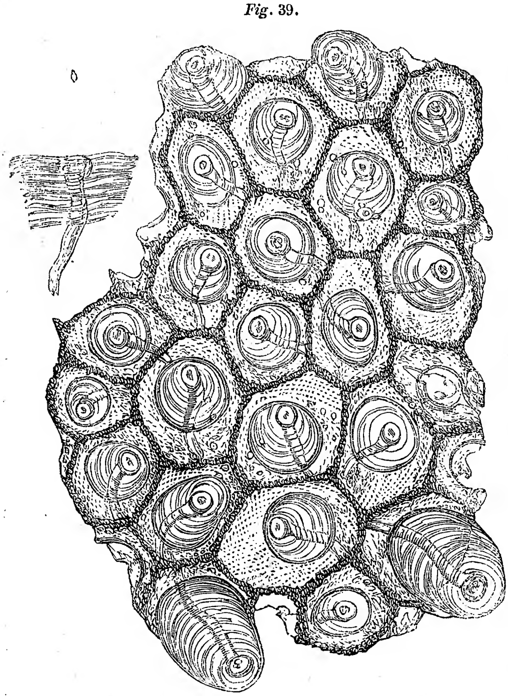
The young or seed leaves of white mustard are used for salad.

Both species are indigenous, and may commonly be seen in flower, in the month of June, in waste places and fields. In the brick fields in the neighbourhood of Notting-hill, they grow in great quantities.

M'Culloch's "Commercial Dictionary" contains the following interesting particulars in relation to the growth &c., of mustard:—

"It was formerly extensively cultivated in Durham, but it is now seldom seen in that county. At present it is principally raised in the neighbourhood of York, and throughout other parts of the North Riding; and being manufactured in the city of York, is afterwards sold under the name of Durham mustard. Two quarters an acre are reckoned a good crop. Mustard is of considerable importance in the materia medica, and is extensively used as a condiment. It was not, however, known in its present form, at our tables, till 1720. The seed had previously been merely pounded in a mortar, and in that rude state separated from the integuments, and prepared for use. But at the period referred to, it occurred to a woman, of the name of Clements, residing in Durham, to grind the seed in a mill, and to treat the meal in the same way that flour is treated. Her mustard was, in consequence, very superior; and being approved by George I., speedily came into general use. Mrs. Clements kept her secret for a considerable time, and acquired a competent fortune. In Bengal, and other eastern countries, mustard is extensively cultivated, as rape is in Europe, for the purpose of yielding oil." (Bailey's *Survey of Durham*, p. 147.; Loudon's *Encyclopædia of Agriculture.*)

Fig. 39.



Fragment of the *outer* membrane of the seed of WHITE MUSTARD. Drawn with the Camera Lucida, and magnified 220 diameters.

The subjoined particulars, in reference to the manufacture of mustard, as furnished by a manufacturer, are given by Pereira:—

"The seeds of both black and white mustard are first crushed between rollers, and then pounded in mortars. The pounded seeds are then sifted. The residue in the sieve is called *dressings*, or *siftings;* what passes through is *impure flour of mustard.* The latter, by a second sifting, yields *pure flour of mustard,* and a second quantity of dressings. By pressure, the dressings yield a fixed oil, which is used for mixing with rape and other oils."

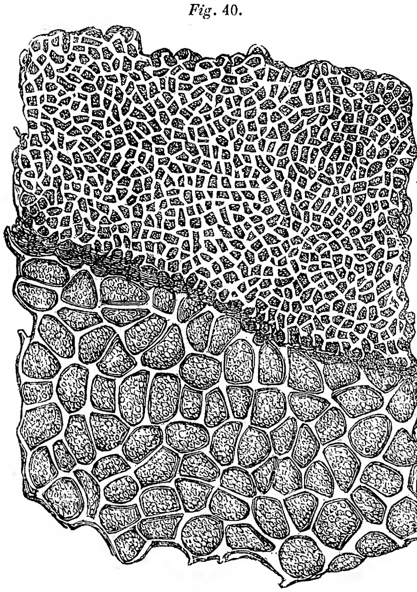
STRUCTURE OF MUSTARD-SEED.

Every entire seed consists of two parts, the husk and the seed proper.

The husk of white mustard-seed is constituted of three distinct membranes.

The *outer* membrane is transparent, and mucilaginous; it consists of a layer formed of two different kinds of cells of large size and very peculiar structure; those of the first kind are of an hexagonal figure, and united by their edges so as to form a distinct membrane, the centre of each cell being perforated; the cells of the second kind occupy the apertures which exist in the previously described cells, and they are themselves traversed by a somewhat funnel-shaped tube, which appears to terminate on the surface of the seed: immersed in water, these cells swell up to several times their original volume, occasion the rupture of the hexagonal cells, and become themselves much wrinkled or corrugated, the extremity of the tubes in some cases being seen protruding from the proximate termination of the cells.

Fig. 40.



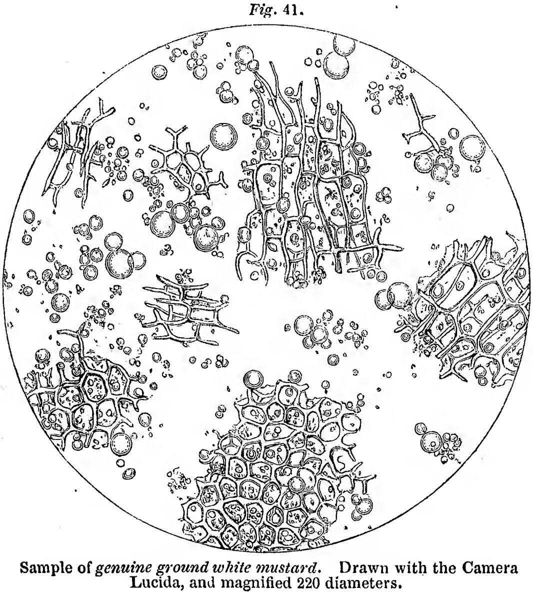
Fragments of the *middle* and *inner* tunics of the mustard-seed, the former covering and lying upon a part of the latter.
A. Portion of the middle tunic. Drawn with the Camera Lucida, and magnified 220 diameters.
B. A fragment of the *inner* tunic, showing the structure of that membrane. Drawn with the Camera Lucida, and magnified 220 diameters.

It has been noticed that when white mustard-seeds are digested in water, a thick mucilaginous liquid is obtained: the source of the mucilage does not appear to have been pointed out; it is certainly, however, derived from the cells forming the tissue above described.

The *middle* tunic consists of a single layer of very minute cells, of an angular form; it is in the cavities of these that the chief part of the colouring matter possessed by the husk is seated.

The *inner* membrane also consists of a single layer of angular cells, which, however, are several times larger than those constituting the middle tunic.

Fig. 41.



Sample of *genuine ground white mustard*. Drawn with the Camera Lucida, and magnified 220 diameters.

The *seed* itself is of a bright yellow colour, and of a soft, waxy consistence, which arises from the quantity of oil it contains; it consists of innumerable very minute cells, in the cavities of which the oil and other active principles are contained.

Notwithstanding the terms "flour" and "farina" of mustard commonly employed, ripe mustard-seed does not contain a single starch granule, as may be ascertained by means of iodine and the microscope.

In black mustard-seed, the outer membrane consists only of the large hexagonal transparent cells disposed in two or three layers, these not being perforated in the centre like those of white mustard; in other respects the structures resemble those of white mustard-seed.

Adulterations of Mustard.

We find the celebrated author of "Death in the Pot," in the year 1820, publishing the following observations in reference to the adulteration of mustard:—

"Genuine mustard, either in powder, or in the state of a paste, ready for use, is perhaps rarely to be met with in the shops. The article sold under the name of *patent mustard* is usually a mixture of mustard and common wheaten flour, with a portion of cayenne pepper, and a large quantity of bay-salt, made with water into a paste, ready for use. Some manufacturers adulterate their mustard with radish-seed and pease-flour.

"It has often been stated that a fine yellow colour is given to mustard by means of turmeric. We doubt the truth of this assertion. The presence of the minutest quantity of turmeric may instantly be detected by adding to the mustard a few drops of a solution of potash, or any other alkali, which changes the bright-yellow colour to a brown or deep orange tint.

"Two ounces and a half of cayenne pepper, a pound and a half of bay-salt, eight pounds of mustard-flour, and a pound and a half of wheaten flour, made into a stiff paste, with the requisite quantity of water, in which the bay-salt is previously dissolved, forms the *patent mustard* sold in pots. The salt and cayenne-pepper contribute materially to the keeping of ready-made mustard."

Professor Brande*, in 1839, writes—

"The bright-yellow powder, sold under the name of *flour of mustard*, and used at the table, is a compound of powdered black and pale mustard-seed, cayenne pepper, wheat-flour, and turmeric."

Dr. Ure, in his "Dictionary," published in 1844, describes two receipts for the manufacture and adulteration of mustard.

"M. Lenormand gives the following prescription for preparing mustard for the table:—

"With two pounds of very fine flour of mustard mix half an ounce of each of the following plants:—Parsley, chervil, celery, and tarragon, along with a clove of garlic, and twelve salt anchovies, all well minced. The whole is to be triturated with the flour of mustard till the mixture becomes uniform. A little grape-must, or sugar, is to be added, to give the requisite sweetness; then one ounce of salt, with sufficient water to form a thinnish paste by rubbing in a mortar. With this paste, the mustard-pots being nearly filled, a red-hot poker is to be thrust down into the contents of each, which removes (it is said) some of the acrimony of the mustard, and evaporates a little water, so as to make room for pouring a little vinegar upon the surface of the paste. Such table mustard not only keeps perfectly well, but improves with age."

"The mode of preparing table mustard patented by M. Soyer, consisted in steeping mustard-seed in twice its bulk of weak wood vinegar for eight days, then grinding the whole into a paste in a mill, putting it into pots, and thrusting a red-hot poker into each of them."

According to Mitchell: "The substances employed in the adulteration of this condiment are not generally injurious to health, they only weaken the strength of the material. Pea-flour, ordinary flour, and linseed-cake, ground very fine, with turmeric powder as a colouring matter, are the bodies used in weakening the usual pungency of mustard. The mineral substances are, yellow ochre, and, as I have been informed, chromate of lead in small quantities, to give a bright yellow to mustard that has had much coloured vegetable matter, as linseed-meal, added to it. I have never found chromate of lead in any sample I have examined, although I am assured that it is occasionally employed.

"The best method of detecting pea-flour, ordinary flour, linseed-meal, &c., is, to take a given weight of mustard-seed and pulverise it finely, add to it ten times its weight of water, and mix well together. Take the same quantity of the mustard to be examined, and add to it the same amount of water as before (ten times its own weight). It will now most likely happen that the mixture of water and powdered mustard-seed will have a much more pungent

* Dictionary of Materia Medica and Pharmacy.

taste than the other; if so, water is to be added, until both taste alike; from the quantity of water added, the probable amount of adulteration may be approximately obtained. This is, however, not an absolutely decisive test, but it is the only one with which I am at present acquainted, that is readily performed."

It is really marvellous that any persons writing in the present day on the falsification of food should have so overlooked the application of the microscope to the detection of adulteration, as have Messrs. Mitchell and Normandy, the two most recent English writers on the subject. The method pointed out by Mr. Mitchell for the detection of the admixture of pea-flour, linseed-meal, wheat-flour, &c., is extremely puerile.

According to Pereira, "*The common flour of mustard* of the shops is adulterated with flour (wheaten), coloured by turmeric and rendered hot by pod pepper."

Normandy, in his "Hand-book of Chemical Analysis," does not notice mustard or its adulterations at all.

Adulteration with Radish-seed.—It has been stated that radish-seed is sometimes employed in the adulteration of mustard; this we are disposed to doubt, for the retail price of radish-seed, usually a shilling a quart, renders it much too dear for this purpose.

In structure, radish-seed resembles very closely black mustard-seed; two of the membranes and the substance of the seed itself are very similar, so that, if used, it would be extremely difficult to detect.

Adulteration with Rape-seed.—Rape, unlike radish-seed, is very cheap, and it is therefore possible, that in some cases it may be used to adulterate mustard; we do not, however, think that it is so frequently; because an article not less cheap is commonly employed, which probably better answers the purpose.

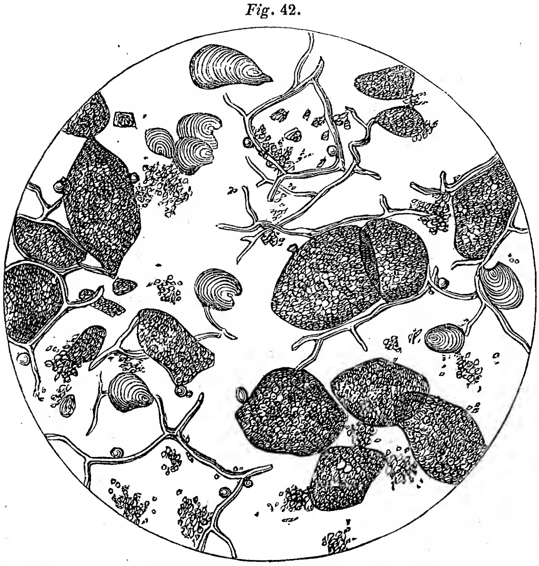
Rape also resembles black mustard-seed very closely in structure.

Adulteration with Wheaten Flour.—The characters of wheaten flour have been already more than once partially described; in our next Report, these characters will be considered more fully, and an engraving given illustrative of its structure.

Immense quantities of wheaten flour are employed in the adulteration of mustard, and many samples almost entirely consist of it.

It has been stated that pea-flour is sometimes used: out of fifty samples of mustard which we have submitted to examination, we have not met with a single instance of adulteration with any other farina than wheaten flour.

Fig. 42.



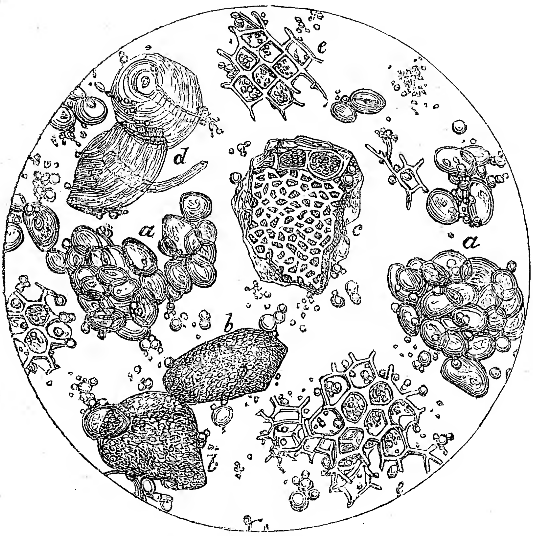
This engraving represents the appearance and characters of *genuine ground* TURMERIC. Drawn with the Camera Lucida, and magnified 220 diameters.

Adulteration with Turmeric Powder.—Turmeric powder is the ground tuber of *Curcuma longa*, one of the *Zingiberaceæ*: it is of a dark yellow colour, and consists of large cells; some of these are loosely imbedded in a reticular tissue, but others, and these the majority, are quite free: they may be recognised with facility, under the microscope, by their size and bright yellow colour.

When crushed, each cell is found to contain colouring matter, as well as a number of starch granules, resembling closely those of Curcuma arrowroot, already described and figured.

On the application of iodine the cells become of a deep-blue, and with potash, of a reddish colour.

Fig. 43.



This engraving represents the articles detected in a sample of "*double superfine* MUSTARD," marked with the names of Messrs. J. & J. Colman: *a a*, *wheaten flour*; *b b*, cells of *turmeric powder*; *c*, portion of *husk of black mustard*; *d*, cells of outer tunic of *white mustard-seed*; *e e*, fragments of the *seed* itself.

Although we have examined a large number of samples of mustard, in no instance have we found turmeric powder to be absent.

By some means or other—probably by moisture and heat—the turmeric powder is made to part with a portion of its colouring-matter to the flour which enters so largely into the composition of the mustard of the shops.

Adulteration with Pod or Capsicum Pepper.—It is stated that pod-pepper is commonly present in mustard: we have diligently searched for it, but have not hitherto detected it in any sample.

Before proceeding to give the results of the examination of samples of mustard, we wish to direct the attention of the reader to the accompanying figure.

RESULTS OF THE MICROSCOPICAL EXAMINATION OF FORTY-TWO SAMPLES OF MUSTARD, OBTAINED AT THE ESTABLISHMENTS OF DIFFERENT GROCERS RESIDENT IN THE METROPOLIS.

Four qualities of mustard are supplied by the manufacturer.

The first is called "seconds:" it is usually of a bright yellow colour, but is thickly studded over with numerous black or reddish-black points: these are fragments of the husks of black mustard-seed.

The next quality is termed "fine:" it also presents a considerable number of black specks, but fewer than in the former case.

The third quality is called "superfine:" it is spotted to a much less extent, although minute specks are still visible.

The fourth, or best quality, is the "double-superfine:" in this the eye can scarcely detect husk at all, although, with the microscope, a little may still be discovered.

These several qualities are vended to the public by a wholesale and retail establishment in the City at the following rates: "seconds," 5*d.*; "fine," 8*d.*; "superfine," 11*d.*; "double-superfine," 1*s.* 2*d.*, per lb.

The qualities of the following samples varied much—from "seconds" to "double-superfine."

The price also varied greatly—from 1*s.* to 2*s.* the pound; the ordinary charge made being 1*s.* and 1*s.* 4*d.* the pound.

1*st Sample.*—Purchased in Oxford-street, price 1*s.* 4*d.* per lb.

Adulterated—possessing but little pungency, consisting chiefly of *wheaten flour*, coloured with *turmeric*, and containing numerous fragments of the husk of both white and black mustard-seed.

2*nd Sample.*—Purchased in Edgware-road, price 1*s.* 4*d.* per lb.

Adulterated—possessing but little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing only a small quantity of husk.

3*rd Sample.*—Purchased in High-street, Bloomsbury, price 1*s.* per lb.

Adulterated—possessing scarcely any pungency, about equal to "seconds" in quality and appearance, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a considerable quantity of husk of black mustard-seed.

4*th Sample.*—Purchased in New Church-street, Edgware-road, price 1*s*. 4*d*. per lb.

Adulterated—possessing but little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing much husk of white and a little of black mustard-seed.

5*th Sample.*—Purchased in James-street, Lisson-grove, price 1*s*. per lb.

Adulterated—possessing but little pungency, about equal to "seconds," consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a considerable quantity of husk of both white and black mustard-seed.

6*th Sample.*—Purchased in James-street, Edgware-road, price 1*s*. 4*d*. per lb.

Adulterated—possessing much more pungency, but still consisting principally of *wheaten flour*, coloured with *turmeric*.

7*th Sample.*—Purchased in Tottenham-court-road, price 1*s*. per lb.

Adulterated—possessing but little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing much husk of both white and black mustard-seed.

8*th Sample.*—Purchased in Tottenham-court-road, price 1*s*. per lb.

Adulterated—possessing but very little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a moderate quantity of husk.

9*th Sample.*—Purchased in Goodge-street, Tottenham-court-road, price 1*s*. per lb.

Adulterated—possessing but very little pungency, and about equal to "seconds" in quality, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing rather much husk of black and a little only of white mustard-seed.

10*th Sample.*—Purchased in Tottenham-court-road, price 1*s*. per lb.

Adulterated—possessing extremely little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a moderate quantity of husk of black and only a small quantity of husk of white mustard-seed.

11*th Sample.*—Purchased in Chapel-street, Somers-town, price 1*s*. per lb.

Adulterated—possessing extremely little pungency, consisting principally of *wheaten flour*, coloured with *turmeric*, and much husk of black mustard-seed.

12*th Sample.*—Purchased in Skinner-street, Somers-town, price 1*s*. per lb.

Adulterated—possessing rather more pungency than usual, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a moderate quantity of husk of both white and black mustard-seed.

13*th Sample.*—Purchased in Skinner-street, Somers-town, price 1*s*. 4*d*. per lb.

Adulterated—possessing extremely little pungency, consisting chiefly of *wheaten flour*, coloured with *turmeric*, and containing husk of both white and black mustard-seed, and most of the former.

14*th Sample.*—Purchased in Brewer-street, Somers-town, price 2*s*. per lb.

Adulterated—possessing rather more pungency than usual, but consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a small quantity of husk only.

15*th Sample.*—Purchased in High-street, Whitechapel, price 1*s*. per lb.

Adulterated—possessing rather more pungency than usual, consisting principally of *wheaten flour*, highly coloured with *turmeric*, and containing a moderate quantity of husk.

16*th Sample.*—Purchased in Drury-lane, price 1*s*. 6*d*. per lb.

Adulterated—possessing but little pungency, although rather more than usual, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a considerable quantity of husk of both black and white mustard-seed.

17*th Sample.*—Purchased in Lower-marsh, Lambeth, price 1*s*. 4*d*. per lb.

Adulterated—consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a considerable quantity of husk.

18*th Sample.* — Purchased in Westminster-road, price 2*s.* per lb.
Adulterated — possessing more pungency than ordinary, consisting principally of *wheaten flour*, coloured with *turmeric*, and not containing much husk.

19*th Sample.* — Purchased in Lower-marsh, Lambeth, price 1*s.* 4*d.* per lb.
Adulterated — possessing rather more pungency than usual, consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a considerable quantity of husk.

20*th Sample.* — Purchased in Clare-market, price 1*s.* 4*d.* per lb.
Adulterated — consisting principally of *wheaten flour*, coloured with *turmeric*, and containing a moderate quantity of husk of both black and white mustard-seed.

The following samples were contained in packages put up in tin-foil, and had upon them either the names of the manufacturer or grocer by whom they were sold. We refrain from giving the names of the grocers from whom the samples were purchased, because the manufacturers are almost invariably the parties by whom the adulterations are practised, and therefore the chief responsibility rests with them.

21*st Sample.* — Purchased in the Strand.

"Extra-superfine Durham Mustard."
Warranted of the best quality, 1*s.* 6*d.* per lb.

Adulterated — colour brownish; possessed of considerable pungency; containing a large proportion of *wheaten flour*, and a small quantity of *turmeric* only; but little husk visible.

22*nd Sample.* — Purchased in Castle-street, Oxford-street, price 1*s.* 8*d.* per lb. Labelled thus: —

"GRIMSDALE'S
Genuine Superfine
Mustard."

Adulterated — pungency not great; containing a very large proportion of *wheaten flour;* highly coloured with *turmeric* powder; but little husk visible.

23*rd Sample.* — Purchased on Ludgate-hill, price 1*s.* 6*d.* per lb. Labelled thus: —

"Finest Durham Mustard."

Adulterated — possessing more than ordinary pungency; containing a very large proportion of *wheaten flour;* coloured with *turmeric;* but little husk visible.

24*th Sample.* — Purchased in Oxford-street, price 1*s.* 8*d.* per lb. Labelled as the last —

"Finest Durham Mustard."

Adulterated — possessing more than usual pungency; containing a very large proportion of *wheaten flour;* coloured with *turmeric;* but little husk visible.

25*th Sample.* — Purchased in Oxford-street, price 1*s.* 4*d.* per lb. Labelled —

"Fine Durham
Mustard."

Adulterated — possessing considerable pungency; containing a very large proportion of *wheaten flour;* coloured with *turmeric;* with but little husk.

26*th Sample.* — Purchased in Drury-lane, price 1*s.* 4*d.* per lb. Labelled —

"Double Superfine
Durham Mustard."

Adulterated — possessing but little pungency; consisting principally of *wheaten flour;* highly coloured with *turmeric*, and containing much husk.

The parties named below are MANUFACTURERS OF MUSTARD. Many of the samples were obtained from casks branded with the following names, and also with letters indicating the qualities.

27*th*, 28*th*, 29*th*, and 30*th Samples.* — FINCH & Co.

A sample of each of the four qualities made was submitted to examination. *All were adulterated.* The samples named "seconds" and "fine" possessed but little pungency, consisted principally of *wheaten flour*, coloured with *turmeric*, and contained much husk. The samples marked "superfine" and "double superfine" possessed considerable pungency, but still contained a very large proportion of *wheaten flour* and *turmeric*, with much less husk visible.

31*st*, 32*nd*, 33*rd*, and 34*th Samples.*—J. & J. Colman.

A sample of each of the four qualities made was submitted to examination. *All were adulterated*—with *wheaten flour*, coloured with *turmeric*, nearly in the same manner, and to the same extent, as in the former case.

35*th*, 36*th*, 37*th*, and 38*th Samples.*—Keens & Welch.

A sample of each of the four qualities made was submitted to examination. *All were adulterated*—in the same manner, and as nearly as possible to the same extent.

39*th* and 40*th Samples.*—Slee.

Two samples, "seconds" and "fine," examined. *Both adulterated*—in the same manner, and to the same extent, as the corresponding samples of the manufacturers previously named.

41*st Sample.*—Gaby & Wells.

One sample about equal to "superfine" examined. *Adulterated*—with a very large proportion of *wheaten flour*, highly coloured with *turmeric*, and not containing very much husk.

42*nd Sample.*—Grimsdale & Co.

One sample about equal to "superfine" examined. *Adulterated*—with a very large proportion of *wheaten flour*, coloured with *turmeric*.

We have now shown—

1st. That *genuine mustard*, whatever be the price paid for it, *is scarcely ever to be obtained.*

2nd. That *the whole of the forty-two samples* submitted to examination *were adulterated.*

3rd. That *the adulteration* practised, *in every case, was the same in kind, varying only in degree, and consisted in the admixture of genuine mustard with immense quantities of wheaten flour, highly coloured with turmeric.*

The mustards of the following manufacturers, Messrs. Finch & Co., J. &. J. Colman, Keens & Welch, and Slee, were analysed for chromate of lead, but in no instance was that poisonous mineral colouring matter discovered. The ash furnished by these mustards was found to vary from 4·0 to 5·8 per cent.

The practice of making inferior qualities of mustard, such as "seconds" and "fine" mustard, is open to much objection, since it gives the unscrupulous grocer the greatest scope for imposition. The poor man buys his mustard by the ounce, and for this he usually pays one penny, receiving so much "seconds," "fine," or "superfine" mustard, as the case may be, according to the conscience of the vendor. As we have seen, "seconds" may be sold retail, and realise a profit, at fivepence per pound; "fine" at eight pence, and "superfine" at eleven pence per pound. We are now, then, in a position to judge of the extent to which the poor man is frequently defrauded in the article "mustard."

The following short correspondence will be read with interest as showing the power of the microscope in the detection of adulteration.

THE ANALYTICAL SANITARY COMMISSION.

MUSTARD.

To the Editor of The Lancet.

Sir,—I noticed in a late number of The Lancet, a statement that genuine mustard was not to be obtained in London, and have found such to be the case. I have been a manufacturer of mustard for twenty years, and during that time have frequently attempted to introduce it to the London trade, but could never succeed. The London mustard is principally made from the white mustard-seed, with the addition of the ingredients mentioned in your analysis. The description of mustard I manufacture is from the *brown* seed (*Sinapis nigra*), of which I take the liberty of sending you a sample. You will find it quite free from the adulterations found in the London mustards. The reason why I could never get it into the London market is, the difference of colour—it being much darker than that made from the white seed; and the brown seed being much dearer and less productive, I have to charge a higher price for it.

I am, Sir, yours obediently,
THOS. DEWAR.

Newcastle-on-Tyne, March 31. 1851.

*** Our correspondent is deceived; the article he has sent to us is not a specimen of pure brown mustard, as it contains a small quantity of turmeric.—ED. L.

We cannot conclude the Report without calling attention to the following communication. The testimony which it affords as to the extraordinary accuracy of the analytical examinations of our Commission is strikingly conclusive. It now appears that the quantity of turmeric discovered consisted of only *one part in* 448 of the quantity examined. The candid communication made by Mr. Dewar is highly creditable, and the new specimen he has forwarded shall be subjected to an early scrutiny.—ED. L.

To the Editor of THE LANCET.

SIR,—In my letter to you of the 31st ult., respecting my mustard, I stated you would find it free from the adulterations found in the London mustards, which I contend it is, except as you observe, "a small portion of turmeric,"—viz., *two ounces to fifty-six pounds* of seed, not for the purpose of gain or adulteration, but simply to enliven the colour, and make its appearance more acceptable. However, your remarks have determined me to relinquish that small portion of extraneous matter, and depend solely on its original colour and strength for its future success.

I am, Sir, yours obediently,
THOMAS DEWAR.

Enclosed is a sample without colouring.
Newcastle-on-Tyne, April, 1851.

BREAD, AND ITS ADULTERATIONS.

BEFORE proceeding to ascertain the adulterations to which bread is subject, it is proper to take into consideration a variety of particulars in relation to the chief constituent of bread—viz., FLOUR.

As there are several kinds of bread, so will it be necessary to speak of several kinds of flour.

While there are important distinctions to be noticed between each of the flours employed in the manufacture of bread, there are also certain points of resemblance.

Thus every flour used in the preparation of bread consists of *nitrogenised* and *non-nitrogenised* elements or constituents: the former are vegetable fibrin, albumen, caseine, &c., which have been named after the corresponding proteine compounds existing in animal substances; the latter are starch, dextrine or gum, and sugar—products more particularly of the vegetable kingdom.

WHEAT-FLOUR.

There are several distinct species of wheat: that which is chiefly cultivated in this country is the *Triticum vulgare;* of this there are two varieties—*T. æstivum*, or summer wheat; and *T. hybernum*, or winter wheat: the former is sown in the spring, and the latter in the autumn. Of these varieties, again, there are several different modifications, into the description of which it is, however, not necessary to enter on the present occasion.

Wheat-seeds or grains, as brought to the market, and as supplied to the miller, are deprived of their *paleæ*, or husks, which, when coarsely ground, form the articles known as bran and pollard.

The number of parts into which ground wheat is separated, and the amount of each yielded by given quantities, vary according to the characters of the wheat, and the processes adopted by different millers.

In wheats which are hard, the integuments separate with difficulty, and therefore the flour produced from these usually contains a greater proportion of adherent bran than do those flours procured from wheats which are soft, and which part with their epidermic coverings more readily.

According to Mr. Hard, a miller of Dartford, in Kent, the following are the products, with the quantities obtained, of one quarter, or eight bushels of ground wheat:—

"*Produce of One Quarter of Wheat, weighing* 504 *lbs.*

Flour - - - - -	392 lbs.
Biscuit, or fine middlings - - -	10 ,,
Toppings, or specks - - - -	8 ,,
Best pollard, Turkey pollard, or twenty-penny -	15 ,,
Fine pollard - - - -	18 ,,
Bran and coarse pollard - - -	50 ,,
Loss sustained by evaporation, and waste in grinding, dressing, &c. - - - -	11 ,,
	504 lbs."

As it is frequently a matter of much importance to determine the composition of samples of wheat flour, we will now describe the various steps by which the analysis may be effected.

A weighed quantity of flour is to be made into a paste, and well kneaded, either on a sieve or in a piece of muslin, water being poured over it until it ceases to acquire a milky colour; the water carries away the starch, and dissolves out the albumen, sugar, gum, and salts, while the mass left on the filter consists of "crude gluten."

This *crude gluten* is itself, however, compounded of no less than four distinct substances—viz., gluten, vegetable fibrine, a very small quantity of mucine or caseine, and oil, in the following proportions:

Gluten - - - -	20
Vegetable fibrine - - -	72
Mucine (caseine ?) - -	4
Oil - - - -	3·7
Starch (accidental) - -	a small quantity.
Crude gluten - -	99·7

Gluten.—This substance is obtained by boiling crude gluten in alcohol, which extracts the gluten, caseine or mucine, and the oil. The caseine is deposited on cooling, and after separation the residual liquid is evaporated until an adhesive mass is obtained, from which the oil is extracted by ether, and gluten alone remains.

Vegetable Fibrine.—This is insoluble in alcohol, and forms the chief part of the crude gluten; it is left nearly in a pure state after the action of that re-agent. It much resembles in its composition muscular fibre.

For the other constituents of wheaten flour we must search in the water, which has passed through the sieve.

Starch.—The starch, after remaining suspended for a time in the water, subsides, forming a precipitate; this may be readily obtained, and, after drying, its amount determined by weighing.

Vegetable Albumen.—This substance is procured by boiling the water, whereby the albumen is coagulated, and forms shreds or flakes, which rise to the surface, where they collect as a pellicle.

Caseine.—After the separation of the albumen, a little acetic acid is to be added, which throws down the caseine. The mucine (or caseine ?) present in crude gluten is soluble in alcohol, from which, on cooling, it is thrown down in the form of white flocculi.

Oil.—The greater part of the oil is present in the outer part of the grain, from which it follows that the bran contains a larger proportion of oil than the central part of the grain. It is best obtained by digesting whole or bruised wheat in ether. When wheat paste is washed in water, part of the oil passes away with it, and part remains in the crude gluten.

Sugar.—The sugar present in wheaten flour is of the kind denominated *glucose;* its amount is determined by evaporating the water to dryness, and dissolving the sugar out of the residue by means of alcohol, which being in its turn evaporated, the sugar is deposited in a granular or semi-crystallised state, and may be collected and weighed.

Gum.—The remaining part of the residue of the evaporated water consists of gum or dextrine, insoluble in alcohol; this also should be dried and weighed.

Water.—The quantity of water present in wheat, on an average, varies from fifteen to seventeen per cent., and is greater in new than in old wheat, and it is this circumstance which makes the former of less value than the latter.

Mineral and Saline Constituents.—The more important of these are silicate of potash and the alkaline and earthy phosphates, which are present in considerable amount. For ordinary purposes it is not necessary to make so precise an analysis as that indicated above; it will be sufficient to ascertain the amount of crude gluten present in a given quantity of flour.

To determine the quantity of this gluten, a little instrument has been invented by Mr. Boland, termed an "*aleurometer*."

Of this instrument the following description is given by Mr. Mitchell*:

"It consists of a hollow copper cylinder, about six inches long, and from three-quarters of an inch to an inch in diameter. It has two principal parts; the one, about two inches long, is closed at one end, forming a kind of cup capable of containing about 210 grains of fresh gluten; it screws into the remainder of the cylinder. The cylinder being charged with gluten, is heated to about 420° in an oil-bath. The gluten by this treatment swells, and according to its rise in the tube (which may be measured by a graduated stem) so is its quality. Good flours furnish a gluten which augments to four or five times its original bulk; but bad flours give a gluten which does not swell, becomes viscous and nearly fluid, adhering to the sides of the tube, and giving off occasionally a disagreeable odour, whilst that of good flour merely suggests the smell of hot bread."

The proceeding adopted by the corn-chandler and the baker for the determination of the quality of wheaten flour is still more simple.

A small quantity (a few grains is sufficient) is made into a paste with water, and its quality judged of by the tenacity of the dough, the length to which it may be drawn into a thread, or the extent to which it may be spread out into a thin sheet.

The following analyses by Dumas show the composition of 100 parts of wheat flour:—

Wheat Flour.		Odessa Flour (Flinty).		Odessa Flour (Soft).	
Water	10·00	Water	12·00	Water	10·00
Gluten	10·96	Gluten	14·55	Gluten	12·00
Starch	71·49	Starch	56·50	Starch	62·00
Sugar	4·72	Sugar	8·48	Sugar	7·36
Dextrine	3·32	Dextrine	4·90	Dextrine	5·81
		Bran	2·30	Bran	1·29
	100·49		98·73		98·46

Wheaten flour contains a greater amount of proteine or nitrogenised compounds—that is, of blood and flesh making principles—than any other description of farina.

Characters of the Starch of Wheat.

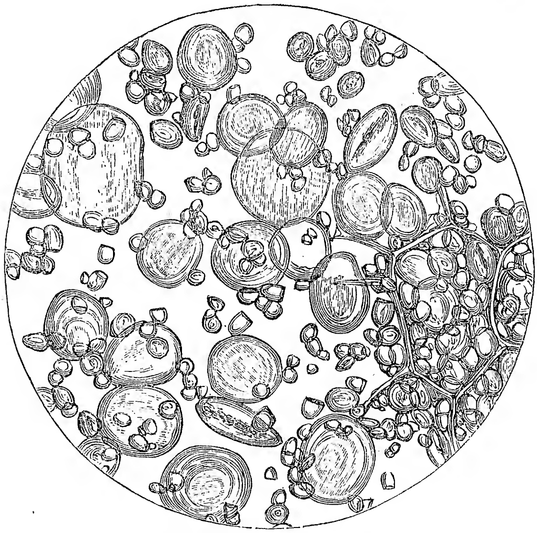
Starch, almost constantly occurs, in the vegetable kingdom, in the form of organised corpuscles: the characters of these frequently vary greatly in different plants; these differences being often so considerable as, by the aid of the

* Treatise on the Falsification of Food, p. 48.

microscope, to afford information of a highly valuable character, and to allow of the observer distinguishing many different farinas from each other.

Viewed with an object-glass magnifying 420 diameters linear, wheat-starch is observed to consist of definite grains or particles; many of these are very small, others are of considerable dimensions, while there are but few of intermediate sizes: the small grains are chiefly round, rarely oval, or muller-shaped, and for the most part provided with a central spot or hilum: the larger granules form rounded or flattened discs, with thin edges. Neither hilum nor concentric rings are in general perceptible on the larger discs, although in some few a central tubercle may be seen as well as indistinct annuli. Occasionally some of the larger granules are more or less misshapen, and present the appearance of a longitudinal furrow, which has been erroneously described as a hilum: this appearance is, however, deceptive; it is really occasioned by the partial folding or curling of the grain on itself, whereby a central depression is produced, the corpuscle at the same time being viewed obliquely. We have frequently seen grains which when stationary presented a round and disc-like appearance, but which, in rolling over and presenting the edges to view, exhibited the longitudinal furrow described, an observation which clearly proves its nature. A few granules attain a very considerable size; these are less regularly circular, and being much flattened, reflect but little shadow; sometimes their edges are faintly marked with radiating lines. Many of the above described particulars, as also the characters of the cellulose, are well exhibited in the figure.

Fig. 44.



This engraving represents the structure and appearances of the starch granules of WHEAT FLOUR, as also the characters of the *cellulose*. Drawn with the Camera Lucida, and magnified 420 diameters.

BARLEY-FLOUR.

There are several distinct species of barley, that, however, which is commonly cultivated in this country is the *Hordeum distichon*, or two-eared barley.

As met with in commerce the seeds or grains are usually enclosed in the *paleæ* or husks; denuded of these they form "*Scotch* or *pot barley*," when rounded they constitute "*pearl barley*," and this again reduced to powder is called "*patent barley*."

The analysis of barley-flour must be conducted very much in the same manner as that of wheat-flour.

The proportion of azotised compounds in barley is less than in wheat-flour; it is deficient particularly in crude gluten, so that barley-paste may be nearly all washed away in water.

The milky fluid obtained by washing barley-paste, deposits, as well as the starch, a proteine matter supposed to be *insoluble caseine:* if this be digested with a solution of ammonia it is dissolved, but is again thrown down on the addition of acetic acid; the liquid which has deposited the starch and insoluble caseine still holds in solution a small quantity of albumen and some soluble caseine.

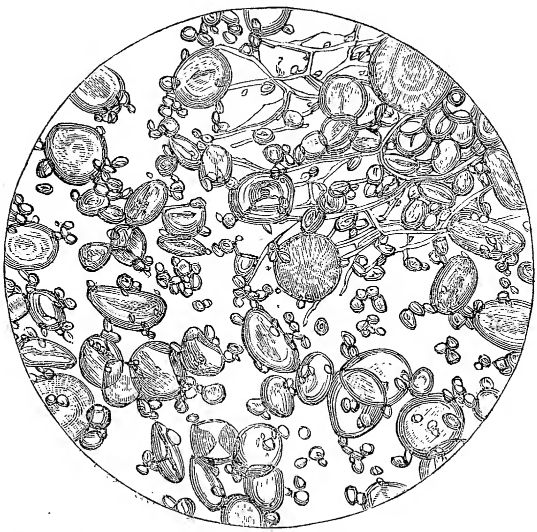
Barley-flour is less nutritive than wheat-flour; its starch corpuscles are less soluble, and therefore resist more the action of the gastric juice; the husk "is slightly acrid;" and it is somewhat laxative.

Characters of the Starch of Barley.

The starch-granules of barley resemble very closely in form and structure those of wheat, so that the description already given applies to some extent to the starch of barley.

Barley-starch consists of small and large grains, with but few of intermediate size; the former, it is to be particularly observed, are three or four times smaller than the corresponding grains of wheat-starch; and of the larger grains many are distinctly ringed, while a much greater proportion of them presents the longitudinal furrow, the nature of which has already been described. These characters are sufficiently well marked to allow of the discrimination by the microscopist of wheat and barley-flour, or starch.

Fig. 45.



This engraving represents the structure and characters of BARLEY-STARCH, together with the *cellulose*. Drawn with the Camera Lucida, and magnified 140 diameters.

Considerable difference is observed between wheat and barley-flour in the action upon them of boiling water and some other reagents: thus, after prolonged boiling, in the case of barley-flour, a substance remains undissolved, which has been denominated "*hordeine*," whereas wheat-flour treated in the same manner is nearly all dissolved.

By the above characters, and particularly by the minuteness of the small grains, barley-starch or meal may be readily and satisfactorily discriminated.

RYE-FLOUR.

The grass from which rye is obtained is the *Secale cereale*.

The seeds or grains resemble those of wheat, but are smaller, and as met with in the market, devoid of husk.

The analysis of rye-flour must be conducted much in the same manner as that of wheat and barley-flour.

Rye-flour is rather less rich in nitrogenised products than wheat-flour, but it contains more sugar; its paste, when repeatedly washed in water, breaks up, and becomes diffused throughout the liquid, the bran only being left behind; the milky liquid, after having deposited the starch, and after the separation of the albumen, is to be evaporated, when the residue will consist of sugar, oil, and the so-called "*soluble gluten*," which may be dissolved out by means of alcohol.

Rye-flour is said to be somewhat laxative.

The roasted grains are not unfrequently employed in the adulteration of coffee.

Characters of the Starch-Corpuscles of Rye.

The starch-granules of rye-flour bear a general resemblance in form and size to those of wheat: there are these remarkable and satisfactory differences, however—viz., that the lesser grains are decidedly smaller than the corresponding grains of wheat, and that many of the larger granules of rye-starch are furnished with a three or four-rayed hilum.

Fig. 46.

This engraving represents the structure and characters of the starch-granules of RYE-FLOUR. Drawn with the Camera Lucida, and magnified 420 diameters.

OAT-FLOUR.

There are several distinct species of oats, that, however, which is chiefly cultivated in this country is *Avena sativa.*

The oat grains or seeds are usually enclosed in their husks; when deprived of these they form what are known as "*groats*," and these crushed constitute "*Embden groats.*"

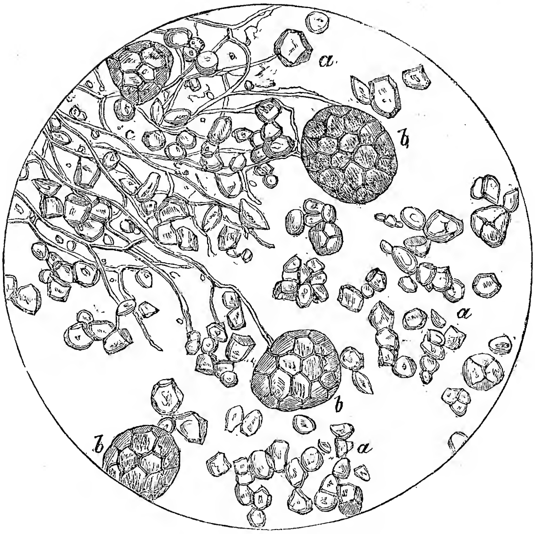
Rye-flour or meal does not form a dough or paste like wheat-flour; notwithstanding which, however, it contains a large amount of nitrogenised matter; this exists principally in the form of "*avenin*," a substance analogous to soluble caseine, and obtained in the same manner, by the addition of acetic acid.

"Oatmeal," Pereira remarks, "is an important and valuable article of food. With the exception of maize or Indian corn it is richer in oily or fatty matter than any other of the cultivated cereal grains; and its proportion of protein compounds exceeds that of the finest English wheaten flour; so that both with respect to its heat and fat-making, and its flesh and blood-making principles, it holds a high rank."

Characters of the Starch-Corpuscles of the Oat.

The starch-granules of the oat present well-marked structural characteristics. They are smaller in size than those of wheat, varying but little in dimensions, are polygonal in figure, without either visible concentric rings or hili, but with central depressions and thickened edges. The great peculiarity of oat-starch, however, is, that many of the grains cohere together, forming bodies of a rounded or oval figure, and presenting a reticulated surface, indicative of their compound structure. These bodies escape readily from the cellulose, and, when oat-flour is diffused through water, may frequently be seen floating about freely in the liquid. A second peculiarity is, that, unlike the other cereal starches, the grains of oat-starch, when viewed with

Fig. 47.

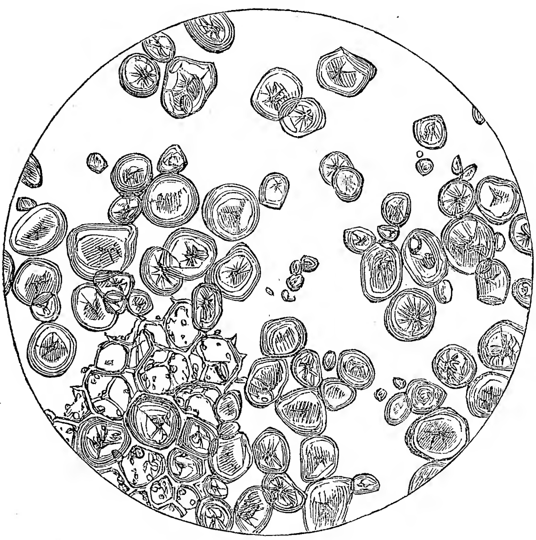


This engraving represents the structure and characters of the starch-corpuscles of OAT-FLOUR, as also of the *cellulose*. Drawn with the Camera Lucida and magnified 420 diameters.

polarised light, do not exhibit the usual crosses. The above particulars are well exhibited in the accompanying engraving.

A figure of oat-starch is given in the new edition of Pereira's "Materia Medica." In this the larger grains are made fully equal in size to those of wheat-starch; whereas they are really several times smaller, as represented in our engraving. This error has probably arisen from the artist having mistaken the compound bodies in question for single granules. The same error pervades some of the measurements given.

Fig. 48.



This engraving represents the structure and characters of the starch-granules of INDIAN-CORN FLOUR, including the *cellulose*. Drawn with the Camera Lucida, and magnified 420 diameters.

INDIAN-CORN FLOUR.

Zea Mays, or Indian corn, is met with in the state of flour, in the shops, under the name of "*Polenta;*" it enters into the dietary of many of our public institutions and charities.

The amount of azotised constituents is less in maize than wheat; it contains, however, a larger quantity of oil, which accounts for its fattening properties.

In those unaccustomed to its use, maize is considered to excite and to keep up a tendency to diarrhœa.

Characters of the Starch-corpuscles of Indian Corn.

The starch-corpuscles of Indian corn bear considerable resemblance to those of the oat; like them, they are polygonal in outline, and present well-marked central depressions, as well as occasionally a divided and radiate hilum; they differ, however, in their much larger size, in not forming compound bodies, and in presenting under the polariscope well-defined crosses. The central depression appears to be a character in common between nearly all the starch-granules of the cereal grasses. This depression, combined with the disc-like form of the grains, gives them a general resemblance to the blood-discs of the mammalia. In those instances in which the grains, as in wheat and barley, are curved upon themselves, the depression exists of course only on one side of the disc.

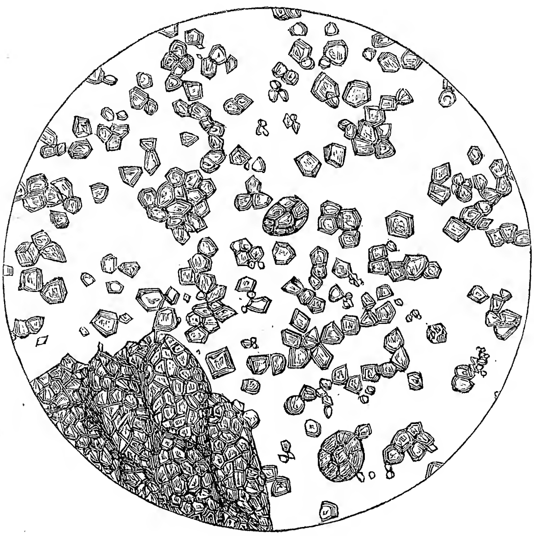
Rice-Flour.

The seeds of rice, *Oryza sativa*, contain a much less proportion of nitrogenised compounds than the other cereal grains, and particularly wheat—viz., about seven per cent.: the quantity of fatty matter is also less.

The substance obtained from rice, termed gluten, is precipitable by acetic acid, and "has a creamy consistence, an agreeable smell, and a bland taste."

Much difference of opinion has prevailed in reference to the value of rice as an article of diet, some persons placing it very high. Analysis, however, clearly proves that it is the least nutritious of the cereal grasses.

Fig. 49.



This engraving represents the starch-corpuscles of Rice-flour. Drawn with the Camera Lucida, and magnified 420 diameters.

This difference of opinion has probably arisen from the fact, that rice is seldom eaten by itself, but is partaken of usually with milk, butter, or sugar, the nutritious properties of which substances have been attributed to the rice itself.

Rice is used as an article of diet in a variety of forms.

Characters of the Starch-corpuscles of Rice.

The starch-corpuscles of rice are small, and for the most part of an angular form, with well-marked central depressions and raised edges; they resemble closely the starch-grains of the oat in their polygonal shape and the occasional occurrence of the compound structures or bodies, but differ in being much smaller.

ON THE ADULTERATIONS OF FLOUR.

We will first cite the statements which have hitherto been advanced in reference to the adulteration of flour by those English authors who have written on the subject of the sophistication of food, and then proceed to ascertain how far these statements are applicable at the present time.

Accum, the earliest great authority on the adulteration of food, although he has devoted a chapter to bread and its adulterations, does not appear to have instituted any particular examinations or analyses of flour.

Dr. Ure, in his Dictionary, under the head "flour of wheat," writes,—

"The first method to detect the adulterations of flour is by specific gravity. If potato-flour be added, which is frequently done in France, since a vessel which contains one pound of wheat-flour, will contain one pound and a half of the fecula, the proportion of this adulteration may be easily estimated. If gypsum or ground bones be mixed with the flour, they will not only increase its density still more; but they will remain after burning away the meal.

"The second method is by ascertaining the quantity of gluten which the suspected sample will afford, by the process prescribed under the article BREAD. The two following chemical criteria may also be employed:—

"1st. Nitric acid has the property of colouring wheat-flour of a fine orange yellow, whereas it affects the colour neither of fecula nor starch.

"2nd. Pure muriatic acid colours good wheat flour of a deep violet, but dissolves fecula or starch, and forms with it a light, colourless, viscid fluid, decomposable by alkalis. It may also be observed, that as fecula absorbs less water than flour, this affords a ready means of detection.

"The adulteration with bean or pea flour may be detected by pouring boiling water upon it, which develops the peculiar smell of these two substances."

Mitchell gives a whole section of his work to the consideration of flour and its adulterations. The substances employed, he writes, in the adulteration of flour, are the following:—"potato-starch (much employed in France), bean, pea, and rye flour, chalk, bone-earth (burnt bones), powdered flints, and plaster of Paris."

On the detection of these adulterations, he offers a variety of observations.

According to Normandy, whose Handbook of Chemical Analyses was published in June, 1850,

"The substances principally employed for the purpose of adulterating wheat-flour, are *potato* or *fecula starch*, *bean-flour*, *Indian-corn flour*, *rye* and *rice-flour*, which alimentary substances are objectionable only when the flour containing them, or the bread made with such flour, is sold as genuine wheat-flour or bread; but besides these so far venial additions, flour is sometimes sophisticated by *alum*, *chalk*, *bone-dust* and *plaster of Paris*, and it is more especially against these that the rigour of the law should be enforced."

"Wheat-flour," states Pereira, also writing in 1850, "is subject to adulteration with various vegetable and mineral substances.

"Among vegetable substances used for the purpose of adulterating wheat-flour, the following have been named:—potato-starch, the meal of other cereal grains (viz., of maize, rice, barley, and rye), of buck-wheat, and of certain leguminous seeds (viz., of beans, peas, and vetch).

"The numerous substances which have been used to adulterate wheat-flour are chiefly chalk and sulphate of lime (plaster of Paris). White clay and bone-ashes are also said to have been used. Sulphate of copper and alum are sometimes added to bad wheat-flour, to improve its quality, and render it more fitted for making bread."

We have thus placed before us a formidable array of articles and substances said to be used in the adulteration of flour. We will now proceed to point out the manner in which the chief of these may be detected.

ON THE DETECTION OF THE ORGANIC ADULTERATIONS OF FLOUR.

On the Detection of Potato-flour.—The starch-granules of the potato have already been described as well as figured in the Report on Arrow-root; they are distinguished from those of wheat-flour described and represented in this Report (*fig.* 44.) by their larger size, ovate form, and the numerous well-marked concentric rings visible on the surface.

For the detection of this adulteration, no other means is requisite than the microscope, and none other is equally simple or certain. It may be mentioned, however, that other methods have been pointed out for the detection of potato-flour.

Thus, a vessel which holds exactly one pound of wheat-flour will contain nearly a pound and a half of potato-starch, and thus by weight and measurement alone the amount of adulteration may to a certain extent be estimated.

The following method, recommended by M. Gay Lussac, is described by Mitchell:—

"Take of the suspected flour about 350 grains, the same quantity of fine sand, and $2\frac{1}{2}$ fluid ounces of water.

"Triturate, in a mortar, the sand and flour, for about five minutes, then gradually add a little of the water, so as to dilute it evenly, and form a homogeneous paste; throw the whole upon a filter, and take about one ounce of the clear liquid, place it in a test glass, and add the same quantity of an aqueous solution of iodine (prepared at the same time by adding a small quantity of iodine to some water).

"If a comparative experiment be made on pure flour, and a flour adulterated with only ten per cent. of starch, it will be seen that, firstly, the water filtered from the pure flour will have a rose tint, approaching to a red; secondly, the solution proceeeding from the adulterated flour will have a deep violent tint, which will disappear much more slowly than the rose tinge of the pure flour.

"If these liquids be examined from time to time, it will be seen, that the tint taken by the water from the pure flour becomes lighter at first at the bottom of the vessel, and disappears altogether in eight or ten minutes; and a similar effect is produced by the tinge of the water from the adulterated flour, but it disappears less rapidly, and the violet colour remains a long time at the surface of the water, and is, so to speak, divided into two distinct portions, the one white and the other coloured."

This method is needlessly tedious, and its indications not very satisfactory. The trituration with sand ruptures many of the starch-granules of the potato, on account of their large size, and thus they are rendered more susceptible of the action of iodine.

On the Detection of Bean, Pea, or other Flour of Leguminous Seeds.— The starch-granules of the majority of the *Leguminosæ* present exceedingly well-marked distinctive characters. These have been already partially described, and in a future Report we shall probably give engravings illustrative of the structure and characters of bean, pea flour, &c.

The starch-granules of the bean, pea, &c. are either oval or reniform, with a very obvious longitudinal furrow.

The microscope, therefore, here also affords the readiest and most satisfactory means for the detection of these adulterations.

As, however, other means have been pointed out, it is proper to describe these briefly.

Mitchell states that the adulteration of wheat-flour with beans and peas "may be detected by the peculiar smell evolved when a small quantity of boiling water is poured upon the flour to be examined. If pea-flour be present, the odour of peas will be evolved; if bean-flour, that of beans. Bean-flour also communicates a rose-coloured tinge to bread adulterated with it."

Again: leguminous seeds contain, as is well known, in considerable quantity, a principle called "legumine," which somewhat resembles caseine, being, like it, precipitable by acetic acid. The suspected flour, therefore, should be digested for some hours in water, which should be filtered, and then tested with acetic acid: if a copious precipitate falls, it becomes probable that it is really adulterated with bean-flour. This evidence is not conclusive, however, from the circumstance that wheat itself contains caseine, precipitable by the same reagent.

Another method of distinguishing the flour of two leguminous seeds, the vetch and the common tick-bean, has been pointed out by Donné. "It consists," says Pereira, "in exposing the suspected flour to the successive action of the vapours of nitric acid and ammonia. Wheat-flour, when thus treated, becomes yellow; but the meals of the leguminous seeds just referred to become red; and hence wheat-flour, adulterated with either of them, becomes more or less spotted with red, according to the proportion of the leguminous meal present."

These methods are for the most part superseded by the microscope, the indications afforded by which are so conclusive.

On the Detection of Maize-flour.— The structure and characters of maize-flour have already been described and figured (see *fig.* 48.); they are exceedingly definite and very distinct from those of wheat-flour, so that there could be no difficulty whatever in distinguishing Indian corn when admixed with wheat-flour, &c. by the microscope, which instrument, indeed, affords, in many cases, the only available means of discrimination.

On the Detection of Rye-flour.— Rye-flour, when admixed with any other cereal farina, may likewise be readily detected by means of the structural peculiarities revealed by the microscope. (See *fig.* 46.)

On the Detection of Oat-flour. — The structural peculiarities of oat-flour are very great, and there is no difficulty whatever in ascertaining the admixture of oat-flour with any other farina. (*Fig.* 47.) But for the application of the microscope to investigations of this nature, the greater number of the adulterations to which the food we consume is liable, would entirely escape detection. Important as chemistry is, very many of these sophistications elude the detective powers of that science.

On the Detection of Barley-flour. — The starch-corpuscles of barley resemble very closely those of wheat-flour; nevertheless, it may be readily discriminated by means of the microscope. (*Fig.* 45.)

On the Detection of Rice-flour. — The characters of rice-flour, as we have seen, are so peculiar, that this farina also may be readily distinguished from all others with which it is admixed. The starch-corpuscles are very small, angular in form, and frequently cohere, forming little masses.

On the Detection of the Inorganic Adulterations of Flour.

On the Detection of Carbonate of Lime or Chalk. — In every case in which mineral substances have been admixed with flour, for the purpose of adulteration, the fact of such admixture may be clearly ascertained by means of the microscope; for, mixed up with the starch-corpuscles, there will always be noticed in such cases a certain proportion of unorganised matter in the form of irregular grains and particles; thus, with but little loss of time, the observer is enabled to ascertain, out of a number of samples, those which are thus adulterated, and is saved all the trouble and expense attending the performance of a number of merely experimental and chemical analyses.

The means to be pursued for the detection of chalk are of an exceedingly simple character. A teaspoonful of flour should be placed in a wine-glass containing a little water; a few drops of hydrochloric acid are then to be added, when, if chalk be present, a brisk effervescence, arising from the escape of carbonic acid, will ensue.

The lime may be detected by means of a solution of oxalate of ammonia, when an insoluble white powder, the oxalate of lime, will be found.

On Bone-dust and the Detection of Phosphate of Lime. — For the detection of bone-dust or flour, a knowledge of the normal structure of bone and a microscope are alone necessary. In a sample of flour adulterated with bone-dust, and examined with that instrument, particles and fragments will be visible, in some of which, bone-cells and other structures characteristic of bone will be visible.

This adulteration, it has been alleged, was formerly one which was very frequently practised; of late, however, it is not often had recourse to, partly in consequence of the diminished price of flour, and the increased value of bone-dust as a manure.

The means hitherto adopted for the discovery of bone-dust in flour have been directed principally to the detection of the phosphate of lime, which enters so largely into the composition of bone.

This is best effected by burning the suspected flour in a crucible, and weighing the ash left after incineration; if it form considerably more than one and a half per cent. of the flour so calcined, then it is certain that it is adulterated with some inorganic substance.

If a portion of the ash dissolved in water give with nitrate of silver an abundant precipitate, and if a considerable quantity of lime be detected by means of oxalate of ammonia, the foreign substance is proved to consist of phosphate of lime.

On the Detection of Sulphate of Lime or Plaster of Paris. — A given quantity of the suspected flour should be incinerated in a crucible, and the ash left weighed; if this be in excess, we must employ the tests proper for sulphuric acid and lime — viz., chloride of barium, or nitrate of baryta, and oxalate of ammonia.

Mitchell gives the following directions for the discovery of plaster of Paris in flour: —

"Take a quantity of the flour, act on in the same manner as in the estimation of gluten, and pour the liquid containing the starch (as well as the plaster) into a conical glass. In course of time all will be deposited, leaving a clear liquid; but the plaster, being heavier than the starch, will be deposited first. When the deposition is complete, pour off the water, and place the glass with the deposited starch and plaster in a warm place. The precipitate will dry, and in a short time fall out of the glass; all the plaster will be found at the point of the cone, which is to be separated, and boiled in a solution of carbonate of soda. During the ebullition, the sulphate of lime present will be decomposed, with the formation of an insoluble carbonate of lime and a soluble sulphate of soda.

"If the whole be now thrown on a filter, and solution of chloride of barium added to the filtered solution, a white precipitate of sulphate of barytes will fall (if plaster of Paris be present), which is insoluble in excess of nitric acid. Wash the insoluble residue of carbonate of lime on the filter, and dissolve in a little nitric acid; an effervescence will take place, and lime may be detected in the solution, by means of oxalate of ammonia, which will produce a white precipitate, soluble in excess of nitric acid."

On the Addition of White Clay.—If it be suspected that the flour contain this substance, a given quantity of it should be incinerated, and the ash weighed as before. If the greater part of this ash be soluble in a solution of potash, and if a dense precipitate fall on the addition of ammonia, it consists of the earth in question, *alumina* or the oxide of aluminium.

Directions for the detection of *alum* and *copper*, found chiefly in the manufactured article bread, but sometimes also in the flour, will be given hereafter.

We will now proceed to ascertain, by a number of examinations and analyses of different samples of flour, the extent to which this article is adulterated at the present time.

Results of the Microscopical and Chemical Analyses of Forty-four Samples of Wheaten-Flour, purchased at the Establishments of Different Corn-chandlers and Bakers resident in the Metropolis.

From the numerous statements quoted in the first part of this Report, in reference to the adulteration of flour, it will be expected that the disclosures which we have to make will not be less startling than those already made known in reference to other articles of consumption. This expectation, however, we are happy to announce, will not be realised.

Forty-four samples of wheat-flour have been submitted to analysis, including several of both *French* and *American* flour.

The samples were first subjected to *microscopical examination.*

In no instance was any other farina than wheat-flour observed, nor was the presence of foreign matters of any kind detected.

They were next subjected to *chemical examination.*

A portion of each was tested for chalk or carbonate of lime: *in none was this substance detected.*

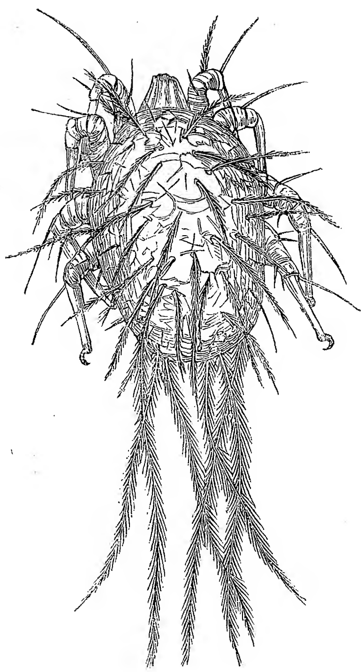
A second portion of each sample was next incinerated: *in no case was there an excess of ash*, and consequently *none of the samples were adulterated with bone-dust, white clay, sulphate of lime, or gypsum.*

In one only of the samples was anything unusual observed, and this contained a small quantity of the *Uredo Caries*, a fungus to be hereafter described.

For these satisfactory results, we are, to some extent, no doubt, indebted to free trade, which, by reducing the price of flour, has removed much of the inducement to its adulteration. We would not, however, attribute this freedom from adulteration to this cause only, as were millers and corn-dealers to be found heartless and dishonest enough to put in practice so gross a fraud, means are not wanting for the adulteration of flour to such an extent as would reduce the price of the article on each sack by several shillings.

It appears, therefore, that millers and corn-dealers are somewhat maligned, and that, as a rule at least, the housekeeper may use the flour she purchases either for puddings or bread, without any great misgivings as to its genineness.

Fig. 50.



The Acarus farinæ, or *meal-mite*. Drawn with the Camera Lucida, and magnified 220 diameters.

We should state, however, that the various samples of flour were not tested for alum.

It now only remains to observe, that the samples were procured from all quarters of the metropolis—Whitechapel, Lambeth, Clare-market, Westminster, Somers-town, Paddington, &c.

The Acarus farinæ.

In our Report on Sugar, in which we gave a description and figure of the *Acarus sacchari*, we spoke of the *Acarus farinæ*, or *meal-mite*.

This mite is of occasional, indeed it may be said to be even of rare, occurrence in flour, and it is never present unless this has become damaged. Any flour, therefore, containing the insect in question is in a state unfit for consumption.

We believe that it is found more frequently in the flour of the *Leguminosæ* than that of the *Gramineæ:* out of between forty and fifty samples of wheat-flour submitted to microscopic examination, we did not once meet with it.

This acarus differs considerably in structure from the sugar-mite, and particularly in its pennate setæ.

The Bearded or Poisonous Darnel.

The poisonous grass, *Lolium temulentum* or *darnel*, is by no means of uncommon occurrence, and numerous accidents have from time to time occurred, in consequence of its becoming mixed up either with the flour of wheat, or some other cereal farina.

The effects of darnel on man are thus described by Pereira:—

"The ill effects of the seeds of bearded darnel on man were known to the ancient Greeks and Romans. The symptoms which they produce are twofold: those indicating gastro-intestinal irritation,—such as vomiting and colic; and those which arise from disorder of the cerebro-spinal system,—such as headache, giddiness, languor, ringing in the ears, confusion of sight, dilated pupil, delirium, heaviness, somnolency, trembling, convulsions, and paralysis. These seeds therefore appear to be acro-narcotic poisons. According to Seeger, one of the most certain signs of poisoning by them is trembling of the whole body. Both Burghard and Schober (quoted by Wibmer) mention death as having resulted from their use. In Cordier's cases their ill effects were directly ascertained by experiments made upon himself; but in most other cases they were the result of accidental poisoning. In general they have arisen from the intermixture of bearded darnel-seeds with other cereal grains. In a prison at Cologne, sixty persons suffered from the use of a bread-meal, containing a drachm and a half of lolium temulentum, in six ounces of meal."

As the chemical tests for darnel when mixed with flour are not very satisfactory or decisive, we have submitted the starch-corpuscles of the seeds to microscopical examination, and find them to be so different from those of wheat or rye, that when admixed with these they may be readily detected.

The majority of the starch-corpuscles resemble very closely those of rice in size and form, but intermixed with the ordinary granules are others of peculiar shape, of which it is difficult to convey an accurate notion; they are, however, somewhat semilunar in outline.

ON THE DISEASES OF THE CEREAL GRASSES.

The grains or ears of nearly all the grasses are subject to several well-marked diseases, resulting from attacks of parasitic fungi, animalculæ, and insects.

The liability of the seeds of grasses to parasitic infection is explained by the large amount of nitrogenised matter contained in them, and the softness of their texture.

Some of these diseases are of the greatest importance to the agriculturist, and are not without interest to the public: to the scientific inquirer they offer much matter for observation and reflection.

Of the majority of the diseases to which corn is subject a clear and succinct account has been given by Professor Henslow*: from this we shall have hereafter to borrow largely.

On the Ergot Mould or Fungus.

This production has excited much interest and discussion.

One of the best memoirs written upon the *Ergot fungus* is that by the late Rev. Edwin Quekett, published in the *Transactions* of the Linnæan Society. Although the sporules had been previously recognised by Phillipar, Phœbus, and Smith, Mr. Quekett was the first to witness their germination into threads or filaments, as also to show that they were capable of infecting sound grain.

This fungus is particularly prone to attack the seeds of rye, the disease produced by it in these being called *spur* or *ergot*. It does not confine its ravages, however, to that one grass, but has been observed to attack a variety of different species, and amongst the rest the ears of wheat.

Grains of rye infested with this fungus increase to several times their original size; they are white and spongy in the interior, and black, or purplish-black, on the exterior.

The internal white part, or *body* of the grain, exhibits little or no remains of its original structure; the integuments have become destroyed, as also the cellulose, together with the contained starch-corpuscles. In place of these normal structures we observe a tissue formed of very minute and angular cells—many times smaller than the original starch-cells; the cavities of these are occupied with one, two, and in some few cases even three little sporules of oil.

Whether this tissue belongs to the fungus, or is to be regarded as a portion of the wheat itself altered by disease, does not appear to have been determined.

We consider that this tissue is part of the fungus itself, and that the hexagonal cells are formed by the cohesion of the more internal of the branched and articulated threads or filaments of the fungus.

This view acquires much confirmation from an examination of the central part of the affected grains.

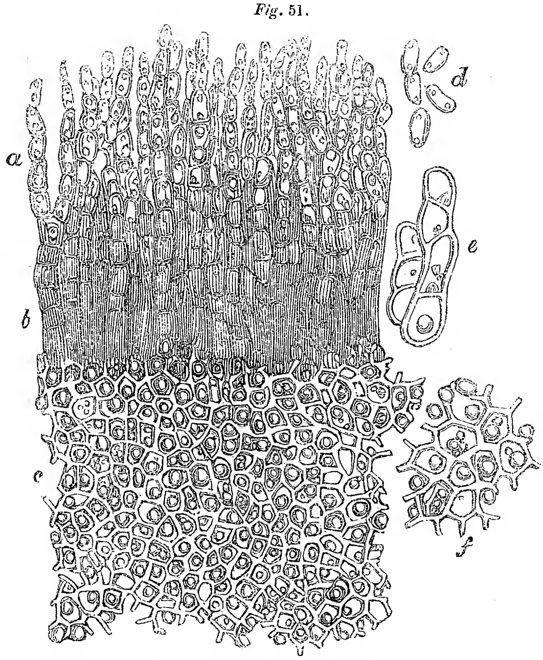
The centres of the ergotised grains are frequently constituted of a spongy substance, which, examined under the microscope, is seen to consist of numerous branched threads, the cells forming which frequently cohere into a tissue, not unlike that already described, situated more externally; the cavities of these cells also include spherules of oil.

The external or *coloured portion* of the grain is of perceptible thickness, but forms much less of its bulk than the internal or colourless part; to the eye it appears black, or dark purple, but under the microscope, light purple.

It consists of straight filaments, of considerable thickness, frequently cohering, usually undivided, but sometimes branched, and for the most part, especially near their terminations, provided with distinct septa.

* Journal of the Royal Agricultural Society, 1841.

Fig. 51.



This engraving represents a transverse section of ERGOT OF RYE. *a.* Terminal colourless filaments bearing the spores, which are seen on the extremities. *b.* The coloured threads which constitute the black or purple portion of the grain. *c.* The cells, with the contained spherules of oil, which form the body or colourless part of the grain, magnified 420 diameters. *d, e, f,* represent minute portions of the same structures, more highly magnified—viz., 670 diameters.

In a figure by Corda, these filaments are represented as simple tubes without septa, a representation which is clearly incorrect.

These coloured filaments, near their distal extremities, diminish in diameter, and terminate in short, colourless, sometimes branched threads also provided with septa, and supporting rows or strings of minute oval corpuscles, the width of each of which is usually much less than that of the coloured filaments.

The colourless threads bearing the sporules constitute the third or *reproductive portion* of the fungus.

The sporules are colourless; separate easily from each other, and form the "*bloom*" of the ergotised grains.

The above structural particulars are well exhibited in the above engraving.

Numerous and well attested instances are on record of dangerous and even fatal effects resulting from the use of bread containing ergot.

"Different parts of the continent—*e. g.*, France (especially in the district of Sologne), Silesia, Russia, Bohemia, Saxony, Denmark, Switzerland, and Sweden, have been, at various periods, visited with a dangerous epidemic (known by the names above mentioned), which affected at the same time whole districts of country, attacking persons of both sexes and of all ages. So long back as 1597 (Tissot), the use of ergotised rye was thought to be the cause of it. Various circumstances have appeared to prove the correctness of this opinion, which has been further confirmed by the effects of ergot on animals, as well as by the occurrence of a disease similar to, if not identical with, ergotism, in consequence of the use of damaged wheat."—*Pereira.*

Two kinds of ergotism have been described, convulsive and gangrenous. In *convulsive ergotism* the symptoms are, weariness, vertigo, muscular contractions, itching or formication, "dimness of sight, loss of sensibility, voracious appetite, yellow countenance, and convulsions followed by death." In *gangrenous ergotism* there is also formication, or a feeling as if insects were creeping over the surface; voracious appetite, coldness and insensibility of the limbs, followed by slow and insidious gangrene.

ON THE BUNT, SMUT BOLLS, OR PEPPER BRAND.

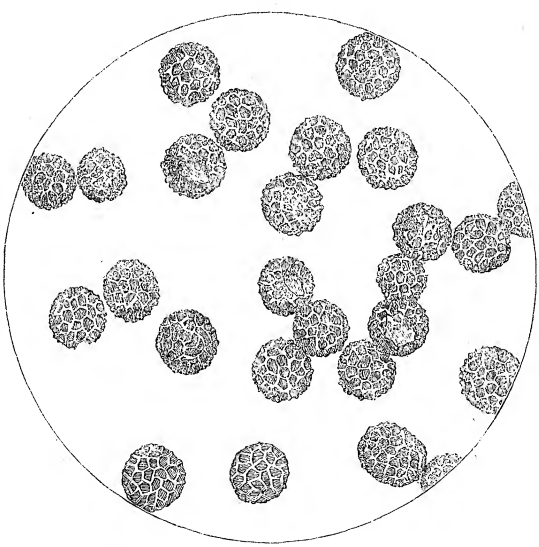
(*Uredo caries*, Dec.; *Uredo fœtida*, Bauer.)

"The fungus which occasions this well-known and much-dreaded disease has hitherto been met with only in the grains of wheat. Its presence is readily recognised by the peculiarly disgusting odour of the infected ear. It may be detected in the young seed, even in the very earliest stages, and in the flower-bud; and when fully ripe, it most frequently occupies the whole interior of the grain, but without bursting the skin, so that the wheat-seed retains very nearly the same size and shape that it would have assumed had it been perfectly sound. When examined under the microscope, the bunt-fungus is seen to consist of vast numbers of extremely minute globules, of a dark colour, and which are at first attached to a mass of matted thread-like matter, analogous to what is termed the spawn in mushrooms, and other agarics; and which in those plants spreads underground, and frequently occasions the remarkable appearances called fairy rings. It is not easy to see this spawn of the bunt-fungus, but the little dark globules called spores may be readily detected. They may be considered analogous to the seed-vessels of flowering plants, and each of them contains a mass of almost inconceivably minute sporules, by means of which the plant is propagated.

"The reproductive powers of fungi are quite beyond our comprehension. Fries, one of our greatest authorities, has calculated that a particular fungus may contain 10,000,000 sporudia. M. Bauer has accurately measured the spores of the present species, and finds their diameter is not more than $\frac{1}{1600}$ of an inch. A single grain of wheat (estimated at less than the $\frac{1}{1000}$ of a cubic inch) would therefore contain more than 4,000,000 such spores. But it is hardly possible to conjecture how many sporules each spore contains, since they are scarcely distinguishable under very high powers of the microscope; and then only appear as a faint cloud or vapour, whilst they are escaping from the ruptured spores.

"When this disease prevails, it greatly deteriorates the value of the sample; imparting its disgusting odour to the flour, it makes it less fit for bread; but I understand that ready purchasers are to be found among the vendors of gingerbread, who have discovered that the treacle, and whatever else they mix up with it, effectually disguises the odour of the fungus: if this in itself is really innocuous, there can be no objection to such a mode of employing the tainted flour; but some are of opinion that it is, to a certain extent, deleterious. Although the bunt-fungus confines its attacks to the young seed, it seems to be a condition essential to its propagation, that it should be introduced into the plant during the early stages of its growth, and that its sporules are most readily absorbed by the root during the germination of the seed from which the plant has sprung. It has been clearly proved that wheat-plants may be easily infected, and the disease thus propagated, by simply rubbing the seeds before they are sown with the black powder, or spores of the fungus. It is also as clearly ascertained, that if seeds thus tainted be thoroughly cleansed, the plants raised from them will not be affected. This fact is now so well

Fig. 52.



This engraving represents the spores of UREDO CARIES, magnified 420 diameters. Drawing made from a preparation belonging to the late Dr. Pereira.

established, that the practice of washing or steeping seed-wheat in certain solutions almost universally prevails."—*Prof. Henslow.*

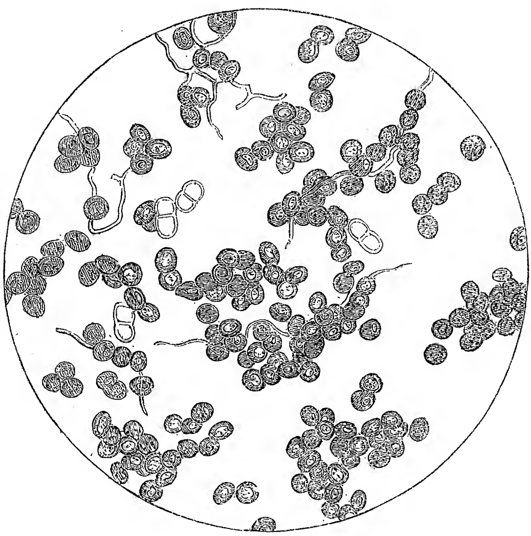
To the above clear and interesting description we have but little to add, except that the surface of the spores usually presents a reticulated appearance, as shown in the figure, indicative probably of a structure compounded of several lesser cells, which form, by cohesion, the external membrane of the spores. In some few of the spores the reticulation is less perfectly seen.

On the Smut, or Dust Brand.

(*Uredo Segetum.*)

"This disease is produced by another fungus, which is often confounded with the last. The smut-fungus indeed resembles the bunt-fungus in colour and shape, but its spores are not half so large, and it possesses none of that disgusting odour which characterises the latter. Although this fungus is generally supposed to attack the grain much in the same way as the bunt-fungus, only that it more thoroughly destroys it, this is not the case. M. A. Brongniart has shown that the smut-fungus destroys the ear, by first occasioning the innermost parts of the flower to become abortive, whilst the little stalks (*pedicles*) on which these are seated, swell and become very fleshy. The fungus then consumes the whole of this fleshy mass, and at length appears between the chaff-scales in the form of a black, soot-like powder. It is stated, however, by others, that it does not confine its attacks to the ear; and although I have not myself witnessed its effects on other parts, it is described as infecting both chaff, straw, and leaves. The spores, when ripe, burst through the epidermis, and disperse in the form of a black powder resembling charcoal.

Fig. 53.



This engraving represents the spores of Uredo Segetum magnified 420 diameters. Drawing made from a preparation belonging to Dr. Swayne.

"The disease is not so much dreaded as bunt, for two reasons; the spores have generally been dispersed before the corn is cut; and even when present in the flour they have no disagreeable odour. It is sometimes, however, very injurious, by diminishing the produce. It is comparatively rare in wheat, but very common in barley, and even more so in oats; rye does not appear to be subject to it. It has been observed in several grasses."—*Professor Henslow.*

The spores are several times smaller than those of *Uredo caries*, and not reticulated. *Fig.* 53.

On the Rust, Red-rag, Red-robin, Red-gum.

(*Uredo rubigo* and *Uredo linearis.*)

"I believe that under the names here quoted, agriculturists have comprehended the attacks of what systematic botanists consider to be two distinct species of fungi; and which the experienced eye of the microscopic observer was alone likely to separate. They form yellow and brown oval spots or blotches upon the stem, leaf, and chaff; and when the spores have burst through the epidermis, they are readily dispersed. Like those of the bunt-fungus and smut-fungus, they consist of very minute grains, but their colour is different, varying from orange-yellow to brown, and their shape is not so perfectly spherical, especially those of *U. linearis* which are usually oblong. Both of these fungi are very common on corn and grasses. I have within the last two months (of July and August) seen more of the red-rag (*U. rubigo*), as it is here called, than of any other of these corn pests. It abounded in the form of an orange powder, which exuded from the inner surfaces of the chaff scales, but was scarcely if ever to be seen in the skin of the seed; it might also be traced in patches beneath the epidermis of the straw, but I did not observe that it had burst through the epidermis anywhere, excepting on the inside of the chaff. It seemed to prevail more among the rough-chaffed wheats than others, and in this parish, more especially in some fields, of the variety called white tunstall. At one time it appeared likely that these fields would be seriously injured by it, but some warm sunny weather coming on, the red-rag lost ground; and I observed that the sori, or spots from whence the spores exuded, turned deep brown. This disease is not so injurious as the true mildew; but although I shall speak of the latter as if it were produced by a distinct species of fungus, and in compliance with the present opinions of most systematic botanists, still I am very much inclined to think that both diseases are occasioned by the same fungus, under different forms or states of fructification."—*Prof. Henslow.*

On the Mildew.

(*Puccinia Graminis.*)

"If agriculturists appear to have confounded, under the name of rust, the attacks of fungi which botanists consider to belong to two distinct species; so also have they frequently applied the name of rust as well as mildew, to the disease we are about to notice. It will be seen by what I have stated in the last section that I am induced to consider these two diseases to be mere modifications in the attack of the same species of fungus, but further observations are required to settle this question. For the present, then, we must consider the mildew fungus, not merely as a distinct species, but also as belonging to a different genus from the two rust fungi. The form of its spores is indeed very different from those we have already noticed. The ripe spores of this fungus are little, intensely dark-brown, club-shaped bodies, having the thicker end divided into two chambers well filled with sporules. They taper gradually at the base into a fine stalk. The sori or patches of spores are composed of multitudes of these bodies, which sometimes burst through the epidermis of the stem and leaves in such profusion that the whole plant appears as if it had been scorched. I have observed this fungus intermixed with the rust fungi, in a way which strengthens my opinion that they are identical."—*Professor Henslow.*

There appears to be considerable reason for believing that the spores of this fungus enter the grass, not by the roots but by the stomata.

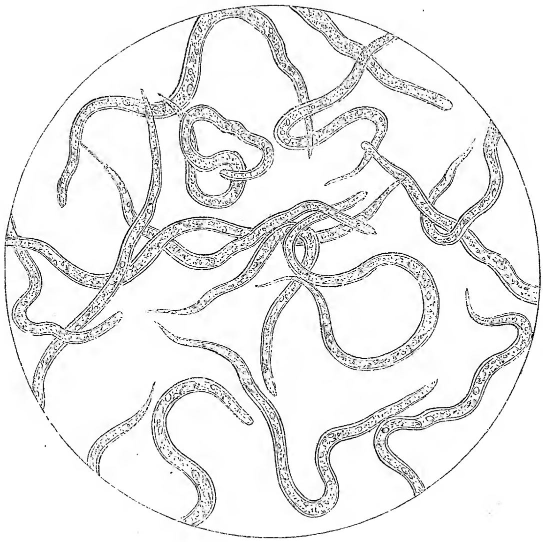
We have now to consider two diseases of corn, produced not by the invasion of parasitic fungi, but animal productions.

On the Ear-cockle, Purples, or Peppercorn.

(*Vibrio Tritici.*)

"It is now just a century since Needham first made known an extraordinary fact concerning the blighted grains found in the ears of wheat infected by a disease known under the name of ear-cockle, purples, or, as I find it called in this part of Suffolk, the peppercorn. The grains which are thus infected turn dark green at first, and ultimately nearly black; and they become rounded, somewhat resembling a small peppercorn, but with one or more deep furrows on their surface. The husks of the chaff spread open, and the awns are twisted, by which means the infected ears are readily observable among the standing corn. Upon opening the blighted grains, they are found to be filled with a moist white cottony substance; but to contain no flour. When Needham placed this cottony mass under his microscope, he perceived, to his surprise, as I did lately to mine, before I was aware that the fact had been previously noticed, that it was composed of a multitude of minute eel-shaped animalcules, which were in active movement twisting and wriggling to and fro, like so many eels or snakes. (See *fig.* 54.)

Fig. 54.



Numerous VIBRIONES TRITICI, magnified 100 diameters. Drawing made from preparation belonging to the late Dr. Pereira.

"The disease which the *Vibrio Tritici* occasions is said to be sometimes very injurious to the wheat-crop; but I presume it must be very local, for it was unknown to some of the earlier writers on the diseases of corn, who sought for it without success; and I could not learn, upon a limited inquiry, that it was known to the farmers near Cambridge, or at Saffron Walden. In this parish, however, it is well known, and my miller informs me that he often has samples of wheat much infested with it; and among what he calls the tail-corn (the last portions of a particular batch), he has found as much as half a peck in the bushel. He says, also, that when the cottony mass composed of the animalcules is extracted from the grain in the process of grinding, it does not pass through the cloth with the fine flour in the beating, but remains behind with the bran. When a sound grain of wheat is sown by the side of one infested with the *vibrio*, the young plant which springs from the former is not infected before March, but then the animalcules begin to find their way from the blighted grain into the earth, and thence into the young corn.

"The most curious circumstance which observers have noticed in the economy of this animal, and which I have had an opportuity of fully verifying, is the wonderful property it possesses of retaining its vitality under circumstances in which we should have supposed it impossible that it could have lived. If a mass of them is suffered to become so perfectly dried that the slight touch of a hair might reduce them to powder, and they are again moistened in a drop of water, they will speedily revive, and become as active as before. They may thus be dried and revived many times before they are killed. Mr. Bauer states the limit to such revivals to lie between six and seven years.

"It does not appear that this vibrio naturally attacks any other corn than wheat—at least it has not been observed to do so. But barley, rye, and oats may become infected by sowing them in the same hole with the grains of wheat which are filled with the vibrio. The experiment, however, succeeds with difficulty, and only to a small extent."—*Prof. Henslow.*

ON THE WHEAT-MIDGE.

(*Cecidomyia Tritici.*)

"Nothing is more common in wheat-fields than to find one, two, or more of the flowers in many ripe ears defective in the grain, even though the parts of the flower had been well formed. This effect may be owing to a variety of causes, and amongst others is frequently occasioned by a minute two-winged fly, called the wheat-midge. This fly may be seen in myriads in the early part of June, between seven and nine o'clock in the evening, flying about the wheat, for the purpose of depositing its eggs within the blossoms. From these eggs are hatched small, yellow maggots, which are the caterpillars of this fly, and by these the mischief is occasioned: they are the cause of the non-development or abortion of the ovary, so that the grain never advances beyond the state at which it appears at the time the flower first expands."—*Professor Henslow.*

A figure of the fly and its caterpillar is given in the *Transactions* of the Linnæan Society.

ON THE MANUFACTURE OF BREAD.

Two kinds of bread are manufactured—the one is made with yeast, ferment, or leaven, and is hence called leavened; the other is prepared without leaven, and is denominated unleavened; although not unfrequently substances are used in the manufacture of this description of bread, the operation of which is, to a certain extent, analogous to that of yeast.

Leavened or Fermented Bread.

Leavened bread should consist only of flour, yeast, and water, with perhaps a little salt; such is the composition of genuine home-made bread, the flavour of which is so agreeable, and so very different from that of ordinary bakers' bread.

In the preparation of the bread of the shops, flour of inferior quality is frequently used, and this is mixed up with large quantities of salt and alum; these substances impart to it a taste very distinct from that of home-made bread, and occasion much of the difference observed between the two descriptions of bread.

Yeast, or the Yeast-Plant.

The substance known as yeast is in reality a plant, belonging to the tribe of *Fungi;* it consists of a multitude of minute oval or circular bodies or sporules, endowed, under certain favourable circumstances, with extraordinary powers of growth and multiplication.

Three kinds of yeast are employed in the manufacture of bread—viz., brewer's yeast, German yeast, and patent yeast. Some bakers use one, and some another, but the greater number make use of patent yeast, on account of its cheapness. The fungus is of the same species in each.

Brewer's Yeast.—This, as is well known, is of a light-brown or fawn colour, and of a frothy consistence; when recent, it is in constant movement, and bubbles of gas escape from it.

Examined with the microscope, it is seen to consist of innumerable minute bodies, termed sporules, of variable size, some circular, and others oval, and all intermingled with very many globules of carbonic acid gas. These sporules multiply rapidly when the yeast is in an active condition.

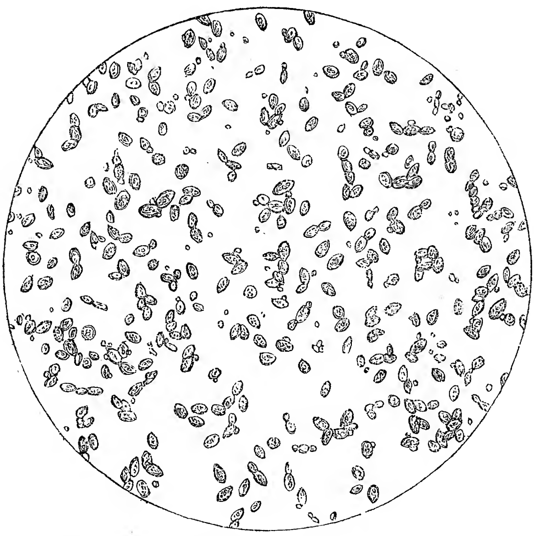
Brewers and bakers "distinguish yeast according to the quality of the beer from which it is obtained. *Ale yeast* is the best and strongest, and is used for bread-making. *Porter yeast* is objected to by bakers, but is used in distilleries. *Small beer yeast* is said to be weak, but rapid in its effects, and is sometimes used in making rolls."—*Pereirà.*

German Yeast.—This, which is sometimes called "*dried yeast,*" consists of sporules only, with but little adherent moisture, and no gas. It forms a paste-like substance, and is obtained from a fermented liquid by filtration. It is imported into this country principally from Germany, in hempen bags, each holding half a hundredweight. When placed in casks, it is apt to burst them, in consequence of the carbonic acid sometimes evolved.

The vitality of yeast is destroyed by mechanical injuries—heat, cold, and chemical re-agents. Dr. Pereira relates a singular circumstance in reference to the effect of blows on yeast.

"A very curious fact was mentioned to me by the importer of German and Dutch yeasts, in Finch-lane, Cornhill, London. It is, that mechanical injury kills or destroys yeast. Foreign yeast is imported in bags, and of these great care is requisite in their removal from place to place. If they be allowed to fall violently on the ground, the yeast is spoiled. A bruise or a blow given to the bag also destroys it. The men who make up the dried yeast into quarter-pound and half-pound balls for sale are obliged to handle it very dextrously, or they injure and destroy it. In fact, falls, bruises, or rough handling, kill it, and the yeast which has thus been mechanically injured may be readily distinguished from good, unaltered yeast. Its colour becomes darker, somewhat like the change which an apple or pear undergoes when it becomes rotten; and from being crumbly or powdery, it becomes soft, glutinous, sticky to the fingers, like flour-paste, and even stinks. I have submitted some of this injured or dead yeast to microscopical examination, but have been unable to detect any difference in its appearance from healthy yeast. The effect of mechanical injuries is also noticed by several writers. Thus Liebig remarks that simple pressure diminishes the power of yeast to excite vinous fermentation."*

Fig. 55.



This drawing exhibits the *sporules* of which a sample of PATENT YEAST was composed; they differ from the sporules of ordinary yeast in their smaller size, oval form, and in being frequently united in twos and threes: they appear to belong to a distinct fermentation fungus, but their development was not followed out. Drawn with the Camera Lucida, and magnified 220 diameters.

Patent Yeast.—This is prepared from an infusion of malt and hops. It is a thin watery liquid, containing innumerable sporules of the yeast-plant in suspension. The hops are added to prevent the liquid from becoming rapidly sour.

This mode of preparation of patent yeast is considerably varied by different bakers. Many add a portion of brewer's or German yeast to an infusion containing either flour or malt, with potatoes. These substances supply the food or nourishment upon which the yeast-cells grow, and multiply with much rapidity, as well as the material for conversion into carbonic acid. Yeast-cells, in the course of a few days, make their appearance in a simple infusion of malt, and sometimes even of flour.

Patent yeast, before being mixed with the flour, is sometimes allowed to drain through a copper basin or sieve perforated with numerous holes; by this means the chief part of the mashed potato employed in the preparation of the yeast is separated.

Discovery of the Development of the Yeast-Plant.

Few productions have created more interest or excited greater discussion than yeast; its nature and the mode of its operation have been made subjects of keen inquiry and dispute.

These points are now, however, to a very great extent, set at rest; its fungoid

* Materia Medica, New Edition, p. 937.

character is generally admitted, and its *modus operandi* in panification is well understood.

In one particular, however, the history of the yeast-plant was until very recently incomplete; this related to its development.

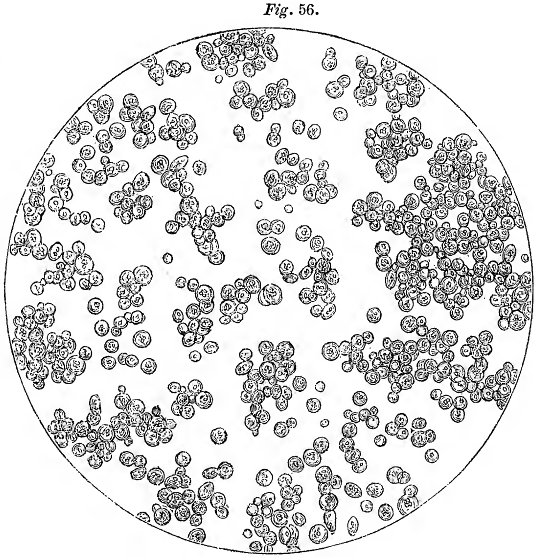
Most observers admit that the yeast fungus, as met with in the different forms of yeast in use, is in an incomplete state of development, and many, influenced by this conviction, have made attempts to discover the plant in its perfect condition.

Thus Turpin, in the ardour of scientific zeal, spent a whole night in a brewery, with a view to trace out the successive steps in the development of the yeast-plant; and although he has stated that he made out distinctly that the cells or sporules became multiplied by budding, and that they adhered together in twos, and even in rows, according to the time which had elapsed after the commencement of germination, yet, as we shall presently see, he failed to discover the yeast fungus in its perfect form.

Animated with the like desire of discovering the true development of this curious production, Dr. Pereira bestowed much time and attention in its examination.

"I have myself," that gentleman writes, "examined yeast at Messrs. Hanbury and Buxton's brewery at various stages of the fermentation of both porter and ale, from a few hours to many days. In the more advanced stages of fermentation, I observed the globules of yeast were frequently in strings or rows, apparently forming moniliform, often branched plants. But as the cells or joints were very readily separable, I could not satisfy myself that the adhesion was otherwise than mechanical, such as we see between the blood-discs when they arrange themselves in series like money-rolls, and such as we sometimes perceive even in inorganic amorphous precipitates. My experience agrees precisely with that of Schlossberger, who states, that he 'never could perceive a budding or bursting of the yeast-cells, accompanied by a discharge of their contents, nor could I ever produce this by compression. These curious brachial and other adjustments of the cells of yeast to each other appeared to me the work of chance.' It is, however, proper to add, that the artificial rupture of the cells has been effected by Mitscherlich, who also confirms Turpin's observation of the budding of the yeast-cells."

Fig. 56.

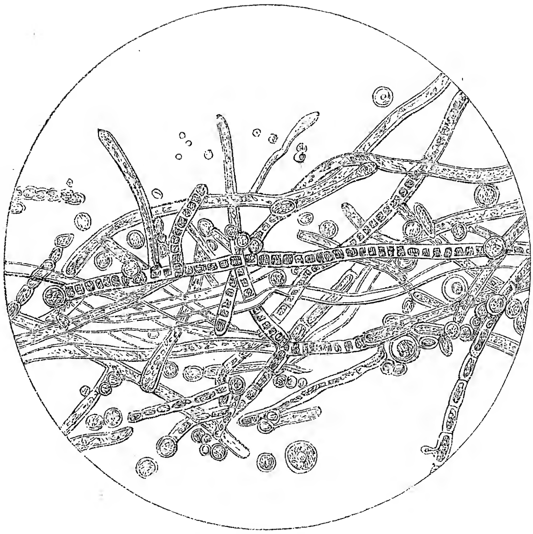


This engraving represents "THE YEAST-FUNGUS" in the first stage of its development, or that of sporules. As generally met with, and as used in the fermentation of bread, yeast consists of an immense number of similar sporules intermixed with bubbles of carbonic acid. Drawn with the Camera Lucida, and magnified 220 diameters.

M. Robin*, after describing the development of the sporules by budding, remarks: "We know only this mode of propagation of this vegetable; but its fructification in the air has not been seen, nor can it be seen, because it perishes from the part at which it is in contact with the atmosphere; so that we cannot yet say whether it ought to be classed amongst the fungi which fructify only in the air, or even amongst the algæ, from which

* Des Vegetaux qui Croissent sur l'Homme et sur les Animaux Vivants.

Fig. 57.



This engraving represents "THE YEAST-PLANT" in the second stage of its growth, or that of thallus; the jointed threads are intermixed with the two kinds of reproductive bodies developed on the vertical filaments of the thallus. Drawn with the Camera Lucida, and magnified 220 diameters.

Fig. 58.

This engraving represents a peculiar state or condition of "THE YEAST-FUNGUS;" the filaments consist chiefly of thallus, but in the course of many of them, single vesicles, of a somewhat oval form, have appeared; the cavities of these are in general but imperfectly filled with the granular matter, and the filament on one side of each vesicle is almost constantly enlarged, and void of contents. The vesicles appear to be formed, as in many *Algæ*, by the union of the contents of two or more cells, and the subsequent dilatation of the receiving cells. Drawn with the Camera Lucida, and magnified 220 diameters.

it is separated by very many particulars, and which fructify under the water."

Impelled with a similar desire, we have applied ourselves diligently to this investigation, and, more fortunate than our predecessors, have succeeded in tracing the yeast-plant through all the stages of its growth up to its perfect state.

The development of the yeast-plant may be divided into three very distinct and natural stages.

First Stage, or that of Sporules.—In this, the ordinary state in which the yeast-plant is met with, it consists entirely of sporules; these are for the most part separate, but sometimes feebly united in twos, threes, and even in greater numbers; they vary in size and form; some are several times smaller than others, and nearly all contain one or two nuclei, which are the germs of future sporules. (See *fig.* 56. p. 153.)

Second Stage, or that of Thallus.—After the lapse of some days, and under favourable circumstances, the sporules become much elongated; a division or partition appears in each, and it now consists of two distinct cells; the extension still continuing, other septa appear, until at length jointed threads, at first simple and undivided, afterwards jointed, are formed, and the plant now exists in the form of root-like threads or *thallus*.

The yeast-plant in the state of thallus constitutes the *Mycoderma Cerevisiæ* of Desmazières.

Third Stage, or that of Aërial Fructification.—After the lapse of a further time, vertical threads spring up from the thallus; these, when the plant has reached its complete development, become branched, each branch bearing at its extremity a row of rounded and beaded corpuscles.

These corpuscles are about the size of the original yeast sporules, but differ from those bodies in their darker colour and firmer texture.

Fig. 59.

Occasionally in the rows of beaded corpuscles one cell several times larger than the rest is seen.

From observation made subsequently on the development of the sugar fungus in saccharine wine, it appears that the beaded threads do not form the last condition or stage in the development of the plant, but that true aërial tufts or heads of sporules are formed.

These heads are figured and described in a Paper by ourselves published in the 36th volume of Medico-Chirurgical Transactions, p. 26. "The state and appearance of the heads vary with the development. At first they present a smooth outline, from being covered by a delicate membrane (Pl. V. *fig.* 2.); this afterwards bursting and becoming retracted, a rounded mass of circular sporules of a brownish colour is disclosed to view. The sporules falling off, leave the dilated extremities of the threads or filaments exposed."

A fungus, somewhat closely resembling the yeast fungus in its perfect form, has been observed by Bennett in the expectoration of an individual attacked with pneumothorax.

Such, then, is a very brief description of the development of the yeast-plant in its several stages.

From a consideration of the structure of the sporules of the yeast-plant, their evident fungoidal character, their rapid growth, &c., it occurred to us that the reason why the true or aërial reproduction had never been discovered was to be found in the fact, that yeast being used always in the state of sporules, sufficient time was not allowed it, under ordinary circumstances, to attain its full development, for which purpose probably many days would be required.

Acting on this impression, we placed in an eight-ounce bottle a tablespoonful of malt, poured over this about four ounces of hot water, and partially closing the mouth with a perforated cork, set it aside for a fortnight.

At the end of that time we were rejoiced to find that our expectations were fully realised, and that we had indeed discovered that which so many other observers had failed to detect. This discovery was made in August, 1850.

The aërial reproduction of this plant clearly shows that the German algologist Kutzing is in error, in regarding it as a confervoid production.

Modus Operandi of Yeast.

The presence of yeast in a substance containing sugar, or starch convertible into sugar and nitrogenised matter, induces certain chemical changes, comprehended under the term vinous or alcoholic fermentation.

These changes in the making of bread consist in the conversion of the sugar of flour into alcohol and carbonic acid gas; the latter, in its efforts to escape from the dough with which it is mixed, distends it, forming vesicular spaces in its interior, and so causing it to become porous and light.

According to some chemists, a minute portion of the starch is itself converted into sugar. If we examine attentively with the microscope the starch-corpuscles contained in fermented and baked bread, we observe that they are still entire, although altered somewhat in form.

Some physicians are of opinion that the presence of yeast imparts injurious properties to leavened bread. This point is one of great practical importance; but so far as we are aware, no complete or conclusive observations have yet been made on the subject.

UNLEAVENED OR UNFERMENTED BREAD.

There are two kinds of unfermented bread: in the one, substances are used in imitation of yeast, from which a gas, always the carbonic, is disengaged, distending the dough, and rendering it vesicular and light; in the other, flour, water, with perhaps the addition of salt, only are employed.

The substances used in the preparation of the finest description of unfermented bread are sesquicarbonate of ammonia, carbonate of soda and hydrochloric acid, or carbonate of soda and tartaric acid.

Of these, by far the best is the carbonate of ammonia: this is a volatile salt, and its great advantage is, that it is entirely or almost entirely dissipated by the heat employed in the preparation of the bread; and thus the necessary effect is produced without much possibility of injurious results ensuing.

In the employment of carbonate of soda and hydrochloric or muriatic acid, the case is, however, different; here we have the formation of chloride of sodium, or common salt, with disengagement of carbonic acid.

Now, although the use of salt, in moderate quantities, with meat, is a general custom, and is probably a salutary one, the effects of this substance on the human system are by no means so clearly ascertained as to justify its use in large quantity in so important an article of consumption as bread.

In those instances where a mixture of carbonate of soda and tartaric acid are used, a tartrate of soda is formed, also with liberation of carbonic acid.

In reference to the action of this salt, we meet with the following observations in the last edition of Dr. Pereira's voluminous but excellent Materia Medica:—

"In its medicinal properties, tartrate of soda resembles the tartrate of potash. It is a gentle aperient. If it be given so as to become absorbed it operates as a diuretic, and renders the urine alkaline. It may be used, therefore, in lithic-acid deposits, but it is objectionable when there are phosphatic deposits in the urine. Dose, as a purgative, two to four drachms, or more. As a diuretic or lithic, it must be given in smaller doses, and largely diluted with water, so as to ensure absorption."

The preparations known as *Baking*, *Egg*, and *Custard powders* are combinations of carbonate of soda and tartaric acid, mixed up with wheat-flour, or other kinds of starch, and often coloured with either *turmeric* or *chromate of lead.*

It is therefore extremely doubtful how far these preparations may be used with safety to the public health: for our own part, we see much less objection in the employment, in the generality of cases, of a substance like yeast, which contains but little saline matter, and the vitality of which is completely destroyed by the heat of the oven, than in the use of egg and baking powders.

A sample of "Borwick's Baking Powder" forwarded to us we found composed of an acid and an alkali—tartaric acid, and either carbonate of potash or soda, probably the former, together with ground rice, a small quantity of wheat-flour, and perhaps a little sugar. Its action in lightening or leavening bread is dependent upon the slow extrication of carbonic acid gas, which, becoming diffused throughout the dough, forms the little cavities noticeable in white bread, and which render it porous and spongy. As soon as the flour throughout which the baking-powder has been diffused is moistened with water, the tartaric acid unites with the soda or potash, forming a tartrate of one or other of these bases, either of which salts possesses diuretic and aperient properties. It is on this account that bread made with these powders, while it may prove of service in some cases of dyspepsia, in others is calculated to do harm. Most of the other baking-powders also consist of tartaric acid and either carbonate of soda or potash, mixed with different kinds of flour or farina. According to a plan commonly employed some time since, the liberation of the carbonic acid gas was effected by means of hydrochloric acid added to the dough containing the alkali; in this case a chloride of sodium or common salt was formed instead of tartrate of soda or potash, as in the present instance.

The water we drink is largely impregnated with a host of saline ingredients; the bread we eat is saturated with alum and "stuff;" and it behoves us to be careful how we add to the large amount of saline matter daily ingested.

That these observations are not misplaced or over-strained will appear from the following published receipts for the preparation of unfermented bread:—

To make White or Flour Bread.

Flour dressed or household - -	3 lb. avoirdupoise.
Bicarbonate of soda, in powder - -	9 drachms, Apothecaries' weight.
Hydrochloric (muriatic) acid - -	$11\frac{1}{4}$ fluid drachms.
Water - - - - - -	about 25 fluid ounces.

Observe the large quantity of soda and acid recommended to be employed in the manufacture of a 3lb. loaf; and remember that it is no easy matter either to blend equally the ingredients, or exactly to add them in neutralising proportions.

Dr. Pereira gives the following receipt for the manufacture of unfermented bread, in which the proportions of soda and acid are much less:—

Receipt for Unfermented Bread.

Flour - - - -	1 lb.
Bicarbonate of soda - - -	40 grains.
Cold water - - - -	$\frac{1}{2}$ a pint.
Muriatic acid - - -	50 drops.

Receipt for an Egg or Baking Powder.

Carbonate of soda - - -	56 lbs.
Tartaric acid - - -	28 lbs.
Potato-flour - - -	1 cwt.
Turmeric powder - - -	$\frac{3}{4}$ lb.

It will be observed that the quantity of tartaric acid in this receipt is much too small to neutralise the soda. It is better adapted for pudding than bread.

The second description of unfermented bread is heavy and compact, and is met with chiefly in the form of biscuits.

THE DIFFERENT KINDS OF BREAD.

Wheat-Bread.—The following observations, in reference to the increased consumption of wheaten bread, extracted from "M'Culloch's Dictionary of Commerce," will be read with interest:—

"The species of bread in common use in a country depends partly on the taste of the inhabitants, but more on the sort of grain suitable for its soil. But the superiority of wheat to all other farinaceous plants, in the manufacture of bread, is so very great, that wherever it is easily and successfully cultivated, wheaten bread is used, to the nearly total exclusion of most others. Where, however, the soil or climate is less favourable to its growth, rye, oats, &c., are used in its stead. A very great change for the better has, in this respect, taken place in Great Britain within the last century. It is mentioned by Harrison, in his description of England (p. 168.), that in the reign of Henry VIII. the gentry had wheat sufficient for their own tables, but that their *household* and poor neighbours were usually obliged to content themselves with rye, barley, and oats. It appears from the household book of Sir Edward Coke, that, in 1596, rye-bread and oatmeal formed a considerable part of the diet of servants, even in great families, in the southern counties. Barley-bread is stated in the grant of a monopoly by Charles I., in 1626, to be the usual food of the ordinary sort of people. (*Sir F. M. Eden on the Poor*, vol. i., p. 561.) — At the Revolution the wheat produced in England and Wales was estimated by Mr. King and Dr. Davenant to amount to 1,750,000 quarters. (*Davenant's Works*, vol. ii. p. 217.) —Mr. Charles Smith, the very well informed author of the Tracts on the Corn Trade, originally published in 1758, states that in his time wheat had become much more generally the food of the common people than it had been in 1689; but he adds (2nd ed., p. 182; Lond. 1766), that notwithstanding this increase, some very intelligent inquirers were of opinion that even then not more than *half* the people of England fed on wheat. Mr. Smith's own estimate, which is very carefully drawn up, is a little higher; for, taking the population of England and Wales in 1760, at 6,000,000, he supposed that 3,750,000 were consumers of wheat; 739,000, of barley; 888,000, of rye; and 623,000 of oats. Mr. Smith further supposed that they individually consumed, the first class, 1 quarter of wheat; the second, 1 quarter and 3 bushels of barley; the third, 1 quarter and 1 bushel of rye; and the fourth, 2 quarters and 7 bushels of oats.

"About the middle of last century, hardly any wheat was used in the northern counties of England. In Cumberland the principal families used only a small quantity about Christmas. The crust of the goose pie, with which almost every table in the country is then supplied, was, at the period referred to, almost uniformly made of barley-meal. (*Eden on the Poor*, vol. i. p. 564.)— Every one knows how inapplicable these statements are to the condition of the people of England at the present time. Wheaten bread is now universally made use of in towns and villages, and almost everywhere in the country. Barley is no longer used, except in the distilleries and in brewing; oats are employed only in the feeding of horses; and the consumption of rye-bread is comparatively inconsiderable. The produce of the wheat crops has been, at the very least, *quadrupled* since 1760. And if to this immense increase in the supply of wheat, we add the still more extraordinary increase in the supply of butcher's meat, (see art. 'Cattle,') the fact of a very signal improvement having taken place in the condition of the population in respect of food, will be obvious.

"But great as has been the improvement in the condition of the people of England since 1760, it is but trifling compared to the improvement that has taken place since the same period in the condition of the people in Scotland."

Rye-Bread. — Rye-bread is rather less nutritious than that made from wheat, but it contains a greater proportion of sugar.

Rye-bread is still extensively used in some countries, particularly in Russia. In England it is but little used; it is occasionally made by the London bakers, and may be procured of Inglis, New-street, Covent-garden.

We are indebted to Dr. Bossey, of Woolwich, for a sample of *Russian* or *black bread;* it is of a dark-brown colour, not unlike that of gingerbread. Water in which it has been macerated becomes deeply tinged; does this colour proceed from the rye itself, or is it due to admixture with some other substance?

Barley-Bread.—Barley-bread is scarcely ever met with in this country, the only baker known to us in London who prepares it, is Inglis, of New-street, Covent-garden.

It is less nutritious than wheat bread, and more difficult of digestion.

Indian-Corn Bread.—Indian-corn bread, although rather less nutritious than that made from wheat, is more fattening, in consequence of the greater quantity of oil contained in it.

We believe there are many bakers in London who make bread of Indian-corn, or maize; it may be purchased of Turner, Bishopsgate-street, and Inglis, New-street, Covent-garden.

Rice-Bread.—Rice-flour is scarcely ever made into bread; although it is said to be not unfrequently mixed with wheat-flour intended for bread.

Oat-Bread. — Bread is seldom prepared from oatmeal, which is, however, largely used in Scotland and the North of Ireland in the form of oat-cake.

ADULTERATION OF BREAD.

Bread is subject to the same adulterations as flour; the reader is therefore referred to what has been advanced on this subject under the head of flour.

There are, however, certain adulterations to which bread is stated to be peculiarly liable; these we shall now proceed to consider.

Adulteration with Rice-Flour. — It is asserted that this adulteration is very frequently practised. The purpose for which rice-flour is employed is, to enable the bread to absorb and retain a larger quantity of water than it would otherwise do, and so cause it to weigh more. This iniquitous purpose is accomplished through the absorbent power of rice for water. In a loaf adulterated with rice-flour the consumer is cheated of a certain amount of nutritious wheat farina, the place of which is supplied by water.

The characters and structure of the starch-corpuscles of rice have already been described.

Adulteration with Boiled and Mashed Potatoes. — This adulteration, next to that by alum, is, perhaps, the one which is most commonly resorted to.

When the cost of flour was double what it now is, the inducement to mix it with potatoes was very great; at the present time, however, the difference in value between potatoes and flour is less considerable, and the same inducement does not exist to the employment of potatoes in the manufacture of bread.

The great objection to the use of potatoes in bread is, that they are made to take the place of an article very much more nutritious.

This adulteration may be readily detected by means of the microscope. The cells which contain the starch-corpuscles are in the potato very large; in the raw potato these are adherent to each other, and form a reticulated structure, in the meshes of which the well-defined starch-granules are clearly seen: in the boiled potato, however, the cells separate readily from each other, each forming a distinct atricle, and the starch-corpuscles are much less distinct, and much altered in form.

Adulteration with Alum and "Stuff." — This adulteration is practised with a twofold object — first, to render flour of a bad colour and inferior quality white, and equal, in appearance only, to flour of superior quality; and second, to enable the flour to retain a larger proportion of water, by which the loaf is made to weigh heavier.

Some bakers buy rock-alum in powder, and mix it up in certain proportions with salt; the majority, however, make use of an article known in the trade as "*hards*" and "*stuff.*"

This consists of a mixture of alum and salt. It is kept in bags, holding from a quarter to one hundredweight; it is sold by the druggist, who supplies either the baker or the corn-chandler; the latter again, in some cases, furnishing the baker with it from time to time as he may require.

In country towns and villages the baker is put to considerable trouble to procure his supplies of "stuff;" for as he is unwilling that his friends and neighbours should know that he makes use of any such article in his bread, he generally contrives to procure it of a druggist living some miles away from his own town.

On a Saturday night a druggist in good business will have several applications in the course of the evening for alum, hards, and stuff.

It is not easy to ascertain the exact quantities of alum and "stuff" used in bread. It may be stated as a rule, however, that the worse the flour, the greater the proportion of these ingredients.

In reference to the quantity of alum employed, Accum writes as follows:—

"The smallest quantity of alum that can be employed with effect to produce a white, light, and porous bread from an *inferior* kind of flour, I have my own baker's authority to state, is from three to four ounces to a sack of flour weighing 240 pounds."

Dr. P. Markham gives eight ounces of alum as the quantity commonly used in making a sack of flour into bread.*

Mitchell gives the following as quantities detected by him in different loaves weighing four pounds each.

	Grains of Alum.
1st loaf	116
2nd ,,	114
3rd ,,	109
4th ,,	108
5th ,,	105
6th ,,	94
7th ,,	58
8th ,,	41
9th ,,	40
10th ,,	$34\frac{1}{2}$
Total in ten loaves	$819\frac{1}{2}$

Taking the yield of a sack of flour at 92 loaves, of four pounds each, the above table gives nearly sixteen ounces as the *average* quantity of alum used in making a sack of flour into bread; but at the rate of 114 grains to the loaf, the amount would be nearly twenty-two ounces to the sack.

On the Detection of Alum.—Alum is a sulphate of alumina and potash: the analysis of this substance, therefore, naturally resolves itself into two parts; that for the detection of sulphuric acid and that for the discovery of the alumina. In most cases it is sufficient to test for the alumina only.

First char 1000 grs. of the flour or bread, then boil in a flask with 4 drachms of nitric acid, 4 of hydrochloric, and 4 of water, evaporate to dryness; when cold add one ounce of distilled water and boil for a few minutes; while boiling dilute with two ounces liq. potassæ, and boil again for a few minutes; then filter, neutralize with hydrochloric acid, and precipitate with ammonia.

The precipitated alumina should be washed, dried, ignited in a platinum dish, and weighed.

That alum is in no way necessary in the manufacture of bread is clearly proved, by the excellent quality of bread, as, for example, home-made bread, made without a particle of that substance being used.

Alum "hards" and "stuff," are used solely for the benefit of the baker, to enhance his profits, and this, too, as we shall presently see, at the expense of health.

Bakers endeavour to excuse themselves for the use of alum, on the plea, that the public will have very white bread, and that without alum this cannot be made. The answer to this assertion is, that a white bread may be made with a flour of *good* quality, and that it is better that it should even be rather less white than that a substance should be used injurious to health. The above plea, it will be observed, takes no notice of the extra quantity of water which the bread retains by its admixture with alum.

It is curious to notice how constantly the adulterating shopkeeper endeavours to shelter himself, and to excuse his dishonest practices, under the assertion

* Considerations on the Ingredients used in the Adulteration of Bread-flour and Bread.

that the public " like it," and " will have it." We have recently heard the chicory-loving grocers assert that the public " like it," and " will have it," as though the public were such great fools as actually to experience pleasure, not only in being cheated of their money, but robbed frequently of health as well.

That alum, in the doses in which it is present in bread, is injurious to health, we will now proceed to show.

" Alum is probably injurious to plants.

" Bourgelat has seen a phthisical condition induced in horses by the use of alum in too great quantities.

" Alum acts chemically on the animal tissues and fluids. If a solution of it in water be added in certain proportions to albumen, it causes a white precipitate. It also forms insoluble combinations with milk and with gelatine. These phenomena explain the action of alum on the fibrinous, albuminous, and gelatinous constituents of the living tissues.

" The immediate topical effect of a solution of alum is that of an astringent—namely, corrugation of fibres and contraction of small vessels, by virtue of which it checks or temporarily stops exhalation and secretion, and produces paleness of parts by diminishing the diameters of the small bloodvessels. It is by these local effects that alum, when taken internally, causes dryness of the mouth and throat, somewhat increases thirst, checks the secretions of the alimentary canal, and thereby diminishes the frequency and increases the consistency of the stools, as observed by Wibmer, in his experiments made on himself with alum, in doses of three grains dissolved in five drachms of water, and taken several times during the day.

" But when alum is applied to a part in large quantities, and for a longer period, the astriction is soon followed by irritation, and the paleness by preternatural redness. And thus, taken internally in large doses, alum excites nausea, vomiting, griping, purging, and even an inflammatory condition of the intestinal canal—effects which may be perhaps induced by small quantities in persons endowed with unusual or morbid sensibility of the stomach and bowels, as in the case of the lady in whom dangerous gastro-enteritis was apparently induced by a single dose of a solution containing between ten and twenty grains of burnt alum.

" After its absorption, alum appears to act as an astringent or astringent tonic on the system generally, and to produce more or less general astriction of the tissues and fibres, and a diminution of secretion. Such at least appear to be its effects in some passive hæmorrhages and mucous discharges. Barbier says alum " irritates the lungs, and often produces cough," but I am not aware of any other practitioner having confirmed this statement. Kraus observes that the urine becomes remarkably acid from the use of alum."*

On the Addition of Chloride of Sodium or Salt to Bread.—The quantity of salt used in the preparation of bread is six or eight times greater than that of alum. It is generally stated at from four to six pounds to the sack of flour.

The latter estimate gives to each quartern loaf upwards of an ounce of salt; there is reason to believe, however, that the quantity employed is frequently much greater.

With fresh meat salt is commonly considered to be wholesome, and it probably is so, but it is doubtful whether the use of it in bread in such large quantities is conducive to health.

In doses by no means considerable, salt exerts a perceptible influence over the secretions, lessening their amount, and producing heat and thirst.

Salt has the same effect on flour as alum, although its action is less powerful—that is, it whitens the flour and enables it to hold more water.

On the Adulteration of Bread with Sulphate of Copper.—Sulphate of copper in very small quantities exerts an extraordinary effect on the colour and retentive capabilities of bread for water.

Of this property, bakers have been found on the continent, especially in Belgium, wicked enough to avail themselves. In England no instance of the employment of this deadly poison is known in the manufacture of bread.

* Pereira's Materia Medica.

The use of copper basins or sieves for the yeast to drain through is very common; a practice in itself not wholly free from danger.

The detection of even minute quantities of copper in bread is not difficult.

On the Adulteration of Bread with Carbonate of Magnesia.—The employment of this earthy salt has been actually recommended, on scientific authority, in the manufacture of bread.

Many years since, Mr. C. Davy took the trouble to make experiments, and to write an article on its use.

Carbonate of magnesia improves the colour of new and inferior flour, and increases the yield, neither of which results, so far as the public are concerned, are in the least desirable. The increased yield simply signifies *more water*.

The amount of magnesia required varies from *twenty to forty grains to the pound of flour*, according to the quality of the latter: from the use of this salt, in these quantities, Mr. Davy did not see the slightest objection.

We, however, are of a different opinion, and entertain a well-founded objection to the admixture, on such a wholesale scale, of earthy and almost insoluble substances in any article of our food, especially so important a one as bread.

State of the Law with respect to the Adulteration and Weight of Bread.—The following abstract is taken from M'Culloch's "Dictionary of Commerce:"—

"Under the assize acts, bakers are restricted to bake only three kinds of bread,—viz., wheaten, standard wheaten, and household; the first being made of the finest flour, the second of the whole flour mixed, and the third of the coarser flour. The loaves are divided into peck, half-peck, eight pounds eleven ounces, and the quartern, four pounds five and a half ounces, avoirdupois.

"Now, however, it is enacted, that within the City of London, and in those places in the country where an assize is not set, it shall be lawful for the bakers to make and sell bread made of wheat, barley, rye, oats, buck-wheat, Indian-corn, peas, beans, rice, or potatoes, or any of them, along with common salt, pure water, eggs, milk, barm, leaven, potato or other yeast, and *mixed in such proportions as they shall think fit*. (3 Geo. 4. c. 106. § 2.; and 1 & 2 Geo. 4. c. 50. § 2.)

"It is also enacted, by the same statutes, that bakers in London, and in the country, that is, in all places ten miles from the Royal Exchange, where an assize is not set, *may make and sell bread of such weight and size as they think fit*, any law or assize to the contrary notwithstanding. But it is at the same time enacted, that such bread shall always be sold by avoirdupois weight, of sixteen ounces to the pound, and in no other manner, under a penalty, for every offence, of not more than forty shillings; except, however, French or fancy bread, or rolls, which may be sold without previously weighing the same.

"Bakers or sellers of bread are bound to have fixed, in some conspicuous part of their shop, a beam and scales, with proper weights, for weighing bread; and a person purchasing bread may require it to be weighed in his presence. Bakers and others sending out bread in carts are to supply them with beams, scales, &c., and to weigh the bread, if required, under a penalty of not more than *5l.* (3 Geo. 4. c. 106. § 8.)

"Bakers, either journeymen or masters, using alum or any other unwholesome ingredients, and convicted on their own confession, or on the oath of one or more witnesses, to forfeit not exceeding *20l.* and not less than *5l.*, if beyond the environs of London, and not exceeding *10l.*, nor less than *5l.*, if within London or its environs. Justices are allowed to publish the names of offenders. The adulteration of meal or flour is punishable by a like penalty. Loaves made of any other grain than wheat without the city and its liberties, or beyond ten miles of the Royal Exchange, to be marked with a large Roman M, and every loaf so exposed. (1 & 2 Geo. 4. c. 50. § 6.)

"Any ingredient or mixture found within the house, mill, stall, shop, &c., of any miller, mealman, or baker, which, after due examination, shall be adjudged to have been placed there for the purpose of adulteration, shall be forfeited, and the person within whose premises it is found punished, if within the city of London and its environs, by a penalty not exceeding *10l.*, nor less than

40*s*., for the first offence; 5*l.* for the second offence; and 10*l.* for every subsequent offence. (3 Geo. 4. c. 106. § 14.) And if without London and its environs, the party in whose house or premises ingredients for adulteration shall be found, shall forfeit for every such offence not less than 5*l.*, and not more than 20*l.* (1 & 2 Geo. 4. c. 5. § 8.)

It thus appears —

1st. That the adulteration of bread with alum is an offence against the law, punishable by a penalty not exceeding 20*l.*

2nd. That the law requires that all bread (except French, fancy bread, and rolls) should be weighed; and the purchaser may require this to be done even when the bread is delivered by the baker at the house.

That the above are fit and proper requirements few will deny; that also the law respecting the adulteration and weight of bread is daily violated with impunity is notorious.

Our forefathers considered, and we think rightly, that to adulterate food and drink, and to convert that which should be a source of health and strength into one of injury and disease, was no light offence. Acting on this feeling, they were at much pains to frame laws calculated to meet an evil of great and undoubted magnitude.

Our present rulers are of a different opinion, and appear to consider that legislation on such matters is wholly unnecessary; for they not only permit various existing enactments relating to food and drink to be scandalously violated, but they even suspend Acts of Parliament, to give greater facilities for adulteration, as has now been done, for some years, in the case of coffee and chicory.

Such conduct is not calculated to increase our respect for the law, or those whose duty it is to execute it.

We have lately heard the present Chancellor of the Exchequer, Sir Charles Wood, express the greatest reluctance to institute excise prosecutions against parties adulterating coffee. We are at a loss to understand why any such reluctance should be either expressed or entertained. Is not the adulteration of coffee and other articles of consumption morally wrong; and is it not, moreover, a crime against the law? Then upon what grounds is the perpetrator of such an offence to be permitted to escape the punishment justly his due?

To be consistent, the Chancellor ought to express the same antipathy to prosecution in cases of theft or murder.

We entertain but little sympathy for crime in any form, and are not anxious to make out excuses for those who, through the food we consume, cheat us of our money, and sometimes rob us of health.

Results of the Microscopical and Chemical Analyses of Twenty-eight Samples of Bread, purchased at the Establishments of Bakers resident in the Metropolis.

1*st Sample.*—Purchased in Judd-street.
Adulterated—with *alum.*

2*nd Sample.*—Purchased in Whitechapel-road.
Adulterated—with *alum.*

3*rd Sample.*—Purchased in Chapel-street, Somers-town.
Adulterated—with *much alum.*

4*th Sample.*—Purchased in Judd-street.
Adulterated—with *alum.*

5*th Sample.*—Purchased in Skinner-street, Somers-town.
Adulterated—with *alum.*

6*th Sample.*—Purchased in New-street, Covent-garden.
Adulterated—with *a considerable quantity of alum.*

7*th Sample.*—Purchased in Long-lane, Barbican.
Adulterated—with *much alum.*

8*th Sample.*—Purchased in Drury-lane.
Adulterated—with *a considerable quantity of alum.*

9th Sample.—Purchased in Chapel-street, Somers-town.
Adulterated—with *alum.*
10th Sample.—Purchased in Clare-street.
Adulterated—with *very much alum.*
11th Sample.—Purchased in Clare-street, Clare-market.
Adulterated—with *a considerable quantity of alum.*
12th Sample.—Purchased in Drury-lane.
Adulterated—with *very much alum.*
13th Sample.—Purchased in Lower Marsh, Lambeth.
Adulterated—with *alum.*
14th Sample.—Purchased in Lower Marsh, Lambeth.
Adulterated—with *alum.*
15th Sample.—Purchased in the Barbican.
Adulterated—with *much alum.*
16th Sample.—Purchased in Upper Whitecross-street.
Adulterated—with *alum.*
17th Sample.—Purchased in Whitecross-street.
Adulterated—with *very much alum.*
18th Sample.—Purchased in Upper Whitecross-street.
Adulterated—with *alum.*
19th Sample.—Purchased in High-street, Marylebone.
Adulterated—with *alum.*
20th Sample.—Purchased in High-street, Marylebone.
Adulterated—with *alum.*
21st Sample.—Purchased in Drury-lane.
Adulterated—with *alum.*
22nd Sample.—Purchased in Whitecross-street.
Adulterated—with *alum.*
23rd Sample.—Purchased—
Adulterated—with *alum.*
24th Sample.—Purchased in Whitecross-street.
Adulterated—with *a considerable quantity of alum.*

It is to be observed,—

1st. That the whole of the *twenty-four samples of bread* examined *were adulterated with alum.*

2nd. That in *no one of the samples was potato, or any other farinaceous matter, other than wheat-flour, detected; nor did any of the breads contain either carbonate or sulphate of lime.*

While the weight of the ash left after the incineration of the samples of flour, the analyses of which have already been given, varied from three to four, and in one case six grains to the ounce, being usually only three grains, that of the ash of the incinerated breads varied from seven to fourteen grains, and in one instance it even reached twenty-one grains.

These weights convey some idea of the quantity of saline matter present in bread adulterated with alum. It must be remembered, however, that the water of crystallisation, which forms a considerable part of the weight of most salts, is expelled by the incineration, and that therefore the quantity of saline ingredients actually present is much greater than the weight of the residual ash.

The League Bread Company.

In June of the present year, 1851, the League Bread Company issued a long address or advertisement, soliciting the confidence and support of the public, mainly on the ground that the bread manufactured by it did not contain alum. The following quotation is taken from this advertisement:—

"The great and chief recommendations of the bread manufactured by this company are, its perfect purity, being warranted free from alum or any other pernicious ingredient, and the great care and cleanliness enforced in its manufacture."—*Times.*

These statements are accompanied by certificates from Dr. Ure and Mr. Scanlan.

To what extent either the statements or the certificates are to be relied upon, as respects alum, will appear by the accompanying analyses.

25*th Sample.* — Purchased at the League Bread Company's Depôt, 10. Charles-street, Middlesex Hospital.

Adulterated — with *much alum.*

26*th Sample.* — Purchased at the League Bread Depôt, University-street, Tottenham-court-road.

Adulterated — with *a small quantity of alum.*

27*th Sample.* — Purchased at the Depôt, 3. Broad-street, Golden-square.

Adulterated — with *a large quantity of alum.*

28*th Sample.* — Purchased at the Depôt, James-street, Oxford-street.

Adulterated — with *much alum.*

It thus appears, contrary to the written statement and warranty of the League, that alum is contained in the bread vended by that Company.

When we became aware how general was the use of alum amongst bakers, remembering the declaration of the League Bread Company above referred to, it occurred to us that we should at least have it in our power to inform the public where bread free from alum might be procured; in this expectation we regr ι to find that we have been unexpectedly disappointed.

ON THE WEIGHT OF BREAD.

The weight of a loaf of bread is made up not alone by the flour contained in it, but depends to a considerable extent upon the water present.

Flour in its ordinary state is estimated to contain about seventeen per cent. of water; but the quantity in new flour is greater than in old.

Bread made without either alum or salt contains, as we shall see presently, a very much larger per-centage of water. Made with alum and salt, the proportion is still higher. And when, with these ingredients, rice-flour is used, the quantity of water imbibed and retained is even greater.

Again, new bread weighs more than stale, the latter losing a portion of its water by evaporation.

This circumstance is well known to bakers, with whom it is a common practice to throw empty sacks over the loaves, as soon as they are taken out of the oven, to prevent the escape of water.

Owing to this circumstance, it is frequently required in contracts that the bread should be delivered cold, and of the full weight.

In order to ascertain the extent to which the weight of bread is affected by certain of the causes above referred to, Mr. Guttridge, baker, of Shepherd's-bush, carefully prepared, under our direction, three loaves, the composition of which was as follows: —

The *first loaf* consisted of flour two pounds, of water and German yeast a sufficient quantity.

The *second loaf* contained, in addition, two scruples of alum and half an ounce of salt.

In the *third loaf* there were the same ingredients, but half a pound of the wheat-flour was replaced by the same quantity of rice-flour.

Immediately on removal from the oven, the first loaf was found to weigh two pounds eight ounces and a half, that is, it had taken up eight ounces and a half of water additional; the second, two pounds ten ounces, so that, deducting the alum and salt, it retained nearly nine ounces and a half; and the third, two pounds ten ounces and a half, it containing nearly ten ounces of water in addition to the seventeen per cent. belonging to the flour from which the bread was made.

At the end of twenty-four hours, the weights were as follows, — first loaf, two pounds, seven ounces, seven drachms; — second loaf, two pounds, nine ounces, three drachms, one scruple; — third loaf, two pounds, ten ounces, one scruple. Thus, the first loaf had lost five drachms, or more than half an ounce; the second loaf less than five drachms, and more than four drachms; the third loaf less than four drachms.

It thus appears that a loaf without alum is less retentive of water than one with, and that with rice the most so; also that the loss of a loaf in weight one day old is usually, for every two pounds of flour, about half an ounce.

Table showing the Weight of Bread as delivered at Houses.

1*st Baker.*

Loaves.		Weight.
Quartern, new	deficient	$3\frac{1}{4}$ oz.
Ditto ,,	,,	$1\frac{3}{4}$
Ditto, one day old	,,	$2\frac{1}{2}$
Half-quartern, new	,,	$1\frac{1}{2}$
Ditto, stale	,,	$2\frac{1}{2}$
Deficiency in four quarterns		$11\frac{1}{2}$

2*nd Baker.*

Half-quartern, one day old	deficient	1
Ditto ,,	,,	$1\frac{3}{4}$
Ditto ,,	,,	1
Ditto ,,	,,	$2\frac{1}{2}$
Deficiency in two quarterns		$6\frac{1}{4}$

3*rd Baker.*

Half-quartern, one day old	deficient	2
Ditto ,,	,,	2
Deficiency in one quartern		4

4*th Baker.*

Quartern, new	deficient	2
Ditto, stale	,,	$2\frac{1}{2}$
Deficiency in two quarterns		$4\frac{1}{2}$

5*th Baker.*

Quartern, new	no deficiency.	
Ditto, stale	deficient	$2\frac{1}{2}$
Deficiency in two quarterns		$2\frac{1}{2}$

6*th Baker.*

Half-quartern, one day old	deficient	1
Ditto ,,	,,	2
Ditto ,,	,,	$0\frac{1}{2}$
Deficiency in a quartern and a half		$3\frac{1}{2}$

7*th Baker.*

Half-quartern, one day old	deficient	1
Ditto ,,	exact weight	
Ditto ,,	rather over weight	
Deficiency in a quartern and a half	Less than 1 oz.	

8*th Baker.*

Quartern, one day old	deficient	$1\frac{1}{2}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	1
Ditto ,,	,,	$1\frac{1}{2}$
Deficiency in four quarterns		$5\frac{1}{2}$

9th Baker.

Loaves.		Weight.
Half-quartern, one day old	deficient	2 oz.
Ditto ,,	,,	2
Deficiency in one quartern		4

10th Baker.

Quartern, one day old	deficient	$3\frac{3}{4}$
Ditto ,,	,,	$3\frac{1}{2}$
Ditto ,,	,,	$2\frac{3}{4}$
Ditto ,,	,,	4
Half ditto ,,	,,	$2\frac{1}{4}$
Half ditto ,,	,,	2
Half ditto ,,	,,	$2\frac{1}{2}$
Deficiency in $5\frac{1}{2}$ loaves		1 lb. $5\frac{1}{4}$ oz.

11th Baker.

Half-quartern, one day old	deficient	$1\frac{3}{4}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	2
Total deficiency in four half-quarterns		$6\frac{3}{4}$

12th Baker.

Quartern, one day old	deficient	3
Ditto ,,	,,	$3\frac{1}{2}$
Total deficiency in two quarterns		$6\frac{1}{2}$

13th Baker.

Half-quartern, one day old	deficient	$0\frac{1}{2}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	$1\frac{1}{2}$
Ditto ,,	,,	2
Ditto ,,	,,	$1\frac{1}{2}$
Total deficiency in six half-quarterns		$8\frac{1}{2}$

It is commonly said, that thirteen make a baker's dozen; it is clear that bakers do not in general reckon the weight of the loaves they vend by this scale. Housekeepers! we advise you to put your scales in order.

The following letter relating to the short weight of bread, and showing the manner in which the evil may be met, is of much importance.

SHORT WEIGHT.

To the Editor of THE LANCET.

SIR, — In your admirable exposures of the nefarious practices of bakers in their trade, I observe you do not limit your investigations to adulteration, but show up the equally dishonest system they follow of mulcting the public in the understood weight of their bread. The Act of Parliament professing to check this latter fraud, in practice is a dead letter, as it places the onus of checking the baker on the purchaser, and imposes a trouble which in ninety-nine cases out of a hundred the public will not take.

I write this to acquaint you with a plan which is in every way a most effectual check to dishonesty in the weight of bread; and, as it has been enforced for about three years in this city by law, its practical efficiency for the purpose has been fully established.

The plan is simply to make it imperative on the bakers to stamp the weight upon all the loaves he makes. The provision to this effect in the Police Act of Edinburgh is twofold. It enacts: 1st., That every loaf of bread shall have impressed upon its upper surface the imperial weight in legible figures and letters; 2nd, That the vendor of any loaf not so stamped shall, if stamped with a false or unjust denomination of weight, be liable to a penalty of, I think, 5*l.*, and if unstamped he shall be liable to a like penalty, and the forfeiture of the bread. Fancy bread is exempt from this law.

I am happy to say, as the originator of this provision, that it has worked most satisfactorily, both for the fair dealer and the public, since it came into operation in Edinburgh. While it makes the baker or vendor of bread responsible for the weight of his loaves, it imposes no extra trouble or other restriction on him in his business. It merely makes him do what every other tradesman does —that is, vend his commodity by weight, and not by lump, as is virtually the way everywhere except in Edinburgh.

If these observations, on a very important matter as regards the interests of the poor *, who are the parties most imposed upon by the short-weight bakers, be thought worthy of publication in your patriotic pages, I shall be very glad.

I am, Sir, your obedient servant,

James S. Torross.

COFFEE, AND ITS ADULTERATIONS.

[second report.†]

In the first Report on Coffee and its Adulterations, published in The Lancet of the 4th of January, we stated that, after the expiration of the three months' notice which we then gave, it was our intention to publish, with the analysis of each sample, the name of the dealer of whom it was purchased, and this whether the coffee on examination was found to be genuine or adulterated.

The time has now arrived for acting up to this declaration. We are fully aware that in following this course we incur immense responsibilty, which the great objects we have in view—viz., the protection of the public health and of the honest trader, alone induce us to undertake.

We know that we expose ourselves to abuse, threats, legal proceedings, and to a misconstruction and misrepresentation of our motives and intentions; but, strong in our cause, we will not allow these considerations to deter us from fearlessly pursuing the course we deem necessary to effect our objects; and we feel assured that, in honestly discharging our duty, we shall secure the approval of the profession, the support of the press, and the thanks of the public.

We believe that the publication of the names of parties who sell adulterated articles is imperatively necessary, and that there is no other way equally efficacious by which the scandalous adulterations now so generally practised upon our food and drink can be kept in check.

Were we simply to describe the various adulterations resorted to, and not at the same time make known the names of the parties who are responsible for them, we believe that we should be doing more harm than good, and that, in place of serving the public, and remedying the evil, we should but extend and perpetuate it, by making known facts in reference to adulterations, of which the dishonest would not be slow to avail themselves.

The publication of Accum's researches, some years since, as well as of other more recent works, treating of the falsifications of food, have clearly been followed by increased adulteration.

So long as the Reports of the Analytical Sanitary Commission continue, (and we do not intend that they shall be brought to a speedy conclusion,) no fear need be entertained that any such result shall be permitted to ensue from its labours.

We propose to pass in review successively every article of food and drink, retracing our steps from time to time, and returning, as we do now, in the case

* The penny loaf, previous to the experiment of the stamping of bread, was never less than from two to three ounces deficient in its regular weight; or, in other words, the baker took about two bites out of his loaf before he handed it to the poor man. He is ashamed to do so now, as his "abstraction" stares him in the face in legible characters when he hands over the loaf.

† April 26th, 1851.

of coffee, to the consideration of articles which have already attracted our attention. In this way, visiting town and city, we shall perform the part of a vigilant Sanitary Police.

We believe that while we shall thus be promoting the interests of the public, and of the honest trader, we shall, in many instances, render an important service to those tradesmen, the commodities vended by whom are not in all cases found, on examination, to be genuine; because we know that, not unfrequently, they are themselves the victims of systematic adulterations practised by the manufacturers.

In the case of the adulteration of coffee there are clearly three parties amongst whom the blame must be shared.

First. The Lords of the Treasury, by suspending for so many years the operation of an Act of Parliament through the Treasury minute of 1840, whereby the adulteration of coffee with chicory is legalised, are very greatly to blame.

Second. Since the adulteration of coffee with beans, roasted corn, and substances other than chicory, is almost exclusively practised by manufacturers of chicory-powder, the conduct of these parties is, in many instances, highly culpable.

Lastly. Those retail grocers are much to blame who not merely adulterate coffee with chicory, but who purchase an article in the state of powder declared to be chicory, although they are well aware, from the price at which it is offered, as well as from other circumstances, that it is not genuine chicory-powder, but a compound specially prepared for the adulteration of coffee.

That the reports of the Analytical Sanitary Commission have already effected much good it would be easy to prove.

Our inquiries and disclosures have been the means of calling the attention of the public and of Parliament to the subject of the adulteration of food, the moral, sanitary, and pecuniary bearings of which have been much discussed.

To take the article coffee. We have already shown the nature of the adulterations, and the extent to which they are practised.

We have likewise shown, that for many of the adulterations discovered, manufacturers of chicory-powder are responsible, and also in what manner, and to what extent, the retail dealer is culpable.

We know that many grocers, in consequence of the exposures made, have abandoned the use of chicory, it becoming evident to them that, with due regard to their own characters, they could not continue mixing it with coffee, and afterwards to sell this compound as genuine coffee.

Others, again, have adopted a middle course, and now sell the genuine and the mixed or adulterated articles separately, professing to inquire of each purchaser which he prefers.

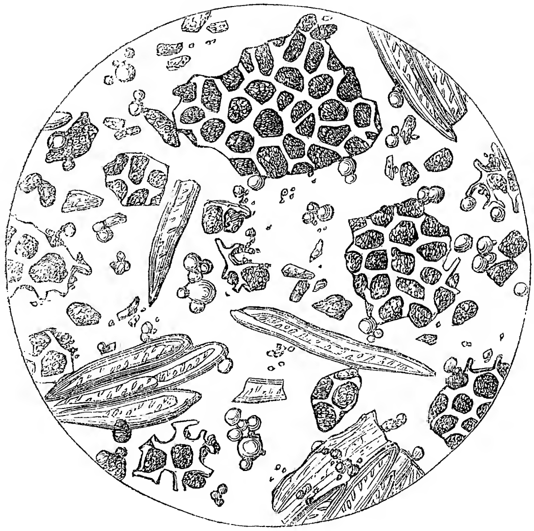
Although this proceeding is undoubtedly a step in the right direction, it is not all that is required, and we hold that in no case ought traders to sell the compound article. Chicory and coffee should be kept perfectly distinct, and sold separately under their own names; the purchaser, should he be unwise enough to prefer the mixture to genuine coffee, himself mixing the ingredients in such proportions as he thinks fit.

So long as the grocer can sell chicory under the name of coffee, and secure three times the profit which he is able to obtain from the sale of genuine coffee, it is clearly his interest to discourage the use of the genuine and promote that of the spurious article. This object it is quite possible for a dishonest trader to effect by selling *inferior* although *genuine* ground coffee, and thus bring discredit upon the pure commodity and injure its character in the estimation of the public.

We shall show also, hereafter, that in some cases the manufacturers have taken alarm, and have, for the present, ceased to adulterate the chicory-powder which they supply.

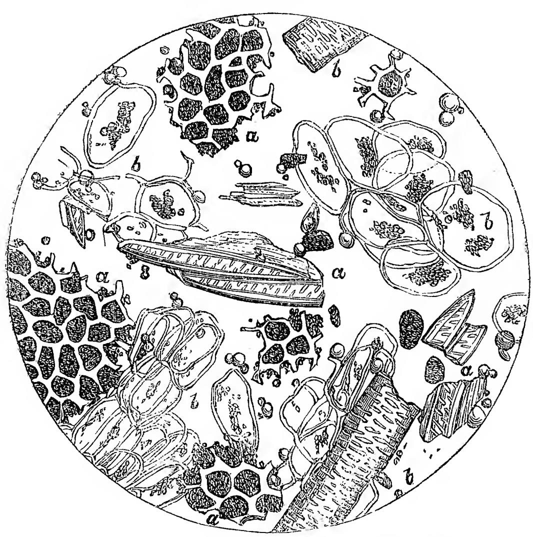
In the Reports on Coffee and Chicory, which have already appeared, we described minutely the structure of the coffee-berry and chicory root, and gave illustrative engravings. We now publish additional ones, exhibiting the characters and appearances presented by coffee examined under the microscope when adulterated with chicory, roasted corn, beans, &c.

Fig. 60.



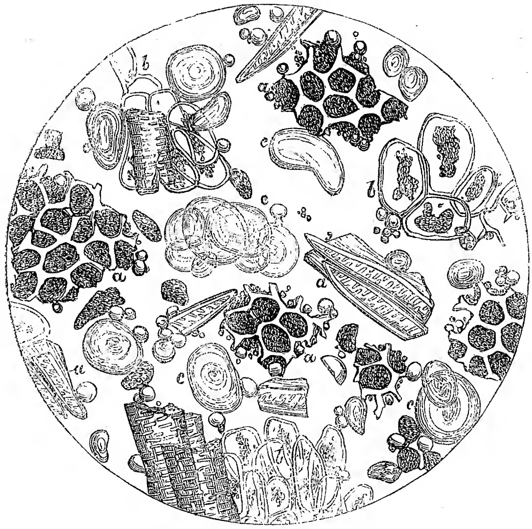
This engraving exhibits the structure and characters of *genuine ground* COFFEE.

Fig. 61.



Shows the structures in a sample of COFFEE *adulterated with* CHICORY.

Fig. 62.



Sample of *Coffee adulterated with both* CHICORY *and roasted* WHEAT.

Fig. 63.

Coffee adulterated with both CHICORY *and roasted* BEANS.

On an attentive examination of the preceding figures it will be apparent even to the ordinary and unscientific observer how remarkably coffee, chicory, wheat, and beans, differ from each other in structure, and how valuable and satisfactory is the means of discrimination furnished by the microscope.

Results of the Examination of Forty-two Samples of Coffee purchased at the Establishments of different Grocers resident in the Metropolis.

1st *Sample.*—Purchased of J. Butterworth, 110. Shoreditch. Price 1*s.* 8*d.* per lb.

Adulterated—with chicory.

2nd *Sample.*—Purchased of D. Punnett, "Punnett's Coffee-Pot," 129. High-street, Shoreditch. Price 1*s.* per lb.

Adulterated—with chicory.

3rd *Sample.*—Purchased at "Tulloch's Great Tea and Coffee Exchange," 71. Shoreditch. Price 1*s.* per lb.

The following is a *verbatim* copy of a bill issued by Messrs. Tulloch and Co., and in which the goods purchased at their establishment were enclosed:—

"The Coffee and Chicory Agitation.

"At the present time, when the public mind is agitated by all the conceivable contrivances which the ingenuity of interested men and selfish motives can suggest, we deem it proper to call attention to the fact, that we have always declared our readiness to grind our coffee under the immediate inspection of those of our customers who are tenacious of chicory. And now to demonstrate and give publicity to our *fair-dealing system*, we have placed *one of our mills in the window*, so that the most incredulous cannot but feel satisfied that they have a genuine article.

"We do not deprecate the moderate use of chicory with the finer description of coffee, as by that means a delightful beverage is brought within the reach of the poorer classes; but we do *condemn* the fallacious conduct of those who, under pretence of selling pure coffee, charge an exorbitant price, when, in reality, they vend an article adulterated to an extent never thought of by their less bombastic neighbours. Still we acknowledge that the people of this country have a right to expect a supply of genuine coffee, if they pay a price which will yield the retailer a fair profit; and we therefore invite all to our establishment, pledging ourselves to supply them with a wholesome beverage.

"Observe! Tulloch & Co., Great Tea and Coffee Exchange, 171. Shoreditch, 100 yards from the Railway Station, towards Shoreditch Church."

A second notice is thus worded:—

"COFFEES.

"The popular beverage of the day is Coffee; its cheapness invites general attention, and as a luxury rich and poor alike concur in esteeming it. It is universally admitted to be an agreeable as well as an invigorating and refreshing stimulant. The Coffee sold at this establishment will be found to possess, in the highest degree, the pure mellow properties peculiar to Coffee in its genuine state; a trial will prove its unsurpassed excellencies.

Good Sound Coffee - - -	1*s.* 0*d.*
Choice Ceylon Coffee - -	1*s.* 4*d.*"

The following is extracted from a third bill:—

"Method of Making Coffee in Dominica.

"The French always make use of Coffee for their breakfast, taking equal quantities of it and boiled milk, (or, more properly speaking, milk that is scalded;) and after their dinner they commonly drink a cup of coffee, without milk; and they have in general excellent health and a fine flow of spirits for this part of the world; whereas the English subjects, whom it is difficult to wean from prejudices, and though they enjoy a good state of health, do not appear to have half the vivacity or liveliness with the French in the same island with us."

Accompanying this quotation was a wood-cut, representing, in the centre, a group of "Coffee-merchants encamped for the night," surrounded by reclining Turks and others, enjoying the luxuries of hookhas and coffee.

Adulterated—with a large quantity of chicory; cold infusion highly and unnaturally coloured.

4th Sample.—Purchased of Phillips & Co., 8. King William-street, City. Price 1*s.* 4*d.* per pound.

Adulterated — with chicory.

5th Sample. — Purchased of Sidney, Wells, & Manuell, Tea-dealers, 8. Ludgate-hill. 1*s.* 4*d.* per pound.

Adulterated — with chicory.

6th Sample. — Purchased of Dakin & Company, Tea-merchants, No. 1. St. Paul's Churchyard. 1*s.* 4*d.* per pound.

Adulterated — with chicory.

In advertisements recently published in the daily papers, Messrs. Dakin & Co. announced that they now adopt the system of selling genuine ground coffee, and also mixtures of chicory and coffee, to be obtained at the option of purchasers. We are still of opinion that the two articles ought, in all cases, to be sold separately.

Since the appearance of these advertisements, we have made two purchases at the establishment of Messrs. Dakin & Co. On the first occasion, on asking for a bottle of coffee, the question was put to us whether we desired to have it pure, or mixed with chicory? on the second, no inquiry was made; coffee was asked for, and this, on examination, was found to contain *chicory.*

Thinking it possible that the sample of adulterated coffee above referred to might have been served by mistake, we have made (since the preceding was in type) a third purchase, and found this sample to be likewise adulterated with chicory.

The following extracts are taken from a prospectus issued by Messrs. Dakin; a copy of which we obtained at their establishment a few days since. (April, 1851.)

"*In order to insure to consumers the certainty of using only pure Coffee,* Dakin & Co. *recommend Purchasers to buy their Coffee whole, and to grind it themselves. With the view of affording every facility for so doing,* Dakin & Co. *continue to supply an excellent cast-iron Coffee-mill, complete, with adjusting screw and enamelled drawer, for the cost-price, namely,* 3*s.* 9*d.*"

We suggest to Messrs. Dakin, whether it would not be an equally effectual way to "*insure to consumers the certainty of using only pure coffee,*" if they were to supply, not only "*excellent cast-iron coffee-mills,*" but also the ground coffee-berry itself in the genuine state.

7th Sample. — Purchased of Holland & Co., 78. Lamb's Conduit-street, "For the Sale of the Finest Teas and Coffee at Reduced Prices." Price 1*s.* per pound.

"Plantation Coffee,
Full Flavour. 1*s.* per pound."

Adulterated — with chicory.

8th Sample. — Purchased of Hawthorn & Co., 74. High Holborn. Price 1*s.* per pound.

The following bill, printed in red type, and in conspicuous characters, we copy *verbatim*:—

"COFFEE FOR THE MILLION.
The Colossal Mills.
Hawthorn & Company
are the
Sole Proprietors
of the
Universally Celebrated
and
Incomparable
EUROPEAN
COFFEE,
ONE
SHILLING
PER POUND.

CAUTION.

THIS EXTRAORDINARY COFFEE having attained such an UNPRECEDENTED CELEBRITY, has induced many firms to assure the public that they can supply the same. Hawthorn & Co. beg to state that this UNIVERSALLY CELEBRATED COFFEE is not CONSIGNED to ANY OTHER HOUSE either IN or OUT of the metropolis; consequently NONE is GENUINE unless obtained from Hawthorn & Co.'s Tea, Coffee, and Colonial Warehouses,

74. HIGH HOLBORN."

A second handbill is as follows: —

"PRODIGIOUS
and
UNPRECEDENTED SALE
of
COFFEES.

"The following copy of a letter received from Messrs. SAVAGE & Company, the mill founders, who constructed our vast and colossal apparatus for pulverising coffee, will convey some idea of the enormous quantity sold at our establishment:

'April 2nd. 1846.

'GENTLEMEN, — Providing three mills the size of those large ones constructed by us for you, are moved by sufficient power, and kept in good condition, we are of opinion that they will grind five tons five cwt. of coffee per day of fourteen hours, or 11,760 pounds of coffee per day; 840 pounds of coffee per hour, fourteen pounds of coffee per minute.

'We are, gentlemen, yours respectfully,
SAVAGE & Co.

'To Messrs. Hawthorn & Company, 74. High Holborn.'

"Though this Powerful Grinding Apparatus is kept in constant operation, HAWTHORN & COMPANY find it

UTTERLY IMPOSSIBLE
to get
SUFFICIENT COFFEE GROUND
on
SATURDAYS;

They therefore earnestly request their friends to forward their orders as early in the week as possible, and beg to state that all orders given on the Saturday exceeding three pounds will be forwarded to any part of the metropolis or vicinity by twelve o'clock on Monday morning.

HAWTHORN & COMPANY,
THE HOLBORN COFFEE MERCHANTS,
Importers of Tea and Colonial Produce.
N.B.—THE INCOMPARABLE EUROPEAN COFFEE,
ONE SHILLING PER POUND,
can only be obtained at
OUR TEA, COFFEE, & COLONIAL WAREHOUSES,
74. HIGH HOLBORN,
THE HOLBORN COLOSSAL MILLS.

"*The immense Rush of Customers, and the long-continued influx of Business,* wholesale and retail, has compelled us entirely to *reconstruct* and very greatly enlarge our premises, which are now *the most spacious and splendid in this part of the metropolis,* and in every respect adapted for our immense and still rapidly increasing business, affording every convenience and comfort to purchasers."

A third and more recent placard is thus printed: —

"A Cup of
STRONG COFFEE

is the ONLY LUXURY I indulge in; I ran half over LONDON, but could not obtain any, till one day an old lady-friend of mine stopped me and said, 'You wear out a deal of shoe-leather unnecessarily; just call in at

HAWTHORN'S,
The eminent Holborn Coffee Merchants,
74. High Holborn,
and get some of their
EXTRAORDINARY
EUROPEAN COFFEE,
One Shilling per Pound,

and you will never drink any other.' I DID so, and must say that it is the STRONGEST AND MOST DELICIOUS COFFEE I ever tasted."

Adulterated — with very much chicory, which forms the principal part of the article; infusion deeply and unnaturally coloured.

9th Sample. — Purchased of Underwood & Co., 54. Long-acre. Price 1*s.* per pound.

Adulterated — with a considerable quantity of chicory, which forms not less than one-third of the sample.

10th Sample. — Purchased of James Appleton, 174. Drury-lane. 1*s.* per pound.

"Rich flavoured Coffees fresh roasted daily.

USE OF COFFEE IN TURKEY.

"Sandys, the translator of Ovid's 'Metamorphoses,' and who travelled in Turkey in 1610, gives the following passage in his 'Travailes,' page 51. (edit. 1657). Speaking of the Turks, he says: — 'Although they be destitute of taverns, yet have they their coffee-houses, which something resemble them. There sit they chatting most of the day, and sip of a drink called coffa, of the berry that it is made of, in little china dishes, as hot as they can suffer it, black as soot, which helpeth, as they say, digestion, and procureth alacrity.'"

Adulterated — with chicory, of which not less than half the sample consists.

11th Sample. — Purchased of W. & G. Law, Coffee Merchants to the Queen, 544. New Oxford-street. Price 1*s.* 4*d.* per pound.

Adulterated — with chicory.

Having been informed, since the above was in type, that Messrs. Law had just adopted the system of selling genuine ground coffee, and also coffee adulterated with chicory, to be procured at the option of the purchaser, we obtained another sample sold as coffee, which we found on examination to contain *chicory*.

In a bill, exhibited in the windows of their establishment, we noticed the following sentence, which occurs after the enumeration of a variety of coffees, with their prices —

"To be had in any quantity, Raw or Roasted, Whole or Ground, and genuine or mixed, according to taste."

12th Sample. — Purchased of Henry Sparrow & Co., 371. Oxford-street. Price 1*s.* per pound.

"STRONG AND FULL FLAVOURED COFFEE, 1*s.* per pound,
Roasted on the same principle as
SPARROW'S CONTINENTAL COFFEE,
Whereby the STRONG AROMATIC FLAVOUR is PRESERVED, which in the ordinary process of roasting is entirely destroyed.

Also by ROYAL LETTERS Patent, Sparrow's CONTINENTAL
Coffee Pot,
Sold Wholesale and Retail by
HENRY SPARROW & COMPANY,
Patentees and Sole Proprietors of the
CELEBRATED CONTINENTAL COFFEE,
371. Oxford-street."

Adulterated — with chicory.

13th Sample. — Purchased of Houle & Co., 282. Oxford-street. Price 1*s.* 4*d.* per pound.

Adulterated — with chicory, which forms nearly one-half the sample; cold infusion unnaturally coloured.

14*th Sample.*—Purchased of W. R. Turner, 267. Oxford-street. Price 1*s.* per pound.

Adulterated—containing very little coffee, but consisting principally of chicory.

15*th Sample.*—Purchased of J. M. Guest, 218. Oxford-street. 1*s.* per pound.

Adulterated—with a considerable quantity of chicory, and a vegetable substance, closely resembling horse-chesnut.

We have on several occasions purchased of Mr. Guest samples of both coffee and chicory; and have invariably found the coffee to be adulterated both with chicory and the vegetable substance above referred to, and the chicory with the latter only. Of this adulteration no doubt Mr. Guest was ignorant, and that it existed in the chicory powder as purchased.

16*th Sample.*—Purchased of A. C. Strugnell & Co., 221. Oxford-street. 1*s.* per pound.

Adulterated—with a considerable quantity of chicory.

17*th Sample.*—Purchased of Pembridge & Hunt, 107. Tottenham-court-road. 1*s.* per pound.

Adulterated—containing a very considerable quantity of chicory.

18*th Sample.*—Purchased of Mr. Bousefield, 111. Tottenham-court-road. 1*s.* per pound.

Adulterated—containing very little coffee, the chief ingredient being chicory, the quantity of which is so considerable as to cause the article to cohere into a firm mass. Cold infusion highly and unnaturally coloured.

19*th Sample.*—Purchased of G. Clarke, Tea and Coffee Merchant, 135. Tottenham-court-road. 1*s.* per pound.

"COFFEE,

"The richest and most grateful beverage we possess, holds an important place in domestic economy, and has peculiar claims on the part of consumers to obtain it pure, wholesome, and free from the vicious acids generated by improper roasting.

"The many tedious and expensive processes that have been introduced have alike proved themselves failures, and the true secret remains, that no improvement has been made on the ORIGINAL METHOD of roasting when conducted with proper care and attention. Our coffees are roasted with every possible care and economy; and with the advantages of our long experience as practical coffee-roasters, we are able to bring out and preserve its delicious qualities, particularly the rich aromatic flavour.

"In preparing for the table, coffee is prepared with or without boiling, according to taste; but all agree that to have COFFEE IN PERFECTION, it must be made QUICKLY, and served up HOT, STRONG, and CLEAR.

"THOROUGH GOOD AND USEFUL COFFEE, WHICH NEVER FAILS TO GIVE SATISFACTION - - } 1*s.* 0*d.* & 1*s.* 2*d.*

CLARKE'S
TEA AND COFFEE WAREHOUSE,
135. TOTTENHAM-COURT-ROAD."

Adulterated—containing very little coffee, the greater part consisting of chicory.

20*th Sample.*—Purchased of Waller & Co., 80. Charlotte-street, Tottenham-court-road. 1*s.* per pound.

Adulterated—containing very little coffee, chiefly chicory.

21*st Sample.*—Purchased of H. M. Beckett, 23. Devonshire-street, Lisson-grove. 1*s.* per pound.

Adulterated—with chicory.

22*nd Sample.*—Purchased of Wm. Harper, 24. James-street, Lisson-grove. 1*s.* 4*d.* per pound.

Adulterated—with chicory.

23*rd Sample.*—Purchased of Mr. Green, 45. New Church-street, Edgware-road. 1*s.* per pound.

Adulterated—with a considerable quantity of chicory.

24*th Sample.*— Purchased of T. Edmunds, 49. Seymour-place, Bryanston-square. 1*s.* per pound.

Adulterated — the greater part of the sample consists of chicory; infusion deeply and unnaturally coloured.

25*th Sample.* — Purchased of Nicholas Hall, 135. Edgware-road. 1*s.* per pound.

"QUALITY THE TEST OF CHEAPNESS.
Finest old Java or Plantation, 1*s.* per pound."

Adulterated — principal ingredient chicory.

26*th Sample.*— Purchased of F. W. Strugnell, Edgware-road. 1*s.* per pound.

Adulterated — with a very considerable quantity of chicory.

27*th Sample.* — Purchased of Bodley & Co., Edgware-road. 1*s.* per. pound.

Adulterated — very little coffee; chief ingredient chicory; infusion deeply and unnaturally coloured.

28*th Sample.*— Purchased of W. J. Martin, 147. Edgware-road. 1*s.* per pound.

Adulterated — with much chicory.

29*th Sample.* — Purchased of Westbrook & Co., 21. Oxford-street. Price 1*s.* 4*d.* per pound.

Adulterated — with chicory.

The purchaser was assured that this article contained no chicory, and was perfectly genuine.

30*th Sample.*— Purchased of C. Belchem, 120. Drury-lane. Price 1*s.* per pound.

Seeing the following notice in the window, printed in large characters, we asked to be supplied with the article referred to therein :—

"By Appointment.
PATENT DESICCATED COFFEE,
And no Chicoree,
Daily roasted by the Company's
Approved Principle.
1*s.* per pound.
Strongly recommended."

A written placard was also placed in the shop entrance, which ran as follows : —

"Noted pure and fresh-roasted
COFFEES,
1*s.* per pound,
Warranted a Genuine Article."

Adulterated — with chicory, and containing numerous fragments of some amorphous substance.

31*st Sample.* — Purchased of James Robinson, 156. Bishopsgate-street Without. Price 1*s.* 4*d.* per pound.

The following is a copy of a written placard, of gigantic proportions, placed near the shop-door : —

"GENUINE COFFEE.
No adulteration.

"We conceive that it is our duty to caution our friends and the public against the present unjust and iniquitous system pursued by many grocers in adulterating their coffee with

Roasted beans,
Dog biscuit,
Chicory, and tan.

"Our advice to purchasers of coffee is, to buy it in the berry, and grind it yourselves; if you cannot do this, purchase it of respectable men only; pay a fair and honourable price for it; you may then depend upon a GOOD and GENUINE article."

Adulterated — with a very large quantity of chicory.

In our first report on coffee, out of between thirty and forty samples of that article purchased at apparently reputable establishments, but two were found to be unadulterated, those having been procured of Mr. J. F. Betts, 262. Oxford-street, and Messrs. Knight and Son, 83. Gracechurch-street, City.

We then expressed a hope that there were hundreds of dealers who, like Mr.

Betts and Messrs. Knight and Son, were sellers of genuine coffee, and who were equally entitled to the respect and confidence of the public.

On this occasion we have the satisfaction of making known the names of other tradesmen, who, amidst considerable temptation, and under disadvantages, have been ascertained to be conducting their business in a fair and upright manner, and to be selling under the name of coffee the genuine commodity,

The samples of coffee obtained at the following establishments have been analysed, and found to be perfectly genuine : —

Messrs. RIDGWAY & Co.,
4 & 5. King William-street,
City.

Mr. HENRY SHARPE,
44. Bishopsgate-street Within,
City.

Mr. E. DEANE,
4 & 5. Shoreditch, High-street.

Messrs. KNIGHT & Son,
83. Gracechurch-street,
City.
(*Second Trial.*)

Messrs. FORTNUM & MASON,
181. Piccadilly.

Messrs. J. BRANSCOMBE & Co.,
88. Pall-Mall.

Messrs. DANN, JOHNSTON, & Co.,
84. New Bond-street.

Messrs. G. PAYNE & Sons,
328. Regent-street.

Mr. J. F. BETTS,
262. Oxford-street.
(*Second Trial.*)

Mr. STANIFORTH,
138. Oxford-street.

Mr. W. HOLLAND,
127. Oxford-street.

From an examination of the Table of Analyses in this Report, it appears —

1st. That out of the forty-two samples of coffee submitted to analysis, *eleven were unadulterated.*

2nd. That *the remaining thirty-one samples were all adulterated with chicory,* which was met with in every proportion, it in many cases constituting the chief part of the article.

3rd. That *in two cases only was any other adulteration than that with chicory observed,* — one consisting of a vegetable substance resembling horse-chesnut, and the other, of some amorphous substance, probably used for colouring, as burnt sugar.

Many of the samples, purporting to be coffee, and sold at 1*s.* and 1*s.* 4*d.* per lb., consisted principally of chicory.

We have compared several of these with the mixture of chicory and coffee sold by Dakin and Co. at 8*d.* per lb., and this we have in many cases found to contain the largest proportion of coffee.

We mention this circumstance, because it serves to show the extent to which the public is defrauded through the vicious system of selling a spurious article under the name of the genuine commodity.

In our first Report on Coffee we gave two Tables of Analyses. From an examination of the first table, it appeared —

1st. That the *thirty-four coffees, with three exceptions, were adulterated.*
2nd. That *chicory was present in thirty-one instances.*
3rd. *Roasted corn in twelve.*
4th. *Beans and potato-flour, each in one case.*
5th. That *in sixteen cases the adulteration consisted of chicory only.*
6th. That *in the remaining fifteen samples the adulteration consisted of chicory, and either roasted corn, beans, or potatoes.*
7th. That *in many instances the quantity of coffee present was very small; and in others, it formed one fifth, fourth, third, half, and so on, of the whole article.*

The results of the analyses of the twenty samples contained in the second table were as follow: —

1st. That *eighteen out of the twenty samples were adulterated with chicory.*
2nd. That *four of the samples contained roasted corn in addition to chicory.*

Contrasting the results obtained from the more recent, with those of the earlier analyses, it appears, that while the adulteration of coffee with chicory has not undergone any diminution, that with roasted corn, beans, &c., has much declined. This satisfactory result we believe to be mainly attributable to the exposures which we have made, and which have done more to check the adulteration of food than has the whole and very costly machinery employed for that purpose by the Excise authorities.

For the increased adulteration of coffee with chicory (which ingredient, in fact, now takes the place, to a considerable extent, of coffee), we have to thank the disgraceful policy pursued by the Lords of the Treasury, with the sanction of Sir Charles Wood, in legalising this adulteration.

The reader, in the course of the perusal of the notices and hand-bills, of which we have inserted copies, cannot fail to have observed the exaggerations, contradictions, and untruths, contained in many of them. In our opinion, these handbills show great want of principle, and exhibit a very unsound state of trade.

In the course of our observations, we have made repeated reference to a certain "Treasury Order." Many of our readers will be curious to learn in what terms an order sanctioning adulteration and fraud could possibly be couched with any appearance of propriety. The following is a copy of it: —

"GENERAL ORDER.

Excise-Office, London, August 31st, 1840.

In pursuance of directions from the Right Honourable the Lords Commissioners of Her Majesty's Treasury, signified by Mr. Gordon's letters of the 6th and 25th instant,

Ordered, — That no objections be made on the part of the Revenue to dealers and sellers of coffee mixing chicory with coffee, or to their having the same so mixed on their premises. By the Board,

(Signed) CHARLES BROWN."

The demoralising nature of this document it is unnecessary to dwell upon; it has been appropriately termed, "An Order to enable Coffee-dealers to defraud the public, especially the Working Classes, and the Revenue of vast sums of money."

THE ANALYTICAL SANITARY COMMISSION.

To the Editor of THE LANCET.

SIR, — We have obtained a copy of your last issue of THE LANCET, and on reading over your Report on "Coffee and its Adulterations" find ourselves referred and appealed to. After alluding to the advertisements that we have recently issued, in which we state our intention of selling pure ground coffee, to purchasers expressing a wish to obtain pure ground coffee, and coffee and chicory mixed, to those desiring coffee and chicory mixed, you mention that you have caused two purchases to be made at our establishment, and that on the first occasion, on requesting a bottle of coffee, you were asked whether you desired it pure, or mixed with chicory. The result of this purchase you have not given, though it would have been more satisfactory had you done so, but you immediately proceed: "On the second no inquiry was made, coffee was asked for, and this, on examination, was found to contain chicory."

"*Obs.*—Thinking it possible that the sample of adulterated coffee above referred to might have been served by mistake, we have made (since the preceding was in type) a third purchase, and found the sample to be likewise adulterated with chicory."

We cannot defend the negligence of the young man who served you, who, in direct opposition to our instructions, omitted in any instance to ask a purchaser whether he desired pure coffee, or coffee and chicory mixed.

When we consider that nine out of every ten who purchase ground coffee desire to have it mixed with chicory, and that the remaining one-tenth ensure obtaining pure coffee by asking for pure coffee, we really think that your purchaser did not, after our advertisements, express himself fairly by simply asking for coffee, when in a previous instance he had been taught that by asking for pure coffee, pure coffee only was supplied.

The great majority of purchasers of ground coffee wish to buy it mixed with chicory, and whilst we maintain that their wishes ought to be respected, we pay like respect to the wishes of all our customers, but we do not consider that we are asking too much of those who wish for pure coffee, when we request them to ask for it pure; precisely in the same way as purchasers of tea ask for black, green, or mixed tea, as they require it.

We have ordered, and have been disappointed in not yet receiving, silver receivers similar to those that we have in use, in order to have regularly assorted pure coffee at different prices, as well as coffee mixed with chicory, at different prices: each receiver will have the contents legibly marked thereon; and a request legibly printed is now being prepared for sticking up in the shop, that purchasers wishing pure coffee will ask for pure coffee. The bottles of pure coffee are all marked pure coffee, and so we hope, by the above arrangements, disappointment will be prevented, and all purchasers at our establishment will be served in accordance with the wish of its proprietors, by having the article supplied to them that they wish to purchase, and none other; and we beg to inform you that this is no new subject forced upon us by your strictures, for we can refer to our advertisements several years back, in which we urged customers wishing for pure coffee, to purchase it in the berry instead of ground.

We are, gentlemen, your obedient servants,

St. Paul's Church-yard, May, 1851. DAKIN & COMPANY.

⁂ Messrs. Dakin and Company will perceive that in our report on Canister Coffee, contained in THE LANCET of last week, we published the analysis of the bottle of coffee referred to in their communication, and stated that it was found to be *unadulterated.* The Messrs. Dakin appear to consider it incumbent on every purchaser desiring to obtain coffee, to state specifically that he requires it to be "pure" or "genuine," and that it is not sufficient that he asks simply for coffee. To this proposition we entirely demur, and are of opinion that every customer inquiring for COFFEE has a right to expect that he receives the article which he demands. In buying tea and sugar, it is not usual to ask for "*pure*" or "*genuine*" tea, or "*genuine*" sugar; neither is it customary, in sending to the wine merchant for a dozen of port to instruct the messenger to ask for "pure" port, nor does the purchaser expect that he will obtain a mixture of *tent* and port, or *cider* and port. We altogether deny the accuracy of the assertion that 'nine out of every ten who purchase ground coffee '*desire*' to have it mixed with chicory."

CANISTER COFFEE, AND ITS ADULTERATIONS.

In our second report on Coffee, published in The Lancet of Saturday, Apr 26th 1851, in enumerating the establishments at which genuine ground coffee was obtained, we omitted to give the prices of the several samples examined. We now compensate for that omission.

	Per pound. s.	d.		Per pound. s.	d.
Messrs. Ridgway & Co.	1	4	Messrs. Dunn, Johnston, & Co.	1	4
Mr. Henry Sharpe	1	4	Messrs. G. Payne & Sons	1	4
Mr. E. Deane	1	4	Mr. J. F. Betts	1	4
Messrs. Knight & Son	1	8	Mr. Staniforth	1	4
Messrs. Fortnum & Mason	1	4	Mr. W. Holland	1	4
Messrs. J. Branscome & Co.	1	4			

It will thus be seen that genuine ground coffee may be purchased at a very moderate price; this fact contradicting, in the most conclusive manner, the assertion so frequently made, that if chicory ceased to be mixed with coffee, the latter article would only be procurable at 2*s*., and the better sorts at even 3*s*. per pound.

In the report inserted in The Lancet on the 4th of January last, we expressed our belief that canister coffee was more adulterated than other coffee; this belief was grounded on the fact that it is commonly sold at the same price as when loose, although the cost of each canister is not less than from twopence to threepence. We now propose to ascertain how far our then-expressed conviction is sustained by analysis.

Results of the Microscopical Examination of Twenty-nine Samples of Coffee procured at the Establishments of various Tea Dealers and Grocers resident in the Metropolis, and contained in Sealed Packages, Bottles, and Canisters.

1*st Sample.* — Purchased of John Cassell, 80. Fenchurch-street, half-pound canister. Price 8*d*.

"JOHN CASSELL'S COFFEE,

"*The richness, flavour, and strength of which are not to be surpassed.*

"Coffee has now become an article of consumption amongst all classes of the community. Hence the importance of supplying an article of such a character as to encourage its consumption in preference to beverages, the use of which promotes a vast amount of misery.

"John Cassell's Coffee meets the requirement of the age, and, as a natural result, the celebrity to which it has attained is wholly unparalleled. Its peculiarity consists in its possessing that rich aromatic flavour, combined with great strength and deliciousness, which is to be found alone in the choicest mountain growths. It may with perfect truth be stated, that no article connected with *domestic economy* has given such general satisfaction, and the demand for it is rapidly increasing.

"John Cassell's Establishment, both for extent and capability, is the first in the empire.

OBSERVE.

"Every canister of John Cassell's Coffee bears his signature, without which none is genuine. Thus,

John Cassell."

Adulterated — with a considerable quantity of chicory.

2*nd Sample.* — Purchased of John Cassell, 80. Fenchurch-street. In paper and tin-foil package. Price 1*s*. 4*d*. per pound.

'*Coffee*

Has now become an article of consumption amongst all classes of the community. Hence the importance of keeping up a supply adequate to the increasing demand, and also of taking care that the article supplied is of such a character as to encourage its consumption in preference to beverages, the use of which produces a vast amount of misery.

"*John Cassell's Coffee* meets the requirement of the age, and the daily increasing demand for it from all parts of the kingdom demonstrates that it has only to be once introduced to be highly appreciated."

Adulterated—with a considerable quantity of chicory.

3rd Sample.—Purchased of Abbiss & Company, 60. Gracechurch-street.

"ABBISS & COMPANY'S
Celebrated
Patent Desiccated
Coffee
for
One Shilling."

It will be remembered that the Chancellor of the Exchequer, when he brought forward his first budget, in the course of an attempted defence of the adulteration of coffee with chicory, made the following remarks:—

"I hold in my hand a circular from a firm in the City, who say, what entirely agrees with what I have heard from other parties, that they have found an increase in the coffee trade in consequence of the admixture with that article of the 'wholesome and nutritive' root, chicory, &c."

This firm, we have reason to believe, is none other than that of Abbiss & Co., from whose circular we now make a few brief extracts:—

"Why, then, should we continue to decline the use of chicory? The public taste demanded it, the legislature sanctioned or permitted it; we had no reason to think that chicory was deleterious, but, on the contrary, possessed tonic qualities, and was decidedly WHOLESOME and NUTRITIVE. These reflections gradually brought us to the determination to *gratify the public taste*, and we found that AN IMMENSE INCREASE IN OUR COFFEE TRADE WAS THE RESULT; thus demonstrating, beyond the slightest doubt, that coffee, with an admixture of GENUINE CHICORY (which we take care to procure by purchasing the article in its raw state, and having it roasted the same as coffee), was preferred to coffee in its pure state."

Here, then, we appear to have the authority upon which the Chancellor of the Exchequer made his very notorious and equally erroneous statements—1st, that chicory root is wholesome and nutritive; and second, that its use occasions an "immense increase in the coffee trade." Let us now see how far Messrs. Abbiss & Co. act up to their own published statements.

In effecting the purchase of the canister of coffee, no intimation was made to us that it contained chicory. On referring to the circular already noticed, however, we observed the following:—

"* A canister containing one pound of good Family Coffee, ONE SHILLING.

"*The Coffees against which this mark is placed are mixed with that proportion of Chicory which, from the experience of several years, we have found to give satisfaction to the Public."

Adulterated—with a considerable quantity of chicory, and some roasted wheat farina.

4th Sample.—Purchased of J. D. Browning, 4. Gracechurch-street. Price 1*s.* 6*d.* per pound.

"PATENT
DESICCATED COFFEE.
(DAVISON & SYMINGTON, PATENTEES.)

"This principle is perfectly novel, being effected entirely by HOT AIR, and has the peculiar advantage of improving the article, both in colour, strength, and quality, preserving purity, richness of flavour, and all its aromatic qualities, whilst it excludes all burnt and acrid matter which, under the ordinary process, invariably arises. It is recommended by the most eminent of the faculty, as being especially adapted to persons of weak digestive organs.

J. D. BROWNING."

Adulterated—with chicory.

5th Sample.—Purchased of Sidney, Wells, and Manduell, 8. Ludgate-hill. Contained in a bottle. Price 1*s.* 6*d.* per pound.

"VERY CHOICE WEST INDIA COFFEE
at 1*s*. 6*d*. per pound,
From the
TEA ESTABLISHMENT,
8. Ludgate-hill."

Adulterated— with chicory.

6*th Sample.*—Purchased of Dakin & Company, No. 1. St. Paul's Church-yard. Price 1*s*. 4*d*. per pound.

On asking to be supplied with a pound bottle of coffee, the inquiry was made, whether we wished to have it pure, or mixed with chicory. We answered pure; and found it, on examination, to be

Unadulterated.

7*th Sample.* — Purchased of Mr. Pringle, 77. Bishopsgate-street Without. Price 1*s*. 4*d*. per pound.

"The Finest Concentrated
MOCHA
COFFEE.

"This Coffee cannot fail to give great satisfaction, being a combination of the Finest Mountain growths of Arabia. It is roasted upon an entirely new principle, which has the peculiar advantage of improving the article in strength and quality, preserving purity, richness of flavour, and all its aromatic qualities. When hot from the cylinder, it is ground and packed in air-tight canisters, to prevent evaporation, and will for a lengthened period retain its strength and full fragrant flavour."

Adulterated — with a considerable quantity of chicory.

8*th Sample.* — Purchased of Mr. Skelton, 49. Bishopsgate-street Within. Price 1*s*. 4*d*. per pound.

"SKELTON'S
COSTA RICA
PATENT
ROASTED COFFEE.

"It is a well-known fact, that from the earliest introduction of Coffee as an alimentary beverage, the roasting has been effected solely by the berries coming in contact with hot metal, or other hot surfaces, which, as a natural result, scorches and chars the outside to a considerable extent before the interior is reached, causing that burnt disagreeable flavour so frequently complained of, besides the highly pernicious effects of empyreumatic oil thus generated.

"The Desiccating Process ensures the most perfectly uniform roast by a current of pure atmospheric air alone, thereby expelling all impurities, as they evolve during the early stage of the process; at the same time, so complete is the apparatus, that the moment the aroma begins to develop itself, which occurs only a few minutes previous to the roasting being completed, that instant all escape is prevented; thus the low-priced coffees become *Mochaised*, and rendered soft and clean to the palate, and the finest coffee is improved, inasmuch as the berries, being roasted uniformly throughout their substance, without charring on a metal surface, make, to all intents and purposes, a new beverage — a faculty Coffee — such as the weakest stomach will bear and enjoy.

"TESTIMONIALS.

"29. New Broad-street, May 3rd, 1848.

"Having been favoured with two samples of the same kind of Coffee, of which one had been roasted by the Patent Desiccating Company's process (Davison and Symington's patent), the other by the ordinary process, I found, on using them, that the beverage made from the former was decidedly clearer and brighter than that from the latter, and that it had also considerable advantage in point of flavour, being free from a certain bitter and somewhat pungent taste, which renders it less palatable and potable.

"Apothecaries' Hall, May, 1848.

"SIR,—I have submitted the sample of coffee roasted by your improved process, left with me, to a careful chemical examination, and find it to be free from the strong, acrid, empyreumatic oil, which gives to Coffee, as ordinarily prepared, so much of its unpleasant flavour, and doubtless, also, its injurious effects on many constitutions, at the same time that it possesses all the fine aromatic properties unimpaired: it is also much more evenly roasted throughout its substance, and I consider it a very great improvement on the old process.

I remain, Sir, yours respectfully,

R. WARRINGTON, Chemical Operator."

Adulterated—with a small quantity of Chicory.

9th Sample.—Purchased of James Robinson, 156. Bishopsgate-street Without, in half-pound canisters. Price 10*d.*

"ROBINSON'S

PATENT COMPRESSED COFFEE,

9. Lamb-street, Spitalfields, London.

"It is a well-known fact, that although the finest Coffee in the world is imported into England, yet the British public have it from the dealer in such a state that the decoction therefrom is deficient of fragrance and briskness, and is unsavoury, flat, and unsatisfying. Those who purchase the Compressed Coffee will have no reason to complain of this. It is roasted upon new and scientific principles, and at the moment it is done to perfection, it is placed in the *Mills* while hot. It is immediately compressed into tin canisters by powerful machinery, and made perfectly air-tight. By this means, the vegetable oil is retained, and the delightful fragrance is preserved, instead of allowing it to evaporate. The coffee is always fresh, as if it were roasted and ground only a moment before, and is remarkable for richness in drinking and fulness to the palate, combined with that delicious flavour which has not been hitherto obtained.—Sold in tin canisters of one-pound and half-pound each, at 1*s.* 4*d.*, 1*s.* 8*d.*, and 2*s.* per pound.

"*Caution.*—None is genuine without the annexed signature, to counterfeit which is felony:—JAMES ROBINSON."

Adulterated—with a large quantity of chicory.

10th Sample.—Purchased of James Robinson, 156. Bishopsgate-street Without; one pound, in stoppered bottle. Price 1*s.* 4*d.*

"ROBINSON'S

PATENT COMPRESSED COFFEE.

One Pound Nett Weight of the

FINEST JAMAICA COFFEE,

One Shilling and Fourpence Per Pound.

"This delicious and aromatic berry, the valuable properties of which, by a process adopted in the roasting, are preserved in the highest perfection, so that in making, the very essence becomes speedily and entirely extracted, rendering it the most nutritious, exhilarating, and economic beverage it is possible to procure.

To be obtained only at

JAMES ROBINSON'S

CELEBRATED TEA AND COFFEE WAREHOUSE,

156. Bishopsgate-street Without.

N.B.—This coffee, roasted on the premises, and packed in bottles with air-tight stoppers, under the immediate inspection of J. R., will be found to retain its full strength and flavour for any length of time, in any climate."

Adulterated—with a considerable quantity of chicory.

11th Sample.—Purchased of Lindsey & Company, No. 1. Waterloo-road.

"ONE POUND CANISTER

Of the Finest Concentrated

PLANTATION COFFEE,

Fresh Roasted and Packed,

FROM

THE GREAT SOUTH WESTERN

TEA ESTABLISHMENT."

Adulterated—chief ingredient chicory; not much coffee.

12*th Sample.* — Purchased of Edmund Folkard, 40. Drury-lane. Half-pound canister. Price 6*d.*

"HALF-POUND CANISTERS
Of the celebrated
EXHIBITION COFFEE,
Consisting of a combination of the Finest Coffees from All Nations.

No. 3. — SIXPENCE.

"This beautiful compound of coffee gives that rich aroma so highly appreciated by Continental travellers, produces a beverage strong, bright, and clear, is rich and mellow in flavour, and must be appreciated by all the LOVERS OF A CUP OF GOOD COFFEE.

"This coffee being roasted on the most improved principle, which confines all that fragrance (which evaporates with the common roaster) so delightful and pleasing to the palate, and being packed hot, both from roasting and grinding, in well-seasoned canisters, which being perfectly air-tight will keep for any reasonable length of time, or in any climate, without the least injury to its original flavour; offering at once a canister of the finest compound of coffees ever imported into Europe.

TO BE HAD ONLY OF
EDMUND FOLKARD,
(From North, Simpson, Graham, and Company,)
GROCER, TEA-DEALER, AND ITALIAN WAREHOUSEMAN,
No. 40. DRURY-LANE,
(Opposite Great Queen-street.)"

Adulterated — scarcely any coffee; nearly all chicory and mangel-wurzel.

13*th Sample.* — Purchased of Edmund Folkard, 40. Drury-lane, half-pound canister. Price 8*d.*

Adulterated — containing very little coffee, but consisting chiefly of chicory and mangel-wurzel.

14*th Sample.* — Purchased of Westbrooke & Company, 21. Oxford-street, corner of Hanway-street. Price 1*s.* 4*d.* per pound.

"FINEST
JAMAICA COFFEE
IMPORTED,
(Containing Chicory),
ONE SHILLING AND FOURPENCE THE POUND.

"Roasted on an improved principle for evaporating the equaceous, bitter, and acidulous properties, retaining the rich aroma and exhilarating qualities of the berry."

Adulterated — with a considerable quantity of chicory.

The words "Containing Chicory" were written on the wrapper, and not printed. In making the purchase, no intimation was given that the article contained chicory.

15*th Sample.* — Purchased of M. Jones & Company, 166. Oxford-street. Price 1*s.* 4*d.* per pound.

"POUND CANISTER
Of Fine Rich
MOUNTAIN COFFEE
At 1*s.* 4*d.* per lb.
No Charge for Canister."

Adulterated — with a considerable quantity of chicory.

16*th Sample.* — Purchased of James Way & Company, 272. Oxford-street. Price 1*s.* 4*d.* per pound.

"WAY'S PATENT COMPRESSED
COSTA RICA COFFEE.
PURE COFFEE.
ROASTED BY STEAM.
THE OLD ESTABLISHED WAREHOUSE,
272. Oxford-street.

"The consumption of COFFEE at this season of the year greatly increases; and as ninety-nine houses out of one hundred adulterate Coffee, the Proprietors of this Establishment offer *Pure Coffee*, feeling confident that the experiments their Coffee Buyer has made during his recent visit to Paris, enables them to supply Coffees such as are used in the *Café in France*. The Public will find that —

1*lb. of Pure Coffee will go as far as* 1½*lb. that is adulterated.*

One Pound of Pure Costa Rica Coffee - -	1*s*. 4*d*.
One Pound of Pure Jamaica Coffee - - -	1*s*. 6*d*.
One Pound of Pure Mocha Coffee - - -	1*s*. 8*d*.

One Trial of the above Coffee as a sample is earnestly solicited.

JAMES WAY & Co."

Adulterated — with a considerable quantity of chicory.

17*st Sample.* — Purchased of Rogers & Company, 97. Crawford-street. Price 1*s*. 4*d*. per pound.

"PURE
PARISIAN COFFEE,
(Requires no boiling.)

"It is a well-known fact that France for nearly a Century has been noted as the only place where Coffee could be procured with that Aromatic Fragrance so pleasing to the taste of the most refined Connoisseur.

"Many attempts have of late been made in England to bring this delightful beverage to the same perfection; but have proved fruitless.

"Messrs. R. & Co., after many years' experience, have succeeded in preparing a true Parisian Coffee, the Decoction of which will be found equal to that obtained in the celebrated Cafés of Paris.

"We especially direct public attention to the manner in which our Parisian Coffee is Ground, as a proof that much greater importance must be attached to the Grinding than is ordinarily the case, since many persons who grind their own through small Mills, do not crush the Coffee sufficiently to allow the whole of its Aromatic properties to be extracted without boiling, which at once deteriorates the beverage by evaporating its Fragrance. Therefore, to make good Coffee, it is necessary that it should be ground sufficiently fine, and not boiled.

"This exquisite Coffee is roasted under the immediate superintendence of the Proprietors, Ground Hot from the Cylinder, and compressed into Air-tight Canisters, thus preserving that delightful Aroma and Fragrance so generally sought after. It also possesses many advantages, being double the strength of ordinary Coffee, and when made is perfectly bright and clear.

Price 1*s*. 4*d*., and 1*s*. 8*d*. per Pound.
(No charge for Canister.)"

Adulterated — more than half the article consisting of chicory, mangel-wurzel, and a third vegetable substance.

18*th Sample.* — Purchased of Stanbury, Brothers, & Co., 2. Portman-place, Edgware-road.

"SELECTION OF THE BEST
COFFEES
IMPORTED,
Packed Air-tight.

"This delicious and aromatic berry, the valuable properties of which, by a process adopted in the roasting, are preserved in the highest state of perfection, so that in making the very essence becomes speedily and entirely extracted, rendering it the most nutritious, exhilarating, and economic beverage it is possible to procure.

TO BE OBTAINED ONLY AT

STANBURY, BROTHERS, AND CO.

"It is warranted to keep fresh and good for six months, if the lid be placed on directly after using."

Adulterated — with a considerable quantity of chicory, which forms nearly one-half the article.

19*th Sample.* — Purchased of T. Horne, 124. Edgware-road. Half-pound canister, price 8*d.*

"HALF A POUND CANISTER OF

T. HORNE'S

Finest Concentrated

COFFEE.

Price 8*d.*, Canister included.

"This coffee is roasted on the best and most approved principle, by which means the rich aroma and exhilarating qualities of the berry are perfectly retained.

"By being packed in perfectly air-tight canisters, it will keep good for any length of time."

Adulterated — consisting principally of chicory; not much coffee.

20*th Sample.* — Purchased of C. E. Back, 123. Tottenham-court-road. Price 1*s.* per pound.

"ONE POUND CANISTER OF

Fine Concentrated

TURKEY COFFEE.

"This coffee is roasted entirely upon an improved principle, whereby that richness of flavour and fragrance so much sought after by all connoisseurs is preserved. It is ground immediately after it is roasted, and while in a warm state secured in packages impervious to the air; it is thus uninjured by the atmosphere, and for a lengthened period retains its full fragrant richness.

TO BE HAD ONLY AT

C. E. BACK'S

EUROPEAN

COFFEE MART."

Adulterated — chiefly chicory; very little coffee.

21*st Sample.* — Purchased of Salmon & Company, 69. Tottenham-court-road. Price 1*s.* 4*d.*

"ONE POUND,

Ground and Compressed,

Finest

JAMAICA COFFEE.

"There are now so many methods of roasting coffee to which the public attention is directed, that the vendors of this superior coffee will not lay claim to any of them: suffice it to remark, that they have tried all plans now extant for roasting coffee, and have come to this conclusion — that there is very little difference between any of them, the grand secret, after all, being, to use only good coffee. None of the systems of roasting, whether patent desiccated, by steam, in silver cylinders, or any other of the new-fangled modes which it is the prevailing practice to vaunt before the public, are capable of converting bad coffee into good. The desideratum required, then, is good coffee. On this we make our stand, and resolve to sell none but 'good coffee.'

SALMON AND COMPANY,

DEALERS IN TEA, COFFEE, AND

COLONIAL PRODUCE."

Adulterated — containing a considerable quantity of chicory.

22*nd Sample.* — Purchased of Bousfield, 111. Tottenham-court-road. Price 1*s.* 6*d.* per pound.

" This canister contains
ONE POUND
of the Finest
MOUNTAIN BERRY MOCHA.
Price 1*s.* 6*d.*,
Canister included.

" This coffee is particularly noted for its great strength and truly delicious flavour, very superior to any other kind imported, and being packed perfectly air-tight immediately after it is roasted, preserves the aroma and richness so very desirable to all who delight in a cup of really fine coffee. To families residing in the country we especially recommend it.

From
BOUSFIELD'S."

Adulterated — with a considerable quantity of chicory, which forms about one-third of the article.

23*rd Sample.* — Purchased of Stubbs, 140. Edgware-road. Price 1*s.* per pound.

" Coffees roasted on the premises daily, and packed hot.

This canister contains
ONE POUND OF
Choice
J A M A I C A   C O F F E E.

" This coffee is particularly noted for its great strength and truly delicious flavour, very superior to any other kind imported, and, being packed perfectly air-tight immediately after it is roasted, preserves the aroma and richness so very desirable to all who delight in a cup of really fine coffee. To families in the country we especially recommend it.

Observe! Sold only by
STUBBS."

Adulterated — with a considerable quantity of chicory, which forms more than half the article.

24*th Sample.* — Purchased of A. Andrews & Co., 57. Tottenham-court-road. Price 1*s.* 4*d.* per lb.

" DR. FOTHERGILL'S METHOD OF MAKING COFFEE.

" Let coffee be made in the usual manner, only a third part stronger; let as much boiling milk be added to the coffee before it is taken from the fire, as there is water; let it settle; drink it with cream, or without, as may be most agreeable. Very little sugar ought to be used with the coffee; on weak stomachs it is too apt to become acid, if made sweet, and this is one reason why many people forbear drinking coffee. I do not presume to settle the important question: which is preferable, tea or coffee? This must be left to the experience of individuals. Though I like tea, I found it not quite favourable to my health; from some circumstances, I tried coffee made in the manner above mentioned, and have drunk it almost constantly many years, without receiving any inconvenience from it, but, on the contrary, very great benefit."

Adulterated — consisting chiefly of chicory, with but little coffee.

25*th Sample.* — Purchased of Mr. Holme, 132. Tottenham-court-road. Price 1*s.* 4*d.* per lb.

" One Pound Nett Weight,
CONCENTRATED
COSTA RICA COFFEE,
OF GREAT STRENGTH AND FLAVOUR.
Sole Proprietor of the Celebrated Compound Coffee.

Adulterated — with a small quantity of chicory.

26th Sample.—Purchased of Hawthorn & Co., 38. Tottenham-court-road.

"HAWTHORN'S
EXTRAORDINARY
COFFEES!
It being the Testimony of Each Consumer that they are
UNSURPASSED AND UNEQUALLED.

"These coffees are roasted, and prepared by H. & Co.'s unique and perfect process, invariably developing all the strength, dispelling all objectionable properties, and always retaining the whole of the fragrant richness of this delightful berry, and, without exaggeration, presenting to the consumer coffee of most exquisite flavour and of matchless strength.

"The wonderfully large sale and wide-spread notoriety throughout London and the provinces, which H. & Co.'s coffees command, insure to all coffees of the freshest, strongest, and most fragrant character, and render it necessary to state that they are procurable only at the

Tottenham-court-road
COFFEE MILLS,
38. Tottenham-court-road,
Corner of Percy-street."

"The Prices for these
Unrivalled and Splendid
COFFEES
are
1*s.* 8*d.*, 1*s.* 6*d.*, 1*s.* 4*d.*, 1*s.* 2*d.*, and 1*s.*

"Their most beautiful flavour, owing to H. & Co.'s scientific admixture of varieties of coffees, and their great strength, resulting from H. & Co.'s peculiar mode of preparation, demand a continuous and increasing engagement of public favouritism and approval."

A bill, extensively distributed to persons passing by the establishment of Hawthorn & Co., is worded as follows:—

"COFFEES *without* CHICORY
or
COFFEES *with* CHICORY,
At the option of the Purchaser.

"HAWTHORN & COMPANY pledge themselves that all their Coffees are of the Finest Sorts, and that their Chicory is also the most genuine; and they now positively assert that they never have used any other than the Best and Purest of each. Hawthorn & Company's high character for Fine Coffees, and their LARGE SALE, is a sufficient guarantee to the customer, that they have not obtained that sale and that character by the use of inferior or of adulterated articles, and is also a security that their Coffees without Chicory, or their Coffees with Chicory, are all respectively of the

FINEST, PUREST, AND MOST GENUINE DESCRIPTIONS;

and they as positively deny any knowledge or use of the various infamous adulterations which are said to have been employed in the admixture of Coffees by some of the grocers in London and the country; and whilst they wish every one should be enabled to procure Fine Coffee and Pure Chicory separately, if desired, they respectfully announce that if bought from them in the mixed state, that none but the best of each is used; and with regard to the beneficial influence of Chicory with Coffee, they quote an extract on the subject from the *Morning Advertiser*—'We will undertake to say, that owing to the far richer flavour as well as greater cheapness of the mixed article, the Retail Dealers would sell Fifty Pounds for every One Pound they vended of Coffee without Chicory.'

THE TOTTENHAM COURT ROAD COFFEE MILLS.

From Hawthorn's Price Current.

"LONDON,
38. Tottenham-court-road,
corner of Percy-street.

HAWTHORN & Co.

"Our aim has been, to obtain unequalled excellence in the Roasting of Coffees; and our Sale of Coffees, for years, has been so considerable, and is so greatly increasing, that to meet this gratifying demand, we have recently erected on our premises the most UNIQUE, ELEGANT, AND COMPLETE MACHINERY IN THE WORLD, for the threefold purpose of Roasting the Raw Coffee, in the first place, without chance of its contracting that unpleasant flavour known as TOO HIGH BURNT; secondly, of preparing Coffees on the FRENCH PRINCIPLE, which developes that MELLOW RICHNESS peculiar to, and justly characteristic of, this favourite article of consumption with our Gallic neighbours; thirdly, of pulverising it when roasted, so that the action of boiling water on Coffees thus prepared will instantly extract all the delicious fragrance and strength of this exhilarating berry.

HAWTHORN AND COMPANY'S COFFEES
ARE ROASTED DAILY,

And we feel justified in using the commendatory expression so often pronounced on our establishment by our numerous French Customers — 'C'est la meilleure boutique pour le Café et pour le Thé en Londres.'"

A fourth placard contains the following: —

"HAWTHORN'S INIMITABLE RICH COFFEE, 1*s*.

HAWTHORN'S truly large sale for Coffees compels them to be continually roasting and grinding them, so that purchasers can always have their

Coffees Hot from the Roaster and Fresh from the Mill,
At your most obedient and attentive servants'

HAWTHORN & Co.,
38. TOTTENHAM-COURT-ROAD."

Adulterated — the greater part of the article consisting of chicory, with but little coffee to be detected.

27*th Sample.* — Purchased of Nicol & Company, 15. Rathbone-place, Oxford-street.

"APOLOBAMBA COFFEE,
(GROUND,)
One Shilling and Eightpence per Pound,
INCLUDING THE CANISTER.

"This peculiarly fine, rich, old, mellow-flavoured coffee, being packed in air-tight tins immediately it is roasted and ground, will retain its freshness and exquisite fragrance any length of time.

FROM
NICOL & CO.'S
COLONIAL COFFEE AND TEA MART."

Adulterated — with chicory, and containing a few particles resembling acorn.

28*th Sample.* — Purchased of Christie & Company, 12. Norton Folgate, Bishopsgate.

"THE PATENT COFFEE ROASTER,
Protected by Her Majesty's Royal Letters Patent.
ONE POUND
Of Exquisitely Fine
JAMAICA COFFEE,
At 1*s*. 6*d*.,
Including Canister.
SOLD WHOLESALE AND RETAIL BY
CHRISTIE AND COMPANY.

"The Royal Society for the Promotion of the Arts have pronounced it one of the most useful inventions of the age; Prince Albert, their President, in June last, delivered to the patentees their premium gold medal, with a complimentary address on the merits of the invention.

"The Patent Roaster dissipates the acidity and burning qualities of the coffee, which the ordinary mode of roasting does not remove, and renders it soft, nutritious, and delightful.

"It is packed hot and warm from the roaster and mills, in air-tight canisters, whereby it can be kept for a length of time in the highest state of perfection.

"The unprecedented demand for this coffee is the best evidence of its unquestionable superiority over all other coffee."

Adulterated — with a considerable quantity of chicory.

29th Sample. — Purchased of J. Chatfield, 10. Aldgate High-street, City.

"HALF-POUND CANISTER OF
CAFE DE LA FLAVOUR FRANCAISE;
OR, THE
TRUE PARISIAN
C O F F E E,
Possessing great strength and superiority of flavour,
FOR SIXPENCE.

"This beautiful compound of coffee gives that rich aroma so highly appreciated by Continental travellers, produces a beverage strong, bright, and clear, is rich and mellow in flavour, and must be appreciated by all the LOVERS OF A CUP OF GOOD COFFEE.

"This coffee being roasted on the most improved principle, which confines all that fragrance (which evaporates with the common roaster) so delightful and pleasing to the palate; and being packed hot, both from roasting and grinding, in well-seasoned canisters, which being perfectly air-tight will keep for any reasonable length of time, or in any climate, without the least injury to its original flavour; offering at once a canister of the finest compound of coffees ever imported into Europe.

This quality to be obtained only at
J. CHATFIELD'S
TEA AND COFFEE ESTABLISHMENT,
No. 10.
Aldgate, High-street,
City."

Adulterated — with a considerable quantity of chicory; taste and odour very disagreeable.

From an examination of the above Table of Analyses, it appears —

1st. *That the whole of the Twenty-nine Packages, Bottles, and Canisters of Coffee, submitted to analysis, with a single exception, were adulterated.*

2nd. *That in Twenty-eight of the samples, the adulteration consisted of chicory; this root, in many instances, constituting the chief part of the article.*

3rd. *That Three of the Samples contained mangel-wurzel.*

4th. *That roasted wheat-flour was present in Two of the Coffees.*

Contrasting these results with those obtained from the analyses of loose coffee, given in our last Report, it is manifest that CANISTER COFFEE is, of the two, by far the more extensively adulterated. This conclusion was anticipated, from the circumstance that coffee in canisters is commonly sold at the same price as loose coffee, notwithstanding the extra cost of the case.

We therefore now repeat the recommendation given in a previous Report, not to purchase coffee in canisters, since the public obtains, in general, an inferior article, and has to pay from two to three pence on each pound, as the price of the canister.

The contradictions, exaggerations, and untruths contained in the advertisements which we have quoted, are not less numerous, unprincipled, and, in some cases, even fraudulent, than were those set forth in the hand-bills inserted in the previous Report.

It will be perceived that mixtures of chicory and coffee, the former constituting in some cases the more considerable portion of the article, are unhesitatingly denominated, "FINEST MOCHA COFFEE;" "FINEST CONCENTRATED PLANTATION COFFEE;" "CHOICE JAMAICA COFFEE," "FINE CONCENTRATED TURKEY COFFEE," &c.

It will likewise be observed, that the occurrence of the word "GENUINE" on the labels, affords little or no guarantee that the coffee thus attested is really what the vendors profess.

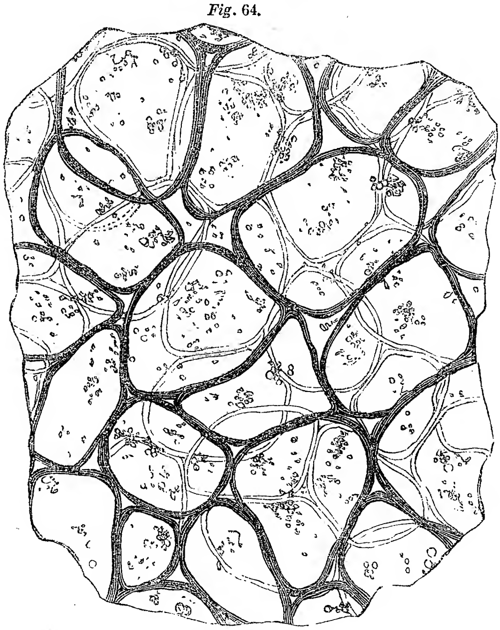
Neither do the words "PATENT CONCENTRATED" indicate what they are meant to imply, since the great proportion of those who make use of them really possess no "patent" at all, the assumption being wholly unwarrantable. The degree of "concentration" may be inferred from the quantity of chicory frequently present.

The phrases, "*Packed in Air-tight Canisters*," "*Hot and Warm from the Mills*," whereby the fragrance, aroma, &c., are retained, read exceedingly well on paper, but we fear do not tend to improve very much the quality of the coffee, since the canisters are not constructed so as to be really air-tight. The bottles furnished with glass stoppers fitted to perforated corks, are nearly air-tight, and doubtless more calculated for the preservation of the article.

To show what little faith the public ought to place in the statements and notifications exhibited in the shop-windows and on the wrappers of grocers' goods, we may mention, that some printers keep these forms of announcements, accompanied by illustrative woodcuts, permanently set up in type, and supply the numerous grocers with the same, at little more than the cost of the paper; the difference in each case merely consisting in the insertion of the name and address of the grocer to whom the bills and placards are supplied.

In our previous Report, we gave engravings exhibiting the structures detected in samples of coffee adulterated with *chicory*, *roasted wheat-flour*, and *beans*; we now insert some additional drawings representing the appearance of samples of coffee adulterated with *mangel-wurzel* and *acorns*.

Fig. 64.

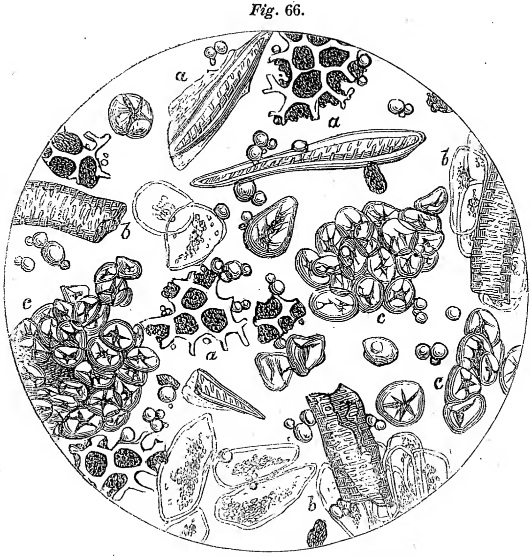


This figure exhibits the cells of which the root of MANGEL-WURZEL is chiefly formed: it will be observed that they are several times larger than those of chicory root.

Fig. 65.

Shows the structures met with in *Coffee adulterated with* MANGEL-WURZEL. *a a*, fragments of the coffee-berry; *b b*, cells of chicory; *d d*, ditto of mangel-wurzel.

Fig. 66.



Sample of *Coffee adulterated with ground* ACORN. *a a*, coffee; *b b*, chicory; *c c*, acorn.

THE ANALYTICAL SANITARY COMMISSION AND MR ABBISS.

To the Editor of THE LANCET.

SIR,—The gentlemen composing the "Analytical Sanitary Commission" have committed, through mistake as to sample or otherwise, a very grave error, affecting seriously my character as a man and a tradesman.

In the strictures on my circular and coffee in this day's LANCET, they have not only published what I had previously done—viz., that I mixed *chicory* with my coffee, but they state that the sample obtained from my shop contained "*some roasted wheat farina.*" While I am ready to concede to any man or body of men the right to publish their own opinion, I must demur to any unfair advantage being taken, and any deviation from truth being made in furtherance of any object, however praiseworthy.

Now, Sir, while *I readily admit that I use chicory*, I distinctly, emphatically, and solemnly declare, that *I never have, in one single instance*, used "*roasted wheat farina*," and that I do not in any way whatever, either myself, or by those in my employment, use or have on my premises, for the purpose of mixing with coffee, any other article than *pure chicory*, although discredit is attempted to be thrown on the assertion. I always buy the root in the raw state, to preclude the possibility of being deceived by a manufactured article.

As I hope no body of gentlemen would allow any man to suffer injury or injustice through their oversight or mistake, I do earnestly demand the Sanitary Commission to do me the justice *publicly to proclaim my innocence* with respect to "some roasted wheat farina" having been found in my coffee, *as publicly as they have proclaimed their error.*

I am ready to meet the Commission any time they may appoint; I am ready to prove by all in my employment, or by those who have left; and I am willing to allow the Commission to examine my men, my stock, or my books, and to render every facility to prove that there is a grave error, which error I trust to the honour of the Commission publicly to retract.

I am, Sir, your obedient servant,

60. Gracechurch-street, City, May 3. 1851. J. A. Abbiss.

P. S.—An early reply will be esteemed.

*** Fully impressed with the great responsibility of the task we have undertaken, it is our practice to observe every precaution, and we make it a rule, before publishing statements in the least calculated to have an injurious effect upon the interests of any one, to submit each article to at least two distinct examinations. This precaution was not omitted in the case of Mr. Abbiss, and in order to ensure absolute certainty, we were at the trouble of procuring a second canister of coffee at the establishment of Mr. Abbiss, and of submitting it also to examination.

Since the receipt of the letter of Mr. Abbiss, we have again analysed the samples of coffee, and find them to contain wheat farina, the quantity in one of the samples being considerable. Had a mistake been committed, we should not have hesitated for a moment to acknowledge the error; and as, in the course of the examination of the many hundreds of articles which will necessarily have to pass through our hands, errors may, and probably will, arise, we take this opportunity of distinctly stating, that in every such case we shall acknowledge the mistake with the utmost promptitude and candour. We now place at the disposal of Mr. Abbiss a sample of the coffee to which our published analysis referred. When Mr. Abbiss has obtained a report upon it from microscopists of distinction, we shall be happy to publish the result in the columns of The Lancet. We entirely acquit Mr. Abbiss of any participation in or knowledge of the adulteration or admixture in question, and we advise him to institute a rigorous investigation, in order to ascertain whether he may not himself have been deceived or imposed upon.

To the Editor of The Lancet.

Sir,—Allow me to state that I have been an assistant at Messrs. Abbiss & Co. for these last five years, and can positively assert that during that time there has been nothing whatever mixed in his coffee but pure chicory; and from my knowledge of the article, having been in the trade for thirty years, am bound to believe your assertion to be quite incorrect.

I am, Sir, your most obedient servant,

60. Gracechurch-street, May 12. 1851. Benjamin James.

To the Editor of THE LANCET.

SIR,—Having for the last seven years had the most ample means of knowing the manner in which Mr. Abbiss's business is conducted, and being satisfied that an adulteration of coffee with wheat farina could not be accomplished without my knowledge, I wish to state, in the strongest and most solemn manner, that no such adulteration has ever been made here, and that I have no alternative than to believe "The Analytical Sanitary Commission" to be in error.

I am, Sir, your obedient servant,

60. Gracechurch-street, May 12. 1851. JOHN THOMAS WAEELWRIGHT.

To the Editor of THE LANCET.

SIR,—I have been in the employment of Mr. James Abbiss for nearly two years, during which time I have often seen the coffee mixed, and sometimes mixed it myself, but with nothing but pure chicory; and to my certain knowledge there never has been anything but pure chicory for the above purpose on the premises. And, Sir, I must tell you, that, from my experience of my master, I believe him to be quite incapable of such a petty fraud as that of which you have so wrongfully accused him.

I remain, Sir, your obedient servant,

60. Gracechurch-street, May 12. 1851. TERTIUS CLARK.

To the Editor of THE LANCET.

SIR,—I beg most respectfully to inform you, that I have been in the employment of Messrs. Abbiss & Co., No. 60. Gracechurch-street, City, for the last four years, during which time I have had the sole management of the coffees, and do most solemnly declare, that nothing but pure chicory is mixed with the coffee. As to wheat farina, I never saw anything of the kind ever since I have been in the trade, which is now twenty-three years.

I remain, Sir, yours respectfully,

60. Gracechurch-street, City, May 12. 1851. WM. JAMES LEWINGTON.

To the Editor of THE LANCET.

Patent Desiccating Coffee Company,
10. Osborn-street, Whitechapel.

SIR,—Having for a considerable time roasted all Mr. Abbiss's chicory, as well as a moiety of his coffee, I am ready to make an affidavit that no adulteration has been effected at my establishment, either by myself or by any person in my employ, and that all goods entrusted to my care, either for roasting or grinding, are returned to their owners in the same pure state as received.

I am, Sir, yours respectfully,

London, May 13. 1851. JOHN RELFE.

To the Editor of THE LANCET.

Patent Desiccating Coffee Company,
10. Osborn-street, Whitechapel.

SIR,—We, the undersigned, being in the employ of the above company, having heard of the charges affecting Mr. Abbiss's moral and commercial character by your paper, beg leave to state, that all coffee and chicory roasted by us for him are received upon our establishment perfectly pure, and returned to him, roasted, in the same condition.

We are, Sir, yours respectfully,

F. RICHARDS, Manager.
T. DURBRIDGE, E. BRADFORD, J. DEAN, } Roasters.

P.S.—If required, we shall be happy to make an affidavit to that effect.

London, May 13. 1851.

*** The evidence of this correspondence is very strong, and would appear to be conclusive with some persons, that the sample of coffee which our commissioner purchased at the establishment of Mr. Abbiss did not contain "roasted wheat farina." As we attach great importance to the *bonâ fide* character of the analytical investigations now in progress, we have not hesitated to place the commissioner who made the examination and wrote the report in direct personal communication with Mr. Abbiss, in order that a thorough inquiry may be instituted by persons of acknowledged skill and ability, who have not yet expressed any opinion on the subject. Whatever may be the result of that inquiry, it shall be made known to the public. We will only state that we shall always be infinitely more prompt in affording redress, if at any time our reports should unfortunately contain an error, than in the infliction of an injury. We, however, cannot dismiss this correspondence at this time without referring to a statement contained in the letter of Mr. Abbiss, published at page 530. of the last number of THE LANCET, and those made by the proprietors and managers of the "Patent Desiccating Coffee Company," whose communications we have just inserted. Mr. Abbiss, in his letter, thus writes: — "I always buy the root (chicory) in the raw state, to preclude the possibility of being deceived by a manufactured article."

From this declaration and others contained in the same communication, we inferred that the entire preparation of the chicory and its admixture with coffee took place in the establishment of Mr. Abbiss, but now it turns out that Mr. Relfe, of the "Patent Desiccating Coffee Company, 10. Osborn-street, Whitechapel, has for a considerable time roasted *all* Mr. Abbiss's chicory, as well as a moiety of his coffee." This is curious, and it is equally singular to observe, that in not one of the seven communications on the subject is it stated where the said chicory is ground. At all events, it is now proved as an undoubted fact, that although Mr. Abbiss purchased his chicory in the raw state, it is not roasted by him, or at his own establishment. How is it that the "Patent Desiccating Coffee Company" are wholesale roasters of *chicory?* Why not adopt the more appropriate title of Patent Desiccating Coffee and *Chicory* Company. We again repeat, that we entirely rely on the statement made by Mr. Abbiss, that he has never intentionally or knowingly sent from his establishment coffee containing any other admixture than chicory. Should it be found, as the result of the inquiry now in progress, that the coffee examined by the Commission really did contain roasted wheat farina, or any substance closely resembling it, not one of the public will gain so much by our labours, in this case, as Mr. Abbiss himself; and as the matter stands, with the evidence which we now publish, the good faith of Mr. Abbiss in conducting his establishment is entitled to the fullest admission.—ED. L.

To the Editor of THE LANCET.

SIR,—In your remarks upon my letter at page 530. in THE LANCET, you conclude thus: —

"We entirely acquit Mr. Abbiss of any participation or knowledge of the adulteration in question, and we advise him to institute a rigorous investigation, in order to ascertain whether he may not himself have been deceived or imposed upon."

The communications which you have received and published are the result of that investigation; and I now beg to call your special attention to the important fact, that the coffee and chicory have been traced from the *raw state*, through the processes of *roasting*, *nibbing*, *grinding*, and *packing;* that *every person* through whose hands they have passed, both on my own premises, as well as on those of the "Patent Desiccating Coffee Company," is ready to make oath, that no admixture of "wheat farina" was ever effected, *in any stage of the preparation.*

Thus you have the evidence of ten persons, being ALL who were concerned in the preparation of the coffee and chicory *from first to last;* and whose united testimony goes to prove AS FAR AS HUMAN TESTIMONY CAN PROVE, that the Analytical Commission must have erred in the matter.

With this mass of conclusive evidence before you, I must call your attention to another quotation from THE LANCET of Saturday last, p. 557.: —

"We will only state, that we shall always be infinitely more prompt in affording redress, if at any time our reports should unfortunately contain an error, than in the infliction of an injury."

I have now to add, that having acted upon your suggestion, (quoted above,) and the results having been perfectly satisfactory and conclusive to my mind, I cannot for a moment doubt but that they will be so to yours.

With respect to your proposal, that I should submit the sample handed to me to the examination of some eminent microscopist, it appears to me, under the circumstances, that no satisfactory results would be obtained by that course, as, being driven by the foregoing evidence to the conclusion that there must have been some error with respect to the sample (notwithstanding the certificate of the commissioner to the contrary), the sample handed to me would naturally participate in such error; and being thus doubtful as to the authenticity of the sample, any results from it must necessarily be unsatisfactory. In saying this, I do not for a moment intend to impute deception to any one; but I submit, it is one of those errors, such as you admit may, and probably will, occur in the course of your investigations.

Having thus fully, fearlessly, and impartially reviewed the matter, I leave the attested facts before you; and it now remains for you promptly and frankly to acknowledge the error into which, by some unfortunate circumstance, your commissioner must have fallen.

I am, Sir, your obedient servant,

Gracechurch-street, City, May 21. 1851. JAMES ABBISS.

To the Editor of THE LANCET.

Patent Desiccating Coffee Company, George-yard,
and 10. Osborn-street, Whitechapel.

SIR, — Supposing your columns to be conducted on fair and honourable principles, I claim (as a right) your permission to be heard in my own defence. Whatever may be the result of the "analytical investigation" now in progress, and on which you appear to attach so *much* importance, I am satisfied that the more full and complete investigation you choose to make into my establishment, the more you, or your "commissioner," as you term him, will be satisfied that all my transactions with the trade are arranged upon honourable and equitable terms.

I think your objection to my designation as a "coffee-roaster" is untenable — *that* is the *bulk* of my trade; and in so designating it, I am not aware that I am excluded from the privilege of roasting chicory, if sent to me, as it is by many of the *largest* and *most respectable* traders in coffee, &c.

In acquitting Mr. Abbiss of any participation in the adulterating process, you indirectly accuse me with mixing other materials in chicory; such an insinuation I hold to be both unjust and unreasonable, until you are prepared to prove your assertion.

When I took the establishment, which has now, I am happy to say, a large and extensive patronage among the most respectable of the wholesale and retail dealers, both in London and the country, there was a notice on the gates, that no one should be admitted, except on business; that notice I immediately withdrew; and I now invite you, and all other inquisitors to inspect my establishment at all times. Your charge is not against the mixture of chicory with coffee, but the insinuation is, that I mix deleterious or inferior articles with them. My reply is to you, come and see; witness for yourself; but do not by mean and paltry insinuation attempt the destruction of character of one who is striving with uprightness and integrity to maintain a respectable and honourable position.

The legitimate office of THE LANCET is to probe, that it may cure the ills of the body politic — not to stab, that it may wound private reputation.

I am, Sir, your obedient servant,

May 17. 1851. J. RELFE.

N.B. — In consequence of the large increase of business, the roasting and grinding department is removed from No. 10. Osborn-street, to Goldie's, late a distillery in George-yard, Whitechapel. I merely mention this, that you may be under no mistake, should you think it desirable to favour me with a visit.

*** We cannot state that we are at all satisfied with the contents of these letters. Mr. Relfe speaks of "mean and paltry insinuations." We have made no insinuation: our statement is distinct and unequivocal. Our Commissioner alleges, in terms as plain and simple as can be used, that in two samples of canister coffee purchased at the shop of Mr. Abbiss, both contained chicory and roasted wheat farina. Mr. Abbiss positively denies the adulteration, and adds that his chicory is bought by him in the raw state, and has been roasted at the establishment of Mr. Relfe. Mr. Abbiss does not deny that chicory was mixed with the samples of coffee which our Commissioner purchased, but he has produced strong evidence to prove that there was no admixture of wheat farina in the samples of coffee obtained at his establishment. Now, our Commissioner makes no insinuation—he asserts positively that the samples do contain roasted wheat farina. Since our last publication that gentleman and Mr. Abbiss have had an interview, and before they separated it was agreed that the samples were to be examined by persons of competent ability, one to be chosen by the Commissioner, one by Mr. Abbiss, the two thus named to choose a third, and the result of their investigation to be published in THE LANCET. Mr. Abbiss now thinks "that no satisfactory results would be obtained by that course:" we think otherwise. If Messrs. Abbiss and Relfe decline such a scrutiny the fault will not rest with us, but with themselves. After the bold statements made in the first letter of Mr. Abbiss (THE LANCET, page 530.) we cannot discover how he can properly withdraw from such an investigation. *It is a question of fact.* Does the coffee purchased, as before stated, contain roasted wheat farina? If not, our Commissioner is wrong; if it does, how did it get there? These are questions which ought to be solved conclusively, and a doubt on the subject should not remain on the mind of any person. *We* now challenge a further scrutiny.—ED. L.

To the Editor of THE LANCET.

SIR,—In THE LANCET of Saturday last, page 584., you state that in the interview I had with your commissioner, it was "*agreed* that the samples of coffee were to be examined by persons of competent authority, &c. &c." I distinctly say that it was not agreed. The commissioner proposed such a course, but I did not "agree" to it. Your own judgment ought to inform you, and it must be evident to every impartial mind that I must be satisfied as to the genuineness of the sample handed to me, before I would rest my reputation on such a test.

In THE LANCET of May the 10th, you admit that "errors may, and probably will arise, in the course of the examination of the many hundreds of articles that will necessarily have to pass through your hands;" as you admit the possibility of error, what guarantee have I that no mistake has been made with respect to my sample? If error be possible, it is just as likely to happen in my case as in any other; if not why not?

What proof have I that the sample the commissioner proposed to submit to arbitration is part of the canister of coffee that came out of my shop? I have only the testimony of your commissioner, and unless you can prove to my satisfaction that he is infallible, why should I believe his single testimony, when you, by implication, disbelieve all the evidence that I have adduced?

Had your commissioner, when he purchased the coffee, and before he took it out of the shop, given me a portion thereof sealed up, I would willingly have submitted it to analytical or microscopical arbitration, and even now, or at any time, I am willing to abide by, and hereby publicly challenge such a test, provided always that I have indubitable evidence that the sample is absolutely a portion of the coffee purchased at my establishment, and that it is in the same condition as when it left my premises.

My reason for insisting upon this point is, that, in my opinion, the samples of coffee with which I am furnished (one from the LANCET Office and the other from your commissioner) never came out of my shop, and, moreover, that the two samples purporting to be out of the same canister, are not the same coffee, being different in colour, granulation, and general appearance; and in this opinion I am supported by every person to whom they have been submitted.

I am, Sir, your obedient servant,

J. W. ABBISS.

60. Gracechurch-street, 26th May, 1851.

*** The above letter having been handed to me by the Editor of The Lancet, I beg to state that at the interview with Mr. Abbiss, some days since, it "was agreed" that the course suggested by me—viz., that competent and impartial gentlemen should examine the coffee purchased by me of Mr. Abbiss, and their "report" be published in The Lancet. Further, *not the slightest objection* was made to the proposal by Mr. Abbiss; on the contrary, he admitted that it was perfectly fair and honourable. On taking his leave, Mr. Abbiss observed, that he would "see Mr. Relfe, of the Desiccating Coffee Company," and further communicate with me on the subject without further loss of time. Since that period I have not heard from Mr. Abbiss. I have only a very few more words to add.

I again distinctly repeat the assertion made by me to Mr. Abbiss, that no "error" has been committed with respect to the samples of coffee purchased by me at his establishment; and with regard to the "opinion" that the samples returned by me to Mr. Abbiss had never gone out of his shop, I am prepared, at any moment, to prove the contrary by *affidavit*. Finally, I think it must be admitted, that I have no reason to be dissatisfied with the way in which this little conflict has terminated.

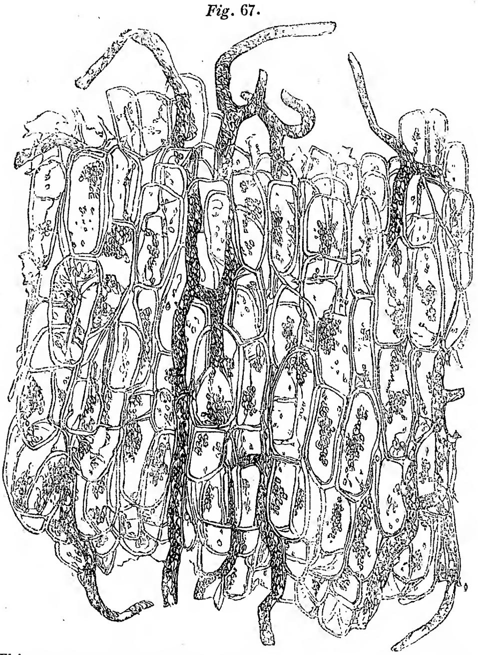
The Commissioner who made the Analysis.

CHICORY, AND ITS ADULTERATIONS.

[SECOND REPORT.]

Since the publication of the first Report on Chicory, we have renewed our inquiries, and have become acquainted with additional facts relating to the adulteration of that article. These we now embody in a second Report.

Fig. 67.



This engraving represents the narrow and branched vessels (*Vasa lactescentia*), so abundant in Chicory-root, which convey the milky juice of that plant, and also show their relation to the ordinary utricles or cells, of which the substance of the root is principally made up.

The structure of chicory-root, as well as of many of the productions used in its adulteration, have already been described, to a great extent; in particular, reference has been made to the *Vasa lactescentia*, or milk-carrying vessels of the root of chicory; and it has been stated that they afford a very satisfactory means of discriminating this root from many other vegetable substances. We now insert an engraving, exhibiting the vessels in question.

Adulteration of Chicory.

The adulteration of chicory with the following substances has already been described:—

Carrot, Parsnip, Mangel-wurzel, Beans, Lupin-seeds, Wheat, Rye, Dog-biscuit, Burnt Sugar, Red Earth, Horse-chesnut, Acorns.

We have now to notice additional adulterations.

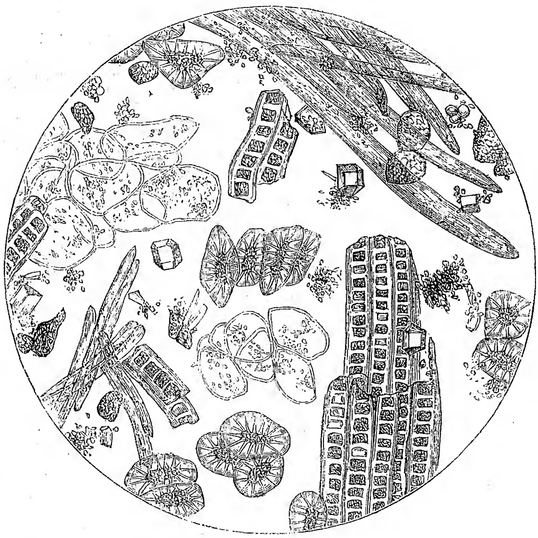
Oak-bark Tan.

Two samples of a powder have reached us, closely resembling ground coffee, but possessing the styptic and peculiar taste of tan.

On submitting this powder to microscopic examination, we detected in it three distinct structures:—

First, curiously constructed radiate cells, resembling those which have been already described in connexion with the sugar-cane and pepper-berry.

Fig. 68.



This drawing exhibits the structures detected in Oak-bark powder,—the *radiate cells*, *woody fibre*, and *utricles of cellular tissue*. Drawn with the Camera Lucida, and magnified 140 diameters.

Second, much woody fibre.

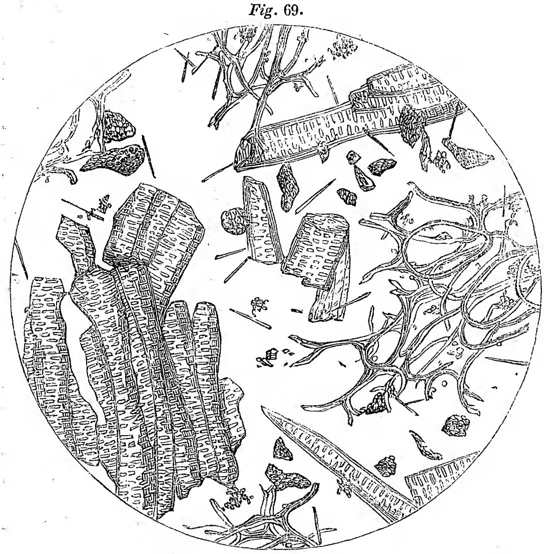
Third, cells or utricles of a rounded form.

On comparing these structures with those met with in oak-bark, we found them to agree with the latter in every particular: the radiate cells formed the epidermis, the woody fibre the chief bulk of the bark, and the cellular tissue was situated on the inner surface, and served to unite the bark to the tree itself. These several structures, as seen in the powder in question, are shown in the accompanying wood-cut.

This powder, therefore, is evidently used-up oak-bark powder, charred, and ground very fine. It may be procured in any quantity, and is stated to be employed in the adulteration of chicory and coffee.

Tan known as "Croats."

Fig. 69.



This drawing exhibits the structures detected in the Tan known in Norfolk by the name of "*Croats*," and used for fuel, &c.

We have received several samples of an article, in the form of cake, bearing a resemblance in colour to coffee, but having the smell and taste of tan.

In it we have detected, with the microscope, fragments of cellular tissue, and bundles of dotted fibres, resembling dotted ducts. These structures are represented in the accompanying figure.

The substance in question consists evidently of the bark of some tree used for tanning.

It has been stated to us that it is employed in the adulteration of coffee and chicory, and that it may be purchased in any quantity.

Mahogany Sawdust.

Numerous statements have been made of the discovery in coffee of mahogany sawdust. This adulteration is so atrocious, that until recently we have refused to give credence to these statements, and until we ourselves had obtained evidence that this substance is actually employed in the adulteration of chicory.

The fragments of mahogany sawdust may be distinguished by their reddish colour, and by the peculiar structure of the woody fibres. We shall hereafter give an engraving representing a sample of chicory adulterated with it.

We have also evidence to show that other kinds of woody fibre besides mahogany sawdust are sometimes employed in the adulteration of chicory.

Baked Horses' and Bullocks' Liver.

In a little work recently published by Mr. P. L. Simmonds, entitled "Coffee as it is, and as it ought to be," the following observations occur in reference to the above adulterations.

"In various parts of the metropolis, but more especially in the East, are to be found liver-bakers. These men take the livers of oxen and horses, bake them, and grind them into a powder, which they sell to the low-priced coffee-shop keepers, at from fourpence to sixpence per pound, horse's liver coffee bearing the highest price. It may be known by allowing the coffee to stand until cold, when a thick pellicle or skin will be found on the top. It goes further than coffee, and is generally mixed with chicory, and other vegetable imitations of coffee."

We have received several samples of an article stated to consist of burnt liver. It formed a coarse granular powder of a black colour, and possessed a disagreeable animal smell.

Dissolved in water, and set aside for a few days, it became extremely offensive and corrupt, showing that it consisted of some imperfectly charred animal matter. As iron was readily detected in the solution, it is probable that in this case the substance consisted of burnt blood.

The best way, then, to detect this adulteration, is to set aside an infusion of chicory or coffee, when, if this substance be present, in a few days the liquid will emit an offensive smell.

Hamburgh Powder.

Dr. Pereira, in 1845, published in the *Pharmaceutical Journal* two very useful articles on the adulteration of coffee and chicory: from the first of these — that on coffee — we extract the following remarks: —

"But while the grocers, on the one hand, cheat their customers by adulterating coffee with chicory, the chicory dealers in turn cheat the grocers by adulterating chicory. The substances employed in effecting the latter fraud are principally *Hambro' powder* and *coffee flights*.

"*Hambro' powder* consists of roasted and ground peas, &c., coloured with Venetian red. The term *coffee flights* is applied to the thin membraneous coat (endocarp) which separates from the coffee seed in the act of roasting."

Venetian Red.

In the article on chicory we meet with the following remarks in reference to Venetian red.

"In a previous number we explained the nature of *Venetian red.* It is essentially the sesqui-oxide of iron, obtained by calcining common copperas (sulphate of iron). The different colours of the product depend on the temperature to which the sesqui-oxide is subjected. When it has been exposed to an intense white heat, its colour deepens, and it is then termed *purple-brown.* The lighter tint of Venetian red is produced by adulteration. Our informant (a manufacturer) told us that Venetian red was 'adulterated to suit the various prices of the market.' We did not think it expedient to pry into the nature of the adulterating ingredient, but a friend suggests that it is *reddle*, the substance used for marking sheep.

"Venetian red is, we believe, the principal substance at present used for colouring chicory; occasionally other agents have been employed. A dealer tells us that he once bought a quantity of chicory, which contained twenty per cent. of logwood and mahogany dust."

It will be seen hereafter that mahogany dust has been detected in one of the samples of chicory powder analysed in this Report; and we strongly suspect it to be present in more than one of the other samples, the examination of which has not yet been brought to a conclusion.

Results of the Microscopical Examination of Twenty-four different Samples of Chicory, purchased at the Establishments of Tea Dealers and Grocers residing in the Metropolis.

1*st Sample.* — Purchased of A. Teetgen, 154½ Whitechapel-road.
Adulterated — containing ground acorn.

2*nd Sample.* — Purchased of John Rose, 143. Whitechapel-road.
No adulteration detected; powder very gritty, the greater part charred, and reduced to the state of charcoal.

3*rd Sample.* — Purchased of William Harvey & Co., No. 4. Mile-end-road.
No adulteration detected; powder very gritty, and, owing to its being too highly roasted, much of it appearing quite black under the microscope.

4*th Sample.* — Purchased of William Chorley, 18. Whitechapel-road.
Adulterated — containing ground acorn.

5*th Sample.* — Purchased of William Ricketts, 16. Mile-end-road.
No adulteration detected; powder gritty.

6*th Sample.* — Purchased of J. P. Miller, 35. Whitechapel-road.
No adulteration detected; powder gritty, and much of it reduced to charcoal.

7*th Sample.* — Purchased of H. Roakes, 1. Constable-row, Mile-end-road.
Adulterated — containing ground acorn.

8*th Sample.* — Purchased of M. A. Snowden, 4. Portland-place, Commercial-road.
No adulteration detected; powder very gritty.

9*th Sample.* — Purchased of Wells & Co., 6. Sydney-place, Commercial-road.
No adulteration detected; powder very gritty, and much of it carbonised.

10*th Sample.* — Purchased of W. J. Crisp, No. 1. Sydney-place, Commercial-road.
No adulteration detected; powder gritty.

11*th Sample.* — Purchased of W. Munday, 1. Hereford-place, Commercial-road.
Adulterated — with much sawdust, and contains Venetian red, both visible to the unaided sight.

12*th Sample.* — Purchased of Samuel James, 93. Whitechapel-road.
No adulteration detected; powder gritty.

13*th Sample.* — Purchased of D. Francis, 13. King's-place, Commercial-road.
No adulteration detected; powder gritty.

14*th Sample.* — Purchased of G. W. Back, 137. Whitechapel-road.
Adulterated — with a very considerable quantity of roasted wheat farina.

15*th Sample.* — Purchased of John Hawkins & Company, 17. High-street, Whitechapel.
Adulterated — with much mahogany sawdust.

16*th Sample.* — Purchased of S. Felgate, 23. Commercial-road.
No adulteration detected; powder gritty.

17*th Sample.* — Purchased of Johnston & Company, 98. High-street, Whitechapel.
No adulteration detected; powder very gritty.

18*th Sample.* — Purchased of Rogers & Company, 97. Crawford-street, Edgware-road.
Adulterated — with a very considerable quantity of roasted wheat farina.

The nature of the evidence afforded in this case by the microscope will be understood by an examination of the accompanying woodcut.

Fig. 70.

Sample of chicory, *adulterated with roasted wheat farina.* This figure has been made from a minute portion of the ground chicory above referred to. The structures marked *a a* are the cells and vessels of chicory-root, while those marked *b b* are the starch-corpuscles of wheat. No bodies in the least resembling these occur in genuine chicory-powder. The quantity in which they are present, and the partial charring which many of them have evidently undergone, clearly show that they could not have found their way into the powder through accident.

19*th Sample.*— Purchased of H. B. Edwards, 87. Edgware-road.
Adulterated — with a considerable quantity of roasted carrot.
20*th Sample.* — Purchased of Clayton & Company, 4. Broadway, Westminster.
No adulteration detected; powder very gritty.
21*st Sample.* — Purchased of E. Folkard, 40. Drury-lane.
Adulterated — with a very considerable quantity of a root resembling mangel-wurzel.

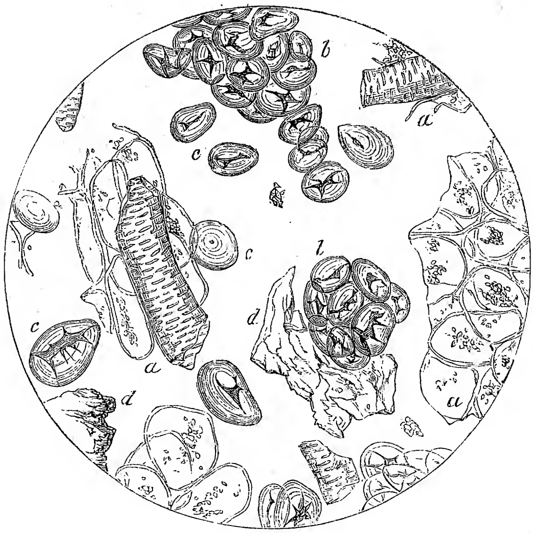
In our Report of last week we gave the analysis of two canisters of "Exhibition Coffee," purchased of Mr. E. Folkard, and stated that both were adulterated with a vegetable substance resembling mangel-wurzel. We find the same production to be present in the chicory powder obtained at the establishment of Mr. Folkard.

22*nd Sample.* — Purchased of James Appleton, 174. Drury-lane.
Adulterated — with a very considerable quantity of roasted wheat farina.
23*rd Sample.* — Purchased of J. M. Guest, 218. Oxford-street.
Adulterated — containing a considerable quantity of ground acorn.

We have on several occasions detected the same production in samples of coffee procured of Mr. Guest. It is one which is evidently frequently contained in powdered chicory; and we have noticed it in smaller quantity in no less than four out of the twenty-three samples, the analyses of which are given in this Report. From the amount generally present, it is evidently used to impart some property to the chicory — probably to render it more bitter — rather than for the sake of its bulk.

The following engraving represents a sample of chicory-powder adulterated with the production in question.

Fig. 71.



This woodcut exhibits the structures detected in the chicory purchased of Mr. Guest. *a a*, cells of chicory; *bb*, fragments containing numerous starch corpuscles; *c c*, separate starch granules; *dd*, portions of a brown membrane, without apparent organisation, very commonly observed, and derived from the testæ of the seed.

From an examination of the analyses contained in the above Table, it appears—

1st. That *Eleven or one-half of the samples were adulterated.*
2nd. That *Four of the chicory-powders were adulterated with Roasted Wheat.*
3rd. That *ground Acorns were present in an equal number of cases.*
4th. That *two of the samples contained Sawdust, and one Mahogany Sawdust.*
5th. That *Mangel-wurzel was detected in one of the chicories.*
6th. That *in one instance roasted Carrot was present.*

In our first Report on chicory we gave the results of the analysis of thirty-four samples, from which it appeared —

1st. That *Fourteen of the samples were adulterated.*
2nd. That *in Nine the adulteration consisted of roasted Corn.*
3rd. That *scorched Beans were present in Four of the samples.*
4th. That *in One case ground Acorn was detected.*

As we remarked on a previous occasion, we do not charge these adulterations upon the dealers: we are fully aware, that in most cases the manufacturers are the guilty parties. The dealers, however, are much to blame in purchasing a manufactured article in the state of powder, which they must know, from the prices usually paid for it, cannot be genuine.

If those grocers whose chicory we have analysed and found to be adulterated wish to stand well before the public, and desire to show that they have no participation in the dishonest practices disclosed, they will forward to us for publication the names and addresses of the manufacturers from whom they purchase the chicory-powder, together with the assurance that they were not aware that the chicory they were selling was adulterated. In this way much good would be effected, and the several frauds detected traced to their source.

In particular, it behoves Mr. Munday and Messrs. Hawkins and Co. to make known in what way the chicory adulterated with mahogany sawdust came into their possession, so that the perpetrators of so scandalous and disgraceful a fraud may be discovered.

We have in our possession numerous samples of adulterated chicory-powder, together with the names of the manufacturers by whom they were prepared;

but as these have not been procured in such a way as to authorise the publication of the names, we refrain from announcing them at present, preferring to try the effect of the proposition contained in the previous paragraphs.

We have, in previous articles, fully considered the subject of the adulteration of coffee with chicory, and we shall now merely offer a few additional remarks.

The law, as we are all aware, sanctions the adulteration of coffee with chicory, to the injury of the revenue and the loss of the public in health and pocket. This same law, however, does not permit the adulteration of coffee with scorched wheat, beans, carrots, &c., but subjects parties practising these deceptions to prosecution, and, in case of conviction, heavy penalties. Such, at least, is the law, but under the present government it is useless and dead-letter law, since, notwithstanding the prevalence of these adulterations, it is never enforced.

But, singular to say, the law, while it provides in word against certain of the adulterations to which coffee is liable, is silent with respect to the adulteration of chicory; so that that which is an offence in the case of coffee, is not illegal in that of chicory, with which the manufacturers may mix corn, beans, carrots, mangel-wurzel, mahogany sawdust, &c., and yet not violate the excise laws; this, to say the least, is grossly inconsistent.

In our first Report on chicory we treated of the properties of that production. we stated that the recent root is described in our best works on Materia Medica as aperient and diuretic. We showed, also, by experiment, that the roasted root, even when mixed with coffee, in some persons excited diarrhœa.

These facts are in themselves sufficient to condemn the indiscriminate use of chicory as an article of diet.

The great increase which is known to have taken place of late years in the frequency of renal disorders, is possibly to be found in the increased consumption of chicory root.

But there is good reason to believe that chicory, from its narcotic character, also exerts injurious effects on the nervous system; so convinced of this is that celebrated German oculist, Professor Beer of Vienna, that he has enumerated chicory-coffee as among the causes of amaurotic blindness.

We recommend the above facts to the careful consideration of the chicory-enamoured Chancellor.

We now postpone for a short time, further disclosures connected with the nefarious system which prevails so extensively in the adulteration of coffee and chicory.

THE ANALYTICAL SANITARY COMMISSION, MR. BACK, & MR. TEETGEN.

To the Editor of The Lancet.

Sir,—In your number of The Lancet of the 10th inst, under the head of the "Analytical Sanitary Commission—Chicory and its Adulterations, (Second Report,)" appears the following:—

"*14th Sample.*—Purchased of G. W. Back, 137. Whitechapel-road.

Adulterated—with a very considerable quantity of roasted wheat farina."

Immediately upon my attention being directed to this charge against me, I communicated with Messrs. Barry and Co., of Type-street, Finsbury, the firm from whom I have for some years past, and do still, purchase my chicory, and who a short time since furnished me with a written assurance and guarantee in the following words, which I take from their letter now in my possession:—

"We deem it right to say, that all chicory sold by us we hold ourselves entirely responsible for its being genuine, and will guarantee all our customers, in the use of it, against any charges that may be made."

At my interview with Messrs. Barry, I handed them The Lancet, and said, —Gentlemen, I now call upon you to vindicate my character, which you know, as well as I feel it to be, is that of an honourable and respectable tradesman; and I assure you, (as I likewise do you, Mr. Editor,) that never at any time since I have been in business have I adulterated or mixed anything whatever, in any way, with my chicory; but that I have always sold it precisely in the same state as it comes into my shop; and this I am in a condition to prove in the clearest possible manner, and also that I never had such a thing as wheat farina in my possession.

Messrs. Barry, having the fullest conviction of the truth of my statement, at once declared their desire to render every assistance in their power to refute the charge you have made against me; and I have since received a letter from them, dated the 12th inst., from which I extract the following:—

"With regard to the statement in THE LANCET, that the chicory purchased of you contained a considerable quantity of wheat farina, if you are prepared to show that it was sold by you as received from us, we are willing to see the Editor of THE LANCET with you upon the subject, or to render any assistance you may require to refute the charge."

Now, Sir, I can show, to the satisfaction of any jury, that I have always sold chicory precisely in the same state as delivered to me by Messrs. Barry; and as I have the fullest confidence in their integrity, I think it right to add, that the charge made by you, in last week's edition of THE LANCET, cannot be well founded.

I request that, in fairness to me, which I am sure I shall meet at your hands, you will insert this letter in your next publication; but if, in the meantime, you think Messrs. Barry's suggestion of an interview, or any other course, desirable, I shall be only too anxious to render every assistance.

I am, Sir, your obedient servant,

Britannia Tea Warehouse, 137. Whitechapel-road, May 13. 1851. G. W. BACK.

*** The contents of this letter are strongly indicative of the integrity and strict propriety of conduct which Mr. Back has pursued; and far be it from us to impeach, in any way, the accuracy of the statement made by Messrs. Barry. Still it is evident that allegations which clash so strongly with the report of our commission demand a searching inquiry. The commissioner, therefore, who made the examination, will place himself in immediate communication with Mr. BACK and Messrs. BARRY; and in this case also the result of a further analytical investigation shall be announced in our columns.—ED. L.

"The following letter has been received by us from Mr. TEETGEN:"—

To the Editor of THE LANCET.

SIR,—In a number of your publication, issued on May 10th, I find my name there mentioned as selling chicory adulterated with acorns. In justice to myself, I therefore beg to state exactly how I manage the coffee and chicory portion of my business, and you will then have an opportunity of judging, and give the public an opportunity of judging also, whether I do not do all I can in my power to sell a *good* and *genuine* artcle. My coffee I buy of the first houses, and of the best quality I can get. My chicory I buy in two ways. The *principal* part I buy in the *raw state*, and of the *choicest* in *the market;* this I have *roasted* and *nibbed* by the best man I can find, and mix it with my coffee, and have both ground together. *This* kind forms the *principal* part of my chicory trade. I send occasionally to Taylor Brothers, Brick-lane, for twenty-eight or fifty-six pounds of *ground* chicory, as it very much blunts the coffee-mill to grind chicory alone. This is sold when *ground* chicory is asked for, and never mixed with any coffee. I have here sent you Taylor Brothers' invoices, and a sample of the ground chicory bought of them, and also a sample of my chicory nibs. I endeavour to do all I can to get the *best articles* of each kind, and what can any man do more?

In order that your publication above referred to may not *unjustly* injure my reputation and business, I now beg the favour that you will insert in your *next number* the *whole* of this letter; and I *further most particularly beg of you or your commissioners, or all of you, to visit and inspect the whole of my stock and business*, and then I will ask you if I can do more to secure a good article. Will you also be good enough to let me know *which* of the two samples *now sent* is like the *one* you purchased at my shop?

For the sake of honesty and *justice to all parties*, I hope you will afford *every facility* to respectable tradesmen to maintain their reputation unspotted. Your publication has of late contained names of some of the most respectable men in the trade, such as Messrs. Hawkins and Co., Mr. Abbiss, &c., whose acquaintance I have the pleasure to possess; and it really appears a sad thing that good and honest members of society should be injured by statements which want fully explaining.—I am, Sir,

Your most obedient servant,

154. Whitechapel Road, May 17. 1850. A. Teetgen.

Nothing further arose out of either of the above cases. At an interview between the Commissioner and Mr. Back, it was arranged that the samples should be subjected to microscopical examination by impartial and independent microscopists. Although such was the arrangement, up to this time it has not been carried into effect, and this not through backwardness on our part.

COCOA, AND ITS ADULTERATIONS.

Cocoa is prepared from the seeds of Theobroma Cacao, which is cultivated chiefly in the West Indies, and parts of South America.

The seeds are enclosed in pods several inches in length, and are arranged round, and attached to a central axis; each pod includes a considerable number of seeds, from twenty to thirty, and in some cases even more. They resemble, somewhat, in shape, almonds, but are about twice as large.

There are several varieties of cocoa, named after the places from which they are procured: the three principal are, Trinidad, Maragnon, and Bahia cocoas. Of these the Trinidad is the best, and the Bahia the least valuable; the latter kind is distinguished by the smoothness of the seeds and their bright red colour.

Dr. Ure, in his "Dictionary of Arts, Manufactures, and Mines," gives the following particulars in reference to cocoa and chocolate: —

"Chocolate is an alimentary preparation of very ancient use in Mexico, from which country it was introduced into Europe by the Spaniards in the year 1520, and by them long kept a secret from the rest of the world. Linnæus was so fond of it, that he gave the specific name *theobroma*, food of the gods, to the cacao tree which produced it. The cacao beans lie in a fruit somewhat like a cucumber, about five inches long, and three inches and a half thick, which contains from twenty to thirty beans, arranged in five regular rows, with partitions between, and which are surrounded with a rose-coloured spongy substance, like that of water-melons. There are fruits, however, so large as to contain from forty to fifty beans. Those grown in the West India Islands, Berbice and Demerara, are much smaller, and have only from six to fifteen; their development being less perfect than in South America. After the maturation of the fruit, when their green colour has changed to a dark yellow, they are plucked, opened, their beans cleared of the marrowy substance, and spread out to dry in the air. Like almonds they are covered with a thin skin, or husk. In the West Indies they are immediately packed up for the market when they are dried; but in the Caraccas they are subjected to a species of slight fermentation, by putting them into tubs or chests, covering them with boards or stones, and turning them over every morning to equalise the operation. They emit a good deal of moisture, lose the natural bitterness and acrimony of their taste by this process, as well as some of their weight. Instead of wooden tubs, pits, or trenches dug in the ground, are sometimes had recourse to for curing the beans — an operation called *earthing* (*terrer*). They are lastly exposed to the sun, and dried. The latter kind are reckoned the best, being larger, rougher, of a darker brown colour, and, when roasted, throw off their husks readily, and split into several irregular fragments; they have an agreeable mild bitterish taste, without acrimony. The Guiana and West India sort are smaller, flatter, smoother-skinned, lighter-coloured, more sharp and bitter to the taste. They answer best for the extraction of the butter of cacao, but afford a less aromatic and agreeable chocolate. The fatty matter is of the consistence of tallow, white, of a mild agreeable taste, called butter of cacao, and not apt to turn rancid by keeping. It melts only at 122° Fahr., and should therefore make tolerable candles. It is soluble in boiling alcohol, but precipitates in the cold. It is obtained by exposing the beans to strong pressure in canvas bags, after they have been steamed or soaked in boiling water for some time. From five to six ounces of butter may be thus obtained from a pound of cacao. It has a reddish tinge when first expressed, but it becomes white by boiling with water.

"The beans, being freed from all spoiled and mouldy portions, are to be gently roasted over a fire in an iron cylinder, with holes in its ends for allowing the vapours to escape, the apparatus being similar to a coffee-roaster. When the aroma begins to be well developed, the roasting is known to be finished; and the beans must be turned out, cooled, and freed, by fanning and sifting, from their husks."

Composition of Cocoa.

The following is the composition of 100 parts of the seeds of West India cocoa, deprived of husk, according to Lampedius: —

Fatty matter	53·10
Albuminous brown matter, containing the aroma of the bean	16·70
Starch	10·91
Gum	7·75
Lignine	0·90
Red pigment	2·01
Water	5·20
Loss	3·43
	100·00 parts.

The above analysis is very nearly accurate, but we believe that the proportion of starch is somewhat underrated.

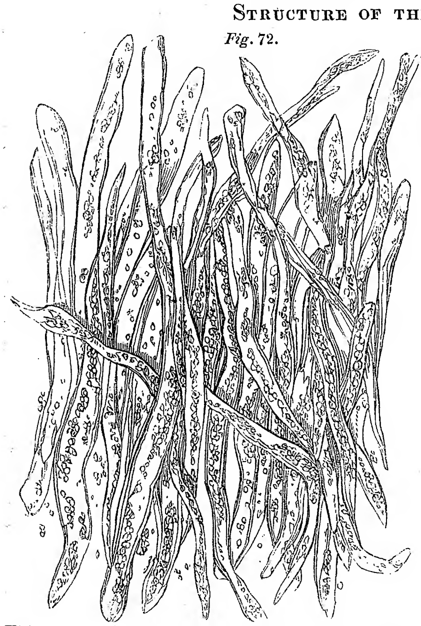
It is evident, then, that the nutritive properties of cocoa are very great, and that from the quantity of fatty matter present, it is especially adapted to the maintenance of respiration, and the temperature of the body, as well as to the development of fat.

When genuine, cocoa is a very wholesome as well as nutritious article of diet, and one which ought to be more generally employed. Cocoa contains theine, the active principle of tea.

The shells, or husks, form about twelve per cent. of the weight of the beans they contain but little fat, much lignine, and some mucilage.

Structure of the Cocoa-seed.

Fig. 72.



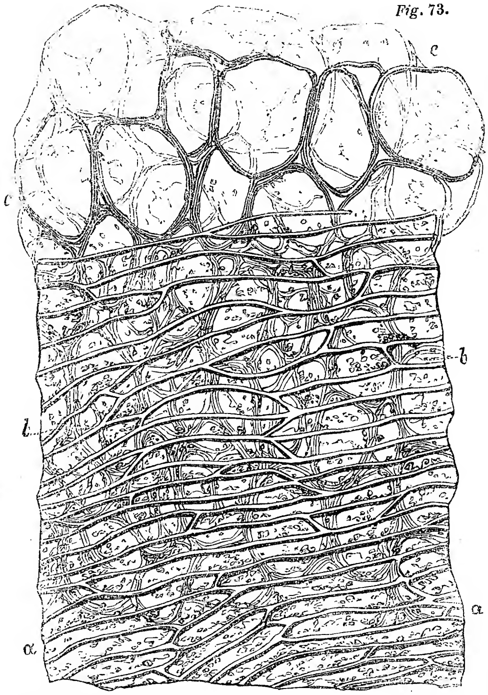
This engraving represents the *tubular fibres* usually observed in greater or less numbers on the surface of the Cocoa-seed. The fibres are magnified 100 diameters.

It is of very great importance that the minute structure of all vegetable substances employed in food and medicine should be thoroughly understood; for without such knowledge it is quite impossible to detect the adulterations to which the majority of these substances are liable.

The structure of the seed, or bean, as it is sometimes called, of the cocoa, is very characteristic, although somewhat complicated: in it, as in other seeds, two parts require to be distinguished, the shell or husk, and the seed proper.

The first structure noticed on the surface of the husk, consists of a considerable number of *tubular fibres* of large size, and containing granular matter and minute corpuscles; they are more abundant on some seeds than others, and do not appear to form part of the seed itself, but to belong rather to the seed-vessel, and are probably derived from the spongy substance which surrounds the seeds when unripe: the fibres for the most part run parallel to each other in the course of the long axis of the seed.

Fig. 73.



This engraving represents the *two outer tunics of the husk of the seed of* Cocoa, *together with the enlarged and mucilage-bearing cells.* *a*, outer membrane; *b*, second tunic; *c*, mucilage cells. This figure, as well as the three following, are magnified 220 diameters.

The *husk* may be separated into three or four distinct tunics or membranes.

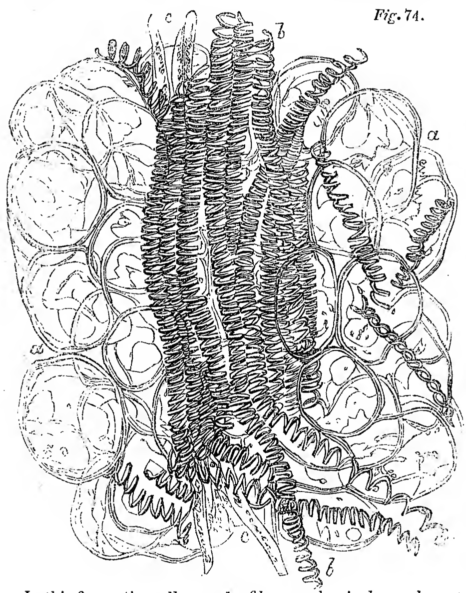
The *first or outer membrane* consists of elongated cells, adapted to each other, and disposed in a single layer, with their long diameters placed transversely to the axis of the seed.

The *second tunic* is constituted of large angular cells, superimposed in several closely connected layers; towards the centre of the membrane formed by them the cells increase greatly in size, their parietes become thin and diaphanous, and their cavities filled with a mucilaginous substance, which, in seeds soaked in water for some hours, is seen to be considerable in quantity.

These two membranes, together with the enlarged cells, are delineated in the accompanying woodcut.

As the cells forming the second membrane approach the surface of the seed, they lose their mucilaginous character, become smaller, and return to their original size.

Fig. 74.



In this figure the *cells, woody fibres,* and *spiral vessels,* are delineated, which constitute the deep portion of the second membrane.

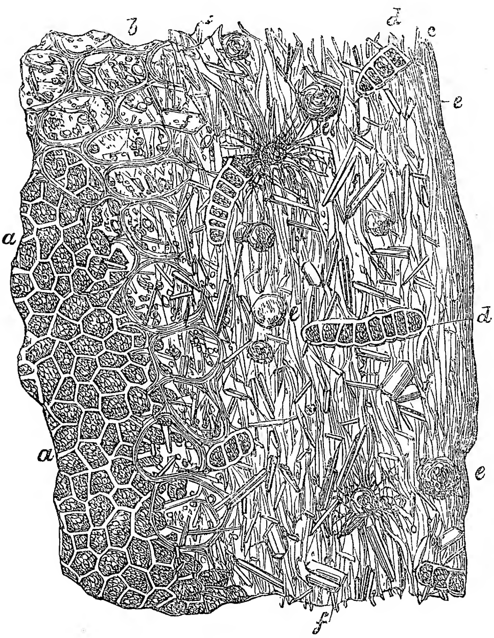
If now the surface of an entire seed enclosed in its membrane be examined, several raised lines or fibres will be observed, commencing at the end of the seed attached to the seed-vessel, spreading themselves out over its surface, and terminating at the distal extremity of the seed: these fibres are composed of spiral vessels, which lie imbedded in fibres of woody tissue and the cells above described.

The second membrane forms the chief substance and thickness of the husk.

The *third* membrane, thin and delicate, consists of angular cells of small size, the cavities of which contain minute globules of fat; in removing the outer tunics this membrane sometimes comes away in part with them, but in general the greater portion adheres to the surface of the seed. This membrane covers not only the outer surface of the lobes of the seed, but also dips down between them, and furnishes each of the opposite sides with a covering; it is most evident, however, on the external surface. It is probable, notwithstanding it may be exhibited as a separate tunic, that it is yet, strictly speaking, not to be regarded as a distinct structure, but that it really belongs to the seed, since on removing it cells belonging to the substance of the seed frequently come away with it; the colourless cells constituting it being evidently gradually transformed into the coloured ones of the seed itself. To each seed-lobe, therefore, according to the above description, there is a distinct membrane.

Situated in the interspaces of the lobes is a fourth structure, attached externally to the second membrane, the cells forming which pass down upon it for a short distance; although clear and transparent, it exhibits a fibrous structure, and on its surface a considerable number of small crystals are always to be seen, consisting probably of margarine, as well as many elongated bodies, rounded at either extremity, and divided into several compartments or cells, and which do not appear to be attached to the membrane on which they lie. From their curious appearance, and the absence of connexion with any of the other structures of the cocoa seed, the observer is led to suspect that they are extraneous growths, probably fungoid. We have detected them in every sample of cocoa-seed submitted to examination. (See *fig.* 75.)

Fig. 75.



In this engraving the several structures above noticed are delineated. *a, third tunic; b, rounded cells,* derived from the second membrane, lying upon the fourth membrane, and situated at the lines of junction of the lobe; *c, fourth or fibrous membrane; d d, elongated bodies; e e, rounded masses of crystalline fatty matter; f f, crystals of margarine.*

We have now completed the description of the several structures which enter into the composition of the husk of cocoa: this, although it contains scarcely any oil, and no starch, and is therefore but little nutritive, is yet present in almost every sample of flake, rock, and other less-carefully manufactured preparations of cocoa.

The French chocolate manufacturers, however, rarely make use of the husk, but generally dispose of it, obtaining about threepence per pound.

The greater part of the rejected and comparatively worthless husks find their way to Ireland.

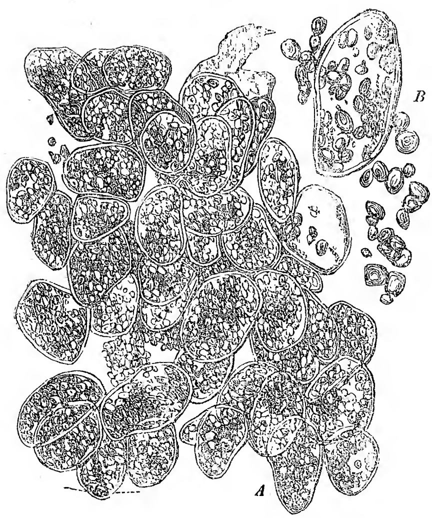
Of these husks, Dr. Ure states 612,123 lbs., out of 753,580 imported for consumption in 1840, were consumed in Ireland, and less than 4000 lbs. of cocoa-beans.

There is reason to believe that in some cases the fragments of husk prove irritating to the intestines, and occasion diarrhœa.

The *seed*, deprived of its husk, is seen to be composed of several lobes, angular in form, and irregular in size and shape; under pressure, these readily separate from each other, and the seed breaks up into pieces, which are known as "nibs."

The lobes are constituted of innumerable minute cells, of a rounded form, the cavities of which are filled with starch-corpuscles and fatty matter.

Fig. 76.



This figure represents the *cells* which form the kernel of the seed. In *A*, the cells and contained starch-corpuscles are magnified 220 diameters; and in *B*, 500 diameters.

On the surface of the seed these cells become angular by compression, and are usually of a deep-red colour: the tint, however, varies greatly; they are frequently, in parts, spotted with purple, and even deep-blue.

Each cell contains many starch-corpuscles, small in size, of a rounded form, and which often present an obscure, radiate, or stellate hilum.

Placed at one extremity of the seed is the *embryo;* this consists of cellular tissue, the cells or meshes of which enclose numerous starch-granules and spherules of oil.

Now, in the more carefully prepared chocolates, the whole of the structures represented in *figs.* 72, 73, & 74. are absent, and those delineated in *fig.* 75., and especially *fig.* 76., only are met with: in some cases the embryo even is removed; but this, since it forms so inconsiderable a part of the entire seed, and contains, moreover, starch and fat, appears to be almost an over-refinement.

On the Adulteration of Cocoa.

In this country cocoa is sold under the names flake, rock, granulated, soluble, dietetic, homœopathic cocoa, &c.

Now there is nothing in these names to indicate that the articles in question are anything more than varieties of cocoa, or to show, what is too frequently the case, that they are compounds of sugar, starch, cocoa, and oftentimes other substances.

The practice of calling these *mixed* articles cocoa is manifestly as improper and deceptive as it is to call *the compound of coffee and chicory*, Patent Compressed Coffee, Finest Old Turkey Coffee, &c.

The French and other continental manufacturers of cocoa adopt a more straightforward and proper course: they never call their compound and manufactured articles cocoa, but chocolate; thus they even denominate the cakes which they prepare, and which contain nothing but cocoa, chocolate—"chocolat sans sucre," although, with strict propriety, they might in this case have used the word cocoa.

The cocoa, then, of the English makers in general is not cocoa at all, but chocolate; whenever, therefore, the word cocoa, an adjective of indefinite signification being prefixed, is employed to designate an article which is not pure or genuine cocoa, *we shall consider and describe that article as adulterated*—a course which is suggested by common sense.

The works of Accum, Brande, Ure, and Pereira, contain but little information respecting the adulteration of cocoa; the only English writers who have treated of it at all fully being Mitchell and Normandy.

The first of these authors, Mitchell, has the following observations on the subject:—

"Chocolate is adulterated with flour, potato-starch, and sugar, together with cocoa-nut oil, lard, or even tallow. Even the so-called finest chocolate is made up with clarified mutton-suet and common sugar, together with ordinary cocoa.

"If in breaking chocolate it is gravelly,—if it melt in the mouth without leaving a cool, refreshing taste,—if it, on the addition of hot water, becomes thick and pasty,—and, lastly, if it form a gelatinous mass on cooling, it is adulterated with starch and such-like substances.

"Where earthy and other solid substances are deposited from chocolate mixed with water, either the beans have not been well cleansed, inferior sugar has been employed, or mineral substances have been added to it, either for the purpose of colouring or of increasing its weight.

"Moreover, when chocolate has a kind of cheesy taste, animal fat has been added; and when very rancid, either vegetable oil, or even the seeds themselves, have been employed in the sophistication.

"The mineral substances employed in the making up of chocolate are some of the ochres, both red and yellow, together with minium (red lead), vermillion, sulphate of lime, chalk, &c. Chocolate so adulterated, more especially with the preparations of lead, are highly injurious; it is, however, only the inferior chocolates that are thus adulterated."

From the work of Normandy we extract the following remarks:—

"Unfortunately, however, many of the preparations of the cocoa-nut, sold under the names of chocolate, of cocoa flakes, and of chocolate powder, consist of a most disgusting mixture of bad or musty cocoa-nuts, with their shells, coarse sugar of the very lowest quality, ground with potato-starch, old sea-biscuits, coarse branny flour, animal fat (generally tallow, or even greaves). I have known cocoa-powder made of potato-starch, moistened with a decoction of cocoa-nut shells, and sweetened with treacle; chocolate made of the same materials, with the additions of tallow and of ochre. I have also met with chocolate in which brick-dust or red-ochre had been introduced to the extent of twelve per cent.; another sample contained twenty-two per cent. of peroxide of iron, the rest being starch, cocoa-nuts with their shells, and tallow. Messrs. Jules Garnier and Harel assert that cinnabar and red-lead have been found in certain samples of chocolate, and that serious accidents had been caused by that diabolical adulteration. Genuine chocolate is of a dark brown colour; that which has been adulterated is generally redder, though this brighter hue is sometimes given to excellent chocolate, especially in Spain, by means of a little annato. This addition is unobjectionable, provided the annato is pure, which, however, is not always the case."

In the above quotations mention is made of the chief adulterations to which cocoa is subject; we will therefore proceed to consider the methods by which they may be detected.

On the Detection of Foreign Fatty Matter.

Animal oils and fats, on exposure to the air for a time, become rancid and disagreeable to the taste; for their detection, therefore, it is recommended that the suspected cocoa should be spread out, and subjected to the action of the atmosphere.

"The adulterations by lard, tallow, oils, and suet," writes Mitchell, "are best detected by the taste, after the chocolate has been exposed for some time to the action of the air in a tolerably warm place. In order to effect the desired change rapidly, the chocolate should be scraped very fine, and spread out upon a plate or piece of paper. In a few days the foreign fatty matters will become rancid, and can then be detected by the peculiarly disagreeable taste and smell which fatty substances in that condition possess."

"The presence of *animal fats*," states Normandy, "may be detected by the palate, for the chocolate generally has, in that case, a cheesy flavour; or, when common butter or oil has been added, it has a rancid flavour. This is quite characteristic, for butter of cocoa always remains perfectly sweet.

"The presence of *animal fats*, or of *oils*, may also be recognised by saponifying a portion of the chocolate as follows:—Rasp about 2000 grains of the chocolate under examination, and boil them with water and some caustic potash. When the fat has saponified, dilute the mass with a sufficient quantity of water, and filter three or four times. The milky filtrate, which is, in fact, a solution of soap, should now be supersaturated with nitric acid; this will separate the fat, which will float on the liquor after cooling. It may then be collected on a filter, and on rubbing a small portion of it between the fingers, the odour will generally indicate its origin; but more effectually still by heating it in a small capsule. Pure butter of cocoa has no odour. Or the chocolate may be exhausted by sulphuric ether, and by evaporating it, the fat will be left behind, and may then be identified, as just said."

The methods of detection pointed out in the above paragraphs are not without practical value; we believe, however, that the presence of foreign fatty matter may frequently be determined with considerable ease and certainty, in the following manner: —

The quantity of fat present in any sample of cocoa of given weight is to be ascertained by boiling, and the size and form of the concrete fat-globules which form on the surface of the decoction when cold noticed.

One half-ounce of genuine Trinidad cocoa, prepared from the kernels only, and boiled for ten minutes with ten ounces of water, yields about sixty-five grains of concrete fat.

The same quantity of genuine flaked cocoa, which contains both kernels and husk, boiled for the same period, yields about forty grains.

When, therefore, a sample of cocoa, treated as above, is found to contain a greater proportion of fat, there is no question, if the excess be at all considerable, and amount to several grains, that foreign fatty matter has been mixed with the cocoa.

But in some cases there may be no excess of fat, and even a deficiency, and yet animal oil or fat may have been added to the cocoa—circumstances sufficiently explained by the fact, that in many adulterated samples sugar, starch, and a small proportion of animal fat, are frequently made to supply, to a great extent, the place of cocoa.

In all cases in which the presence of animal oil or fat is suspected, not only should the quantity of fat present be determined, but the number, size, and form of the fat globules and discs which collect on the surface of a cup of cocoa when cold should be noted; if these be numerous, firm, shot-like, and globular, except on the upper surface, which is slightly flattened, and very small, rarely exceeding the twelfth of an inch in diameter, then there is no doubt but that the globules in question consist of the fat or butter proper to cocoa.

If, however, on the other hand, the globules be large, flat, or disc-like, exceed this size considerably, attaining, some of them, to one-fourth of an inch, and even more in diameter, then animal fat or oil is probably present, a conclusion which may be still further confirmed by testing the fat, keeping it for a time, and observing whether it becomes rancid or not. The suspected cocoa should be cooled in an open vessel exposed freely to the air, and not in a saucepan with the lid on, for in this latter case the droplets of oil of even pure cocoa will frequently concrete in large and flattened discs.

Cocoa as ordinarily met with is mixed with variable, and often very considerable, quantities of sugar and starch. In order to ascertain whether the presence of these substances modifies in any way the quantity of oil which collects on the surface, or the size and form of the globules, we instituted the following trials or experiments.

One ounce of a mixture consisting of equal parts of genuine cocoa and white sugar were boiled for ten minutes in ten ounces of water; the globules of oil which formed on the surface of the fluid when cold did not differ materially in size and shape from those which occurred on the decoction of pure cocoa, but there were fewer of them, and the quantity of oil was not so great by a few grains.

The same quantity of a mixture consisting of three parts of cocoa and one of potato-flour was treated in a similar manner; in this case the quantity of fat which rose to the surface was much less than in the former case, and the globules of oil smaller.

It is thus evident that the presence of neither sugar nor starch modifies very considerably the size and form of the fatty globules of cocoa, although less fat, especially when starch is used, collects on the surface.

On the Detection of Starch.

For the detection of starch we are recommended to make use of iodine. Now those who give this recommendation surely cannot be aware of the fact that the cocoa-seeds contain certainly not less than 11 per cent. of starch, and therefore that this re-agent, if properly applied, invariably shows the presence of starch in every sample of cocoa, even the most genuine. But little reliance, therefore, ought to be placed on iodine for the detection of this adulteration, and those not aware that starch exists in cocoa might be led by its use into serious error.

It is not a little remarkable that those who advise the use of iodine make no reference, although their works were published within the last year or so, to the microscope as a means of detecting starch in cocoa, and yet this instrument is capable, not only of affording a good idea of the amount of starch present, but enables the observer to discriminate the several kinds of starch from each other, and to say whether wheat, potato, sago, or arrow-root starch, has been employed in the adulteration.

In determining the quantity of starch present in any sample of cocoa, it is well not to rely solely upon the microscope, but to observe the consistency of the decoction when cold; if the amount of starch be very considerable, forty or fifty per cent., the liquid will be thick and jelly-like.

In making observations on the comparative density of cold decoctions of cocoa containing different per-centages of starch, we noticed that after a time the starch ceased to be uniformly diffused throughout the fluid, and that it, as well as the heavier particles of cocoa, subsided, leaving a supernatant stratum of clear liquid; this stratum varying in thickness according to the quantity of starch present, and being most shallow where there was most fecula, and deepest where this was least.

It then occurred to us that in the fact of the subsidence of the starch we had a means of determining with considerable precision the per-centage of that substance present in any sample of cocoa.

We accordingly filled five tubular glasses, each seven inches and a half in height, three-fourths of an inch in diameter, and holding twelve drachms of water, with five different cold decoctions of cocoa, containing, respectively, 50, 40, 30, 20, and 10 per cent. each of starch; in the first, the thickness of the clear stratum was one inch; in the second, one inch and a half; in the third, two inches; in the fourth, two inches and a half; and in the fifth, three inches. It is to be understood, however, that these measurements are approximately correct only, and that to obtain perfectly accurate results it is necessary that the experiments should be carefully repeated. The proportion of the ingredients forming each decoction was 220 grains by weight of the mixture of cocoa and potato flour, to eight ounces of water, the boiling being continued for five minutes in each case.

Should the cocoa contain sugar as well as starch, this must be first removed, by means of cold distilled water, and its amount ascertained.

The specific gravity of the decoction also enables us to form an approximate opinion as to the amount of starch present; this of course being greatest where there is most fecula.

Mr. Mitchell gives the following directions for the detection of starch in cocoa, from which it is clear that he was not aware that the seeds naturally contain a considerable quantity of starch: —

"Act upon about half an ounce of the suspected chocolate with a teacupful or more of hot water. Mix all well together in a mortar, and set aside to cool; when cold, add a few drops of a solution of iodine in water (prepared as described under the article Flour). If starch or flour be present, or ground beans or peas, or any substance containing starch, a blue coloration will occur. This coloration will be intense in proportion to the quantity of starch present. If only a very small quantity of starch be present, it will be advisable to strain the mixture of chocolate and water through a linen cloth, and act on the strained liquid with the solution of iodine. An alcoholic solution of iodine is also suited to this purpose. If the chocolate acted on be pure, only a yellowish-brown coloration will take place."

The directions by Normandy are more brief, but to the same purpose: —

"Genuine chocolate should dissolve in the mouth without grittiness; it should leave a peculiar sensation of freshness, and after boiling it with water the emulsion should not form a jelly when cold; if it does, starch or flour is present. The admixture of flour or of starch, moreover, may be readily detected by the blue colour which is imparted to the decoction, after cooling, by solution of iodine."

Perhaps the best method of proceeding in order to determine the amount of starch present is to boil the cocoa thoroughly, the sugar having first been separated; strain the decoction and remove the fat when cold; the residue will consist principally of starch.

On the Detection of Sugar.

The presence of sugar in cocoa may be readily detected by the taste. To determine the quantity, the following simple but efficient proceeding may be adopted: — Dissolve a weighed quantity of cocoa containing sugar in cold water, filter, dry the residue by means of blotting paper and heat, weigh; the loss will indicate very nearly the amount of sugar with which the sample of cocoa operated upon was admixed.

To show to what extent this method may be relied upon, we may mention that we dissolved one ounce of a mixture in equal proportions of cocoa and sugar in cold water, and afterwards dried the residue; the weight of this was only twenty-eight grains short of the four drachms.

On the Detection of Mineral Substances.

Of the mineral substances employed in the adulteration of cocoa, some are used for the sake of their weight; of these the chief are carbonate of lime or chalk, and sulphate of lime or plaster of Paris, and especially the former.

Other substances are employed for the colour they impart, and these are frequently had recourse to; the principal are red earth, red ochre, or Venetian red.

For the detection of these earths, an ounce of each of the samples of cocoas to be analysed should be incinerated, and the ash weighed and tested.

If chalk or carbonate of lime be present, an effervescence will ensue on the application of a mineral acid.

If the presence of any of the red earths be suspected, the ash will be more or less deeply coloured and ferruginous from the presence of iron, for which it may be tested; for this purpose it should first be treated with hydrochloric acid; this should afterwards be diluted, and the proper re-agents applied.

Mitchell gives the following directions for the detection of earthy matters: —

" A considerable quantity of the suspected chocolate must be treated with successive portions of hot water, as long as anything seems to be dissolved. The best method of operating is as follows: —

" The finely-scraped chocolate (say a quarter of a pound) is placed in a large vessel, and two or three quarts of warm water poured upon it, and the whole well stirred. After about a quarter of an hour, the supernatant liquid may be poured off, and the residual matter again treated with hot water, until nearly tasteless. It is now to be collected, dried, and tested."

Under this head Normandy has the following observations: —

" *Brick-dust*, and other *earthy matters*, are detected by incinerating a given weight of the chocolate or cocoa under examination; the impurities remain among the ashes, and may be easily recognised. This adulteration is also readily detected by grating 500 grains of the chocolate in as fine a powder as possible, throwing it into about half a pint of cold water, stirring the whole briskly for about ten minutes, leaving it at rest for about two minutes, and decanting the supernatant liquor. The earthy matter will then have subsided, and will be left as sediment."

Results of the Microscopical and Chemical Examination of Numerous Samples of Flake, Granulated, Rock, Soluble, Dietetic, Homœopathic, and other Cocoas.

In the following analyses our object has been, to ascertain, approximately, the per-centage of starch, sugar, and cocoa, present in each sample of cocoa submitted to examination, as well as the different kinds of starch employed.

The correct determination of these important particulars involves the expenditure of a considerable amount of time, and requires much careful observation.

For these reasons our inquiries have not been directed, on the present occasion, to the detection of the mineral ingredients sometimes employed in the adulteration and colouring of cocoa. The requisite analyses for the discovery of these will be undertaken hereafter, and the results announced in a future report.

It has already been stated that when the quantity of starch contained in water is not sufficient, after boiling, to cause the gelatinisation of the whole liquid, it gradually separates, subsides, and forms a precipitate, greater or less, depending on the amount of starch present.

By the observation of this fact, we are furnished with the means by which the per-centage of starch contained in any sample of cocoa may be approximately ascertained.

For this purpose, a weighed quantity of the mixture of starch and cocoa, previously freed from sugar by washing, must be boiled in a known bulk of water, the decoction being poured, while hot, into a tall, narrow, cylindrical test-glass, having lines marked upon it, indicating different per-centages.

The scale denoting the per-centages must be previously determined by carefully conducted experiments, the particulars of which it is not necessary to detail, since the principle by which they may be worked out has been stated—viz., the subsidence of the starch in water, when not present in too great amount.

In the first part of this Report it was likewise stated that cold water acts but slightly upon cocoa, so that after it has been immersed in that fluid for some minutes, on being re-collected, dried, and weighed, it will be found to have suffered but little loss.

Thus, of four different samples of genuine cocoa, the diminution of weight amounted in each case to only about three grains per cent.: the knowledge of this fact at once points out a simple and efficient way by which the quantity of sugar contained in any sample of cocoa may be determined. The loss of weight which the sample sustains, then, through the action of cold water, over the three grains, represents the amount of sugar present. To be on the safe side, however, in the following analyses we have allowed, for loss, five grains of cocoa in every hundred.

By substracting the combined weight of the starch and sugar, the relative amounts of which have been ascertained by the processes above described, from a given quantity of cocoa, we are enabled to determine the per-centage of the latter, presuming the sample under analysis to consist only of the three ingredients referred to.

The method ordinarily recommended to be pursued for the detection of animal fat, is to expose the suspected cocoa to the action of air and moisture, when, if it become rancid, it is considered to be adulterated with either lard, suet, or tallow.

We, however, are disposed to place more reliance on the size and form of the concrete fat-globules which collect on the surface of a decoction of the cocoa.

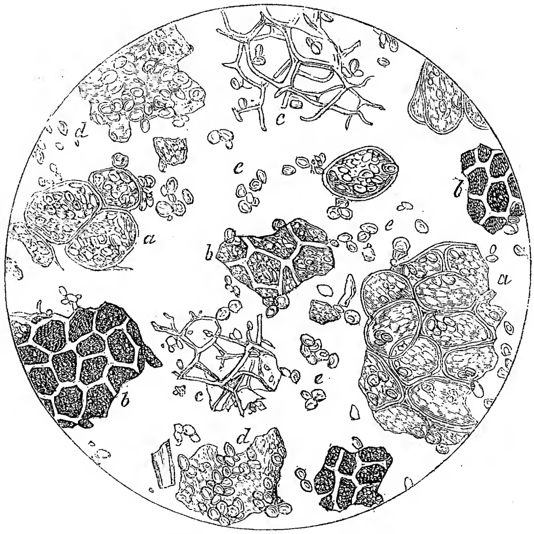
The oil-globules, when concrete, of genuine cocoa, are small, firm, and round, or shot-like, except on the upper surface, which is sometimes slightly flattened.

In the cocoa adulterated with animal oil, the globules which form on the surface are much larger, and flat and lenticular in shape.

We have already stated that the quantity of oil which rises to the surface in a decoction of cocoa containing sugar or starch, especially the latter, is much less than in the case of pure cocoa, but that these substances do not appear to affect in any considerable degree the size or form of the fat-globules, and consequently do not render the test we have pointed out of less value.

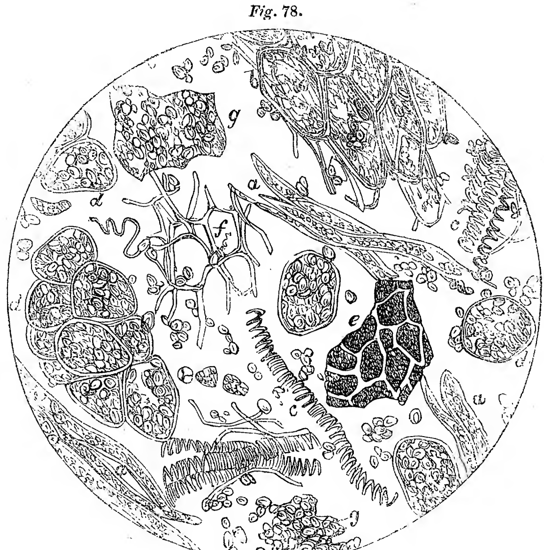
As we shall hereafter insert representations of the microscopic appearances presented by cocoas, containing different kinds of starch, in order that these may be the more readily comprehended, we call attention to the two following woodcuts:—

Fig. 77.



Represents the structures met with in a sample of GENUINE TRINIDAD COCOA, prepared by *M. Lebaigue.* It will be noticed that *the tissues forming the husk of cocoa are absent,* and that those of the seed itself are much broken up, many of the cells being ruptured, so as to permit the escape of the starch-corpuscles and fat, points of importance in the manufacture of chocolate. *a a,* cells of the kernel of cocoa; *b b,* membrane on surface of lobes; *c c,* tissues of embryo; *d d,* free masses of starch; *e e,* loose starch-corpuscles.

Fig. 78.



Exhibits the structures present in a sample of *unadulterated* FLAKED COCOA, which usually *contains both seed and husk. a a,* tubular fibres on surface; *b b,* second membrane of husk; *c c,* spiral vessels; *d d,* cells of kernel; *e,* membrane covering lobes; *f,* tissue of embryo; *g g,* free masses of starch-granules; *h h,* loose starch-corpuscles.

Several kinds of cocoa are manufactured, the chief being flake, granulated, soluble, rock, dietetic, homœopathic, broma, &c.; of each of these we shall treat separately.

Flaked Cocoa.

Flake cocoa as generally prepared contains the husk, which forms about twelve per cent. of the seeds. It is to be regretted that the value of this, one of the simplest and nicest preparations of cocoa, should be lessened by the presence of so much comparatively worthless matter.

While genuine flaked cocoa of good quality cannot be purchased under tenpence or one shilling per pound, it is no uncommon circumstance to see in the shop-windows samples ticketed fivepence and sixpence per pound; such samples, it is needless to say, at this price, must either be damaged or adulterated.

1*st Sample.*—Purchased of J. H. Kemper, 1. Waterloo-terrace, Commercial-road East. Price 10*d.* per pound.

Copy of placard in window:—

"Kemper's Pure Cocoa.
Pure, and Warranted
Genuine."

On analysis, the article was found to be as "warranted"— *Genuine.*

2*nd Sample.*—Purchased of Owen Sparrow & Co., No. 1. Aldgate. Price 8*d.* per pound.

Analysis.—100 parts consist of about 20 parts *sugar*, and the remaining 80 parts of a combination of cocoa and starch, in about the proportion of 18 of the latter to 100 of the former, the starch being a mixture of *potato* and *wheat flours.*

3*rd Sample.*—Purchased of Messrs. Ridgway & Co., 4. & 5. King William-street, City. Price 10*d.* per pound.

Genuine.

4*th Sample.*—Purchased of J. Lawrence, 51. High-street, Bloomsbury. Price 1*s.* per pound.

Genuine.

5*th Sample.*—Purchased of Hall, South-row, Golden-square. Price 8*d.* per pound.

Analysis.—100 parts consist of nearly 11 parts *sugar*, and the remaining 89 parts of a combination of cocoa and *potato-flour*, in the proportion of about 14 of the latter to 100 of the former.

6*th Sample.*—Purchased of Stevenson & Co., 55. Strutton-ground, Westminster. Price 5*d.* per pound.

Copy of placard in window:—

"Flaked Cocoa,
Nutritious and Cheap.
5*d.* per lb."

Analysis.—100 parts consist of about 11 parts *sugar*, and the remaining 89 parts of a combination of cocoa and starch, in the proportion of about 12 of the latter to 100 of the former, the starch being a mixture of *wheat*, *potato*, and *sago flours.*

7*th Sample.*—Purchased of H. Reeves, 6. Great Chapel-street, Broadway, Westminster. Price 6*d.* per pound.

Analysis.—100 parts consist of a mixture of cocoa and starch, with a very small quantity of *sugar*, the starch being in the proportion of about 14 per cent., and being a mixture chiefly of *potato-flour*, with some *sago-meal.*

8*th Sample.*—Purchased of Waller & Co., 80. Charlotte-street, Tottenham-court-road. Price 6*d.* per pound.

Analysis.—100 parts consist of nearly 10 parts *sugar*, and the remaining 90 parts of a combination of cocoa and starch, in the proportion of about 10 of the latter to 100 of the former, the starch consisting of *sago-meal* and *wheat-flour.*

9*th Sample.*—Purchased of W. Harper, 24. James-street, Lisson-grove. Price 8*d.* per pound.

Analysis.—100 parts consist of about 14 parts *sugar*, the remaining 86 parts of a mixture of cocoa and *potato-flour*, the latter being in the proportion of about 16 parts to 100 of cocoa.

10*th Sample.*—Purchased of W. Strugnell, 109. Edgware-road. Price 10*d.* per pound.

Analysis.—100 parts consist of about 8 parts *sugar*, the remaining 92 parts being nearly all cocoa, with a very small per-centage of *potato-flour*.

GRANULATED COCOA.

11*th Sample.*—Purchased of Hanks, 27. Ryder's-court.

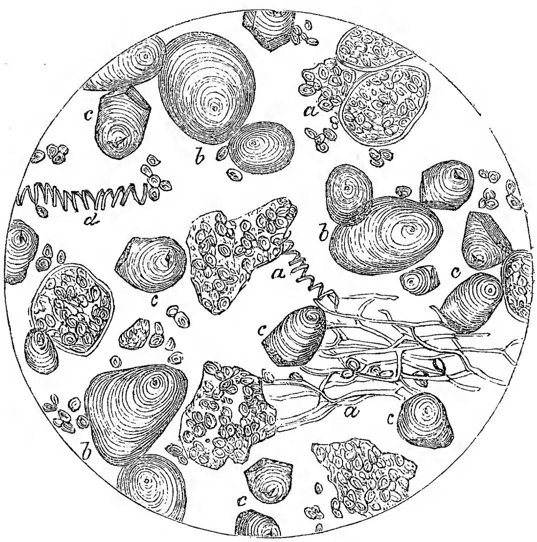
"FRY'S
GRANULATED COCOA.
ITS ADVANTAGES
Are perfect and instantaneous solubility, requiring no boiling, and fineness of flavour: it is also nutritious and easy of digestion.
MADE BY
FRY & SONS, BRISTOL.

Directions.

"Fill the cup with boiling water, and sprinkle in one or two teaspoonfuls, give it a stir, and use milk or cream and sugar to suit the taste. It may be made in the kitchen, as chocolate, by boiling half milk and half water, and when off the fire, stirring in one or two ounces to a pint; or it may be milled like other chocolate.
Price, ½ lb. package, 7*d.*"

Analysis.—100 parts consist of about 28 parts *sugar*, and the remaining 72 parts of a combination of cocoa and starch, in the proportion of about 27 of the latter to 100 of the former; the starch being a mixture of *potato-flour*, *Maranta arrow-root*, *sago-meal*, and a few granules of *Curcuma or East Indian arrow-root.*

Fig. 79.



J. S. FRY & SONS' CELEBRATED SOLUBLE COCOA.
a a a, granules and cells of cocoa; *b b b*, granules of *potato-flour*; *c c c*, granules of *sago-meal.*

12*th Sample.* — Purchased of Handford & Davies, 61. High Holborn. Price 1*s.* the pound package.

"HANDFORD & DAVIES'S
PURE
GRANULATED COCOA.

ADDRESS TO THE PUBLIC.

"This COCOA has now, for more than two years, been before the public, and the large and continually increasing consumption of it is a proof how fully it is appreciated. We pledge our reputation that there is *not one atom* of any article besides cocoa in it, and that the finest in the market. Vast quantities of stuff are sold under the name of soluble cocoa, but which, in fact, is a vile compound of Japan-earth, sago-dust, brown sugar, and cocoa; the price is seductive, being as low, in some cases, as 6*d.* per lb. and the public think they are purchasing a cheap article, when, in truth, they are buying a very dear one — dear, because in a pound of it there is not frequently half a pound of cocoa, — dear, because it is decidedly unwholesome, and worse than useless when taken as a restorative of health. The plea that it does not require to be boiled is delusive, for the direction demands that the water with which it is made must boil; if so, why not have put the cocoa into the water, and let it boil, as the water will not take longer to boil because you have put a little cocoa into it, from the fact, pure cocoa only requires to be boiled about ten minutes.

"Those who are directed by their medical men to drink cocoa, for the purpose of renovating their strength, we strongly urge to make trial of our pure granulated cocoa; it is manufactured from the finest Granada nut with the greatest care, under a process peculiar to us, and we confidently state that it will be found to be more nutritious, easy of digestion, agreeable, and economical than any other cocoa."

Genuine.

BROMA.

13*th Sample.* — Purchased of — Staniforth, 138. Oxford-street. Price 7½*d.* per quarter-pound packet.

"STRICKLAND'S BROMA,
Prepared from the
TRUE CHOCOLATE NUT,
Made after the Original Receipt.
F. S. ORR, MANUFACTURER,
GREENWICH, KENT.
The only Genuine Broma.

"DIRECTIONS FOR USING.

"Mix one ounce of BROMA with as much cold Milk as will make it into a soft Paste, then pour on a pint of boiling Milk-and-Water in equal proportions, and boil for about one minute, stirring it occasionally; or may be made without boiling.

ADD SUGAR AT PLEASURE."

Analysis. — 100 parts consist of about 22 parts *sugar*, and the remaining 78 parts of a combination of cocoa and starch, in the proportion of 55 of the latter to 100 of the former, the starch being a mixture of *tapioca-starch*, *Maranta arrow-root*, and *sago-meal.*

14*th Sample.* — Purchased of G. & W. Law, New Oxford-street. Price 8*d.* per quarter-pound packet.

"BROMA,
MANUFACTURED BY J. S. FRY & SONS,
BRISTOL.

"Directions for making Broma.

"Put a large teaspoonful into a teacup; then a small quantity of *boiling* water, mixing the broma well with the spoon; then nearly fill the cup with boiling water; stir it well, and add sugar, with milk or cream to suit the palate."

Analysis. — 100 parts consist of about 24 parts *sugar*, and the remaining parts of a combination of cocoa and starch, in the proportion of about 25 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root* with a little *sago-meal.*

15*th Sample.* — Purchased of T. Edridge & Co., No. 1. Oxford-street. Price 4*d.* per quarter-pound packet.

"STRATTON'S
Original
BROMA.
A Genuine
Preparation of the fragrant and
Delicious cream-flavoured Trinidad
COCOA-NUT.
Prepared by the Sole Inventors,
J. W. STRATTON AND CO.,
Homœopathic Steam Mills, Lambeth, London.

"This peculiar preparation, like most articles of sterling merit, is constantly being imitated by unprincipled persons, envious of the high reputation we have obtained from upwards of twenty years' extensive practical experience in the manufacture of chocolate, cocoa, broma, &c.

"Each packet bears our signature, which is a guarantee against spurious imitation.

J. W. Stratton & Co.

"Directions.—Put two teaspoonfuls of this cocoa into a teacup; pour a few spoonfuls of cold milk; beat into a stiff paste; then fill the cup with boiling milk, or milk-and-water."

Analysis. —100 parts contain about 35 parts of a mixture of *potato-flour*, *Maranta arrow-root*, with a few grains of *sago-meal.*

We have heard of late a good deal about homœopathy and homœopathists, and are acquainted with some of the delusions and deceptions of the so-called system. We have heard, too, of homœopathic coffee, arrow-root, cocoa, &c.; but we are at a loss to comprehend what can be the nature of "homœopathic steam mills."

Soluble Cocoa.

16*th Sample.* — Purchased of R. A. Hollis, 78. Judd-street. Price 2*d.* per quarter-pound package.

"Soluble
COCOA,
Manufactured
By D. DUNN,
Pentonville, London."

Analysis. — 100 parts consist of about 18 parts *sugar*, and the remaining 82 parts of a combination of cocoa and starch, in the proportion of about 25 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root*, *tapioca-starch*, *Indian-corn meal*, *potato-flour*, with a few granules of *Curcuma arrow-root.*

17*th Sample.* — Purchased of Henry Thorpe, 30. Chapel-street, Edgware-road. Price 2*d.* per quarter-pound packet, of a hexagonal form.

"BEST SOLUBLE COCOA,
TYLER & ESSEX,
LONDON."

Analysis. — 100 parts consist of about 11 parts *sugar*, and the remaining 89 parts of a combination of cocoa and *potato-flour*, the latter in the proportion of about 50 parts to 100 of the former.

18*th Sample.* — Purchased of Bodley & Co., 5. Portman-place, Edgware-road.

"STRATTON'S
IMPROVED
SOLUBLE COCOA,
WHICH REQUIRES NO BOILING.
A DELICIOUS PREPARATION OF THE
GENUINE COCOA-NUT.
Prepared only by the Sole Inventors,
J. W. STRATTON & CO.

"To obtain this pure preparation of the genuine cocoa-nut, as invented by us, the sole manufacturers, it is requisite to see that our name is on the envelope, as some unprincipled firms have condescended to the meanness of imitating our labels."

Analysis. — 100 parts consist of about 13 parts *sugar*, and the remaining 87 parts of a combination of cocoa and starch, in the proportion of about 45 of the latter to 100 of the former, the starch being a mixture of *potato-flour* and a little *sago-meal.*

19*th Sample.* — Purchased of Waller & Co., 80. Charlotte-street, Tottenham-court-road. Price 1½*d.* per quarter-pound packet.

"GENUINE SOLUBLE
COCOA.
GRAHAM & HEDLEY,
Manufacturers,
LIVERPOOL.

Use equal to coffee, beat into a paste, then add
boiling water."

Analysis. — 100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a combination of cocoa and *sago-meal*, the latter in the proportion of about 24 parts to 100 of the former.

20*th Sample.* — Purchased of W. J. Martin, 147. Edgware-road. Price 2*d.* per quarter-pound packet.

"BARON
DUPUYTREN'S
CELEBRATED
SOLUBLE COCOA."

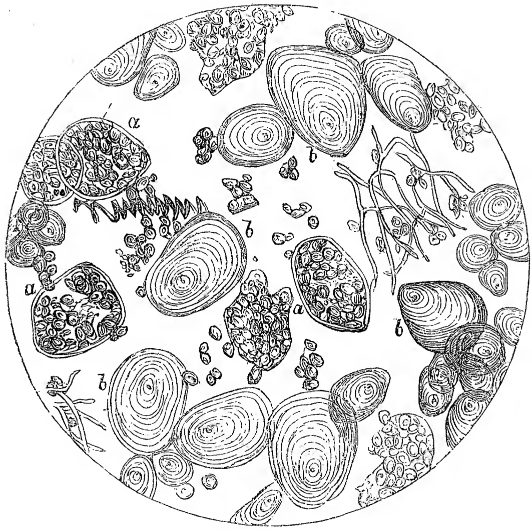
Analysis. — 100 parts consist of about 20 parts *sugar*, and the remaining 80 parts of a combination of cocoa and *potato-flour*, the latter in the proportion of about 55 parts to 100 of the former.

21*st Sample.* — Purchased of J. H. Kemper, 1. Waterloo-terrace, Commercial-road East. In quarter-pound hexagonal packet. Price 2*d.*

"STEANE, DAVIS, AND CO.'S
Superior
SOLUBLE COCOA,
MADE IN ONE MINUTE WITHOUT BOILING.
MANUFACTORY,
OXFORD."

Analysis. — 100 parts consist of about 15 parts *sugar*, and the remaining 85 parts of a combination of cocoa and *potato-flour*, the latter in the proportion of about 40 parts to 100 of the former.

Fig. 80.



STEANE, DAVIS, & CO.'S SUPERIOR SOLUBLE COCOA.
a a a, starch-corpuscles, cells, and spiral vessels of cocoa; *b b b*, granules of *potato-flour*.

22*nd Sample.* — Purchased of E. Bynner, 35. Newport-street, Soho Price 1½*d.* the quarter-pound packet.

" TAYLOR BROTHERS'
SOLUBLE
COCOA."

Analysis. — 100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a combination of cocoa and starch, in the proportion of about 32 of the latter to 100 of the former, the starch being a mixture of *potato and wheat flours.*

23*rd Sample.* — Purchased of Hawthorn & Co., 38. Tottenham-court-road. Price 1½*d.* per quarter-pound packet.

" The Celebrated
SOLUBLE COCOA,
HAWTHORN & Co.,
Manufacturers."

Analysis. — 100 parts consist of about 26 parts *sugar*, and the remaining 74 parts of a combination of cocoa and *sago-meal*, the latter in the proportion of about 22 parts to 100 of the former.

24*th Sample.* — Purchased of Hawthorn & Co., 38. Tottenham-court-road. Price 2*d.* per quarter-pound packet.

" Superior Soluble
COCOA,
Manufactured by
BARRY & Co.,
London."

Analysis. — 100 parts consist of about 20 parts *sugar*, and the remaining 80 parts of a combination of cocoa and *sago-meal*, the latter in the proportion of about 16 parts to 100 of the former.

HOMŒOPATHIC COCOA.

25th Sample. — Purchased of Henry Sparrow, Oxford-street. Price 4*d.* the quarter-pound packet.

"SPARROW'S
IMPROVED DIETETIC COCOA,
Especially recommended by the Homœopathic profession.

"Prepared from the finest Trinidad nuts, on an improved principle, whereby the fine bland oil (so peculiar to the finest cocoa) is incorporated with the farinaceous properties of the nut, and consequently will agree with the most delicate stomach.

INVALIDS

and others who are recommended cocoa should be particular what kind they use, as cocoa prepared from old or damaged nuts is *rancid* and therefore *decidedly unwholesome.*

NONE GENUINE UNLESS SIGNED THUS,—

H. Sparrow."

Analysis. — 100 parts consist of about 16 parts *sugar*, and the remaining 84 parts of a combination of cocoa and starch, in the proportion of 20 of the latter to 100 of the former, the starch being a mixture of *tapioca-starch* and a few granules of *Maranta arrow-root.*

26th Sample. — Purchased of J. Leath, 9. Vere-street, Oxford-street. Price 1*s.* 4*d.* per pound packet.

"LEATH'S
Dietetic or Homœopathic
COCOA.

"Three things have been sought in the preparation of this article of diet: —

"Pleasantness of flavour, nutritiveness, and facility of digestion. It is compounded from the best samples of the Theobroma Cocoa, therefore most especially adapted for dyspeptic persons, and also for those who from other causes are compelled to resort to medical treatment, whilst it is an equally delicious and economical article for the daily consumption of every one.

"All that is nutritive in the useful product from which this cocoa is prepared, has been carefully preserved, whilst all that is obnoxious has been as carefully rejected.

British Homœopathic Pharmacy,
9. VERE-STREET, OXFORD-STREET."

Analysis. — 100 parts consist of about 16 parts *sugar*, and the remaining 84 parts of a combination of cocoa and starch, in the proportion of about 25 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root, sago-meal, and potato-flour.*

27th Sample. — Purchased of W. Headland, 15. Princes-street, Hanover-square. Price 1*s.* 6*d.* per pound packet.

"The Homœopathic or Dietetic
COCOA,

Is a preparation containing all the nutritious properties of the Nut, *without any objectionable admixture.*

Prepared by W. HEADLAND, *Homœopathic Chemist.*"

Analysis. — 100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a combination of cocoa and starch, in the proportion of about 22 of the latter to 100 of the former, the starch being a mixture of *tapioca, Curcuma arrow-root, potato-flour, with a little Maranta arrow-root.*

28th Sample. — Purchased of T. Halstead, 17. Norton Folgate. Price 4½*d.* per quarter-pound packet.

"CADBURY BROTHERS'
(Birmingham)
HOMŒOPATHIC COCOA."

Analysis. — 100 parts consist of about 24 parts *sugar*, and the remaining 76 parts of a combination of cocoa and *wheat-flour*, in the proportion of about 16 of the latter to 100 of the former.

29*th Sample.* — Purchased of Wm. Tulloch, 171. Shoreditch. Price 8*d.* per half-pound canister.

"GRAHAM & HEDLEY'S
Superior Homœopathic Cocoa.

"This exquisite preparation, made from the recipes of the most able Homœopathists, combines in an eminent degree all the aromatic and nutritious properties of the Cocoa-nut, the disagreeable oily matter being separated by a new and peculiar process, by which it is rendered more highly nutritious. It may be taken with advantage by the most delicate, being light and easy of digestion.
Liverpool."

Analysis. — 100 parts consist of about 20 parts *sugar*, the remaining 80 parts being nearly all cocoa, with a very small per-centage of *sago-meal.*

30*th Sample.* — Purchased of G. & W. Law, 1. New Oxford-street. Price 1*s.* 4*d.* per half-pound packet.

"HOMŒOPATHIC COCOA,
made by
J. S. Fry & Sons, Bristol."

Analysis. — 100 parts consist of about 20 parts *sugar*, and the remaining 80 parts of a combination of cocoa and starch, in the proportion of about 20 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root, sago-meal, and Canna arrow-root, or Tous les Mois.*

31*st Sample.* — Purchased of T. Christie, 9. Whitechapel. Price 4*d.* per quarter-pound packet.

"PREPARED HOMŒOPATHIC COCOA
Particularly adapted for Persons of weak Digestive Powers, & Invalids generally.
Prepared only at Steane, Davis & Co.'s
Mustard & Cocoa Steam Mills, Oxford."

Analysis. — 100 parts consist of about 26 parts *sugar*, and the remaining 74 parts of a combination of cocoa and starch, in the proportion of about 16 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root and potato-flour.*

32*nd Sample.* — Purchased of Nicol & Co., 15. Rathbone-place. Price 4½*d.* per quarter-pound packet.

"NICOL & CO.
Manufacturers of Homœopathic Cocoa
by Special Appointment.

"This is the most pure and genuine cocoa, and far surpasses in quality any made, and is most extensively used and recommended by all medical men, as a most nutritious and pleasant beverage, at 1*s.* 6*d.* per pound.
15. Rathbone-place."

Analysis. — 100 parts consist of about 10 parts *sugar*, and the remaining 90 parts of a combination of cocoa and wheat-flour, in the proportion of nearly 10 of the latter to 100 of the former.

33*rd Sample.* — Purchased of Edwin Frost, 288. Oxford-street. Price 4*d.* per quarter-pound packet.

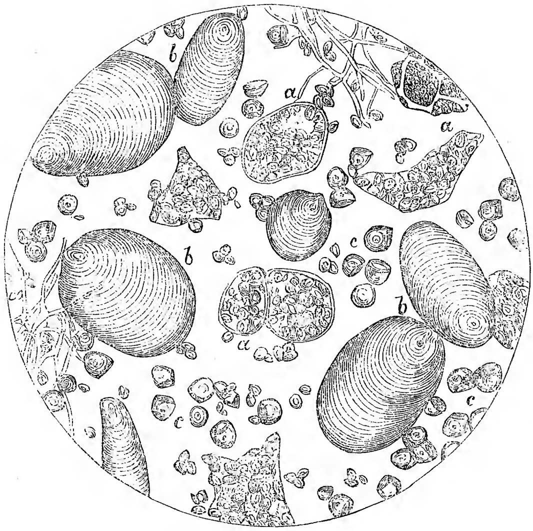
"TAYLOR BROTHERS'
HOMŒOPATHIC COCOA.

"Prepared under the most able Homœopathic advice; and combining the pureness, fine aroma, and nutritious property of the Fresh nut.

"Cocoa is the best of all flavoured drinks; it is highly nutritious; it may be taken with benefit by the most delicate or consumptive constitutions.

(*See* Domestic Homœopathy, by John Epps, M. D.)

Fig. 81.



TAYLOR BROTHERS' HOMŒOPATHIC COCOA.
a a a, granules and cells of cocoa; *b b b*, granules of *Canna-starch* or *Tous les Mois*; *c*, granules of *tapioca-starch*.

TAYLOR BROTHERS

Confidently challenge a comparison between this and all or any of the so-called HOMŒOPATHIC COCOAS. One trial will suffice, and add to the present large consumption of their article."

Analysis. — 100 parts consist of about 20 parts *sugar*, and the remaining 80 parts of a combination of cocoa and starch, in the proportion of about 18 of the latter to 100 of the former, the starch being a mixture of *tapioca-starch and Canna arrow-root, or Tous les Mois.*

34th Sample. — Purchased of J. Hale, 53. Brewer-street, Golden-square. Price 9*d.* the half-pound packet.

"EPPS' PREPARED COCOA."

Analysis. — 100 parts consist of about 13 parts *sugar*, and the remaining 87 parts of a combination of cocoa and starch, in the proportion of about 25 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root, sago-meal, and potato-flour.*

35th Sample. — Purchased of E. Frost, 288. Oxford-street. Price 8*d.* per half-pound packet.

"BARRY AND COMPANY'S
HOMŒOPATHIC
COCOA,
London.
Strongly recommended to invalids, as being wholesome, nutritious, and easy of digestion."

Analysis. — 100 parts consist of about 25 parts *sugar*, and the remaining 75 parts of a combination of cocoa and starch, in the proportion of about 18 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root, with a little potato-flour and sago-meal.*

That professed homœopathists should puff themselves and the articles they vend, by making general use of the word "homœopathic," is not surprising. It is, however, to be regretted, that respectable dealers and manufacturers should, by adopting a similar practice, give indirect countenance to so gross a delusion as homœopathy.

36th Sample. — Purchased of W. Holland, 127. Oxford-street. Price 9*d.* per half-pound packet.

"RELFE'S
PECULIARLY PREPARED HOMŒOPATHIC
COCOA.
Strongly recommended by the most eminent of the faculty, for persons of delicate constitutions, as being very nutritious and easy of digestion.
Prepared and Sold by
J. H. Browing.
John Relfe, 4. Gracechurch-street, London."

Analysis. — 100 parts consist of about 12 parts *sugar*, and the remaining 88 parts of a combination of cocoa and starch, in the proportion of about 24 of the latter to 100 of the former, the starch being a mixture of *Tacca* or *Tahiti*, with a little *Maranta arrow-root.*

37th Sample.—Purchased of James Way & Co. 272. Oxford-street. Price 4*d.* per ¼ lb.

"TAYLOR BROTHERS'
DIETETIC COCOA,
London,
Adapted for Homœopathic Patients and Dyspeptics."

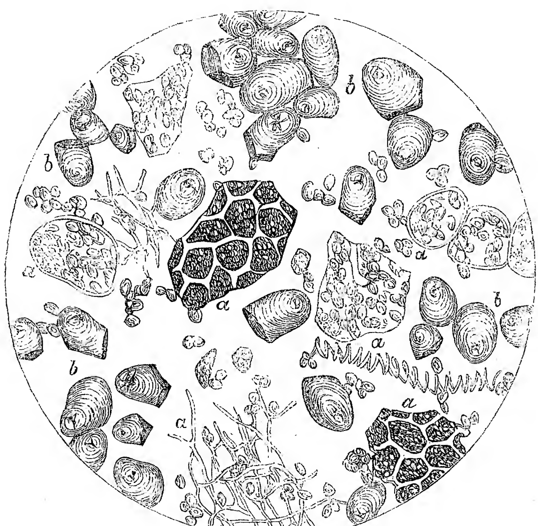
Analysis. — 100 parts consist of about 18 parts *sugar*, and the remaining 82 parts of a combination of cocoa and *starch*, in the proportion of about 26 of the latter to 100 of the former, the starch being a mixture of *Maranta arrow-root* and *potato-flour*.

38th Sample. — Purchased of G. B. White, 147. Shoreditch. Price 3*d.* per ¼ lb. packet.

"WHITE'S
PURE
HOMŒOPATHIC
COCOA."

Analysis. — 100 parts consist of about 8 parts *sugar*, and the remaining 92 parts cocoa, with a small proportion of *sago-meal.*

Fig. 82.



White's Pure Homœopathic Cocoa.
a a a, starch-granules, cells, and fragment of cocoa;
b b b, granules of *sago-meal.*

Roll Cocoa.

39th Sample.—Purchased of Owen Sparrow, 1. Aldgate. Price $2\frac{1}{2}d.$ a roll.

"GRAHAM & HEDLEY'S ROLL COCOA.

"Cocoa has never been used in this country to any extent, owing to the difficulty of preparing it for the table, when purchased in the *raw* state, and to the almost impossibility of procuring it genuine when manufactured.

"Graham & Hedley have in consequence been induced by some of the most extensive growers, to undertake its manufacture, in order to bring this most wholesome and nutritious beverage more into consumption with the industrious millions, and they now offer it to the public prepared in a perfectly pure state, and in a new and more convenient form for use, being moulded into *rolls or sticks*, each piece of which is stamped

'Graham & Hedley's Roll Cocoa, *Warranted Genuine.*'

"This is strongly recommended as being the best preparation of cocoa ever offered to the public, as well as the most economical substance that can be used for morning and evening meals. To invalids (to whom it is essential to have the article genuine), the advantages of using this must be apparent. A quarter of a pound will go as far as a pound of that usually sold in *red* packages."

Genuine.

40th Sample.—Purchased of E. Bristow, 2. Newcastle-place, Edgware-road. Price 3*d*. per roll.

"GENUINE ROLL COCOA,
Made by
Taylor Brothers,
The Most Extensive Manufacturers of Cocoa in Europe, Inventors and Sole Proprietors of the Original Soluble and Dietetic Cocoas.
(A designation so unwarrantably adopted by certain provincial makers.)

"*This* Roll Cocoa is not put forth on the strength of *professors' certificates*, which, it is well known, can be obtained at any time for a few pounds, and which, as regards Roll Cocoa, really signify nothing; for supposing that all they state be correct in reference to the *particular roll or sample under test*, it is obvious that such can be *no guarantee for the quality of what is produced afterwards.*

"The *test* which Taylor Brothers submit to with confidence is the test of *public taste*, and the *testimonial* they rely upon is that of their *established reputation*, as the *first manufacturers* in Europe; and their *guarantee for quality* is the *name* they have at stake.

"The Roll Cocoa is *warranted perfectly genuine*, and is only another form of presenting to the public 'Taylor Brothers' Refined Cocoa Nibs,' which are the choicest kernels of the finest growths, the form of roll being more convenient, but adding nothing to the purity of the cocoa, and is *not a patent right*, as some makers pretend, being the most simple process in the manufacturing *a plain chocolate;* the Dietetic and Homœopathic require much greater art and nicety, and are far better adapted for the purposes intended. All Roll Cocoa is simply the nibs merely ground and moulded into that form, and as such, requires no testimonial at all from *professors of chemistry*, especially not such nonsensical jargon as the plainest common sense cannot fail to detect in one or more of the testimonials set forth respecting it.

"Purchasers will please compare this with any Roll Cocoa before the public, and see that each roll is stamped

Taylor Brothers' Roll Cocoa, *Warranted Genuine.*"

Genuine.

Rock Cocoas.

41st Sample.—Purchased of R. H. Feltoe, 298. Oxford-street. Price 1*s*. per lb.

Analysis.—100 parts consist of a combination of cocoa and starch, the latter being in the proportion of about 18 parts to 100 of the former, the starch being a mixture of *potato-flour* and *sago-meal.*

42*nd Sample.*—Purchased of Houle & Company, 282. Oxford-street. Price 10*d.* per pound.

Analysis.—100 parts consist of a combination of cocoa and starch, the latter being in the proportion of about 18 parts to 100 of the former, the starch being a mixture of *potato-flour* and *sago-meal.*

43*rd Sample.*—Purchased of Holland & Company, 78. Lambs' Conduit-street. Copy of placard:—

"Genuine Rock Cocoa,
ground from the pure nut.
Price
One shilling per lb."

Analysis.—100 parts consist of a mixture of cocoa and *wheat-flour*, in the proportion of about 35 of the latter to 100 of the former.

44*th Sample.*—Purchased of James Appleton, 174. Drury-lane. 10*d.* per pound.

Genuine.

45*th Sample.* — Purchased of G. B. White, 174. Shoreditch. Price 1*s.* per pound.

Analysis.—100 parts consist of about 8 parts *sugar*, and the remaining 92 parts of cocoa, with a small proportion of *sago-meal.*

46*th Sample.*—Purchased of William Oakley, 72. High-street, Whitechapel.

"Strongly recommended and very rarely obtained.
Pure Cocoa.
10*d.* a pound.

"This article, being invaluable to invalids for its nutritious properties, is made on the premises."

Genuine.

47*th Sample.* — Purchased of Rogers & Company, 97. Crawford-street, Edgware-road. Price 1*s.* per pound.

Analysis.—100 parts consist of a mixture of cocoa and *wheat-flour*, the latter in the proportion of about 45 per cent.

48*th Sample.*—Purchased of H. Williams, 92. Crawford-street, Bryanston-square. Price 1*s.* per pound.

Analysis.—100 parts consist of a mixture of cocoa and *wheat-flour*, the latter in the proportion of about 35 per cent.

49*th Sample.*—Purchased of A. Andrews & Co., 57. Tottenham-court-road. Price 10*d.* per pound.

Analysis.—100 parts consist of a mixture of cocoa and *wheat-flour*, the latter in the proportion of about 35 per cent.

Soluble Cocoas.

50*th Sample.*—Purchased of M. Jones & Co., 166. Oxford-street. In hexagon tin-foil package, price 2*d.*

"FRY & SONS'
CELEBRATED
SOLUBLE COCOA."

Analysis.—100 parts consist of about 8 parts *sugar*, and the remaining 92 parts of a combination of cocoa and starch, the latter in the proportion of about 26 parts to 100 of the former, the starch being a mixture of *sago-meal* and *potato-flour.*

51*st Sample.*—Purchased of E. Frost, 288. Oxford-street. In hexagon tin-foil package, price 2*d.*

"TAYLOR BROTHERS'
CELEBRATED
SOLUBLE COCOA."

Analysis.—100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a combination of cocoa and starch, the latter in the proportion of about 42 parts to 100 of the former, the starch being a mixture of *potato* with some *wheat flour*.

52nd Sample.—Purchased of G. W. Back, Whitechapel. Price 2*d*. per packet.

"BARON DUPUYTREN'S
EXHIBITION COCOA
FOR 1851
Entered at Stationers' Hall, according to Act of
Parliament."

Analysis.—100 parts consist of about 16 parts *sugar*, and the remaining 84 parts of a combination of cocoa and *wheat-flour*, the latter in the proportion of about 40 parts to 100 of the former.

53rd Sample.—Purchased of W. Lodge, 47. Great James-street, Lisson-grove, Price 1*d*.

"BEST
SOLUBLE COCOA,
Per ONE PENNY Packet.
TYLER & ESSEX."

Analysis.—100 parts consist of about 12 parts *sugar*, and the remaining 88 parts of a combination of cocoa and *wheat-flour*, the latter in the proportion of about 65 parts to 100 of the former.

54th Sample.—Purchased of G. Clark, 135. Tottenham-court-road. Price 1½*d*. per quarter-pound packet.

"SOLUBLE
COCOA,
Manufactured by
J. S. FRY & SONS."

Analysis.—100 parts consist of about 8 parts *sugar*, and the remaining 92 parts of a combination of cocoa and starch, the latter in the proportion of about 30 parts to 100 of the former; the starch being a mixture of *potato-flour* and *sago-meal*.

55th Sample.—Purchased of W. Holland, 127. Oxford-street. Price in a jar, 1*s*. 6*d*.

"FRY'S
BEST CHOCOLATE
or
COCOA PASTE,
Made by J. S. Fry & Sons.

Analysis.—100 parts consist of a mixture of cocoa, sugar, *potato-flour*, and *sago-meal*, made into a stiff paste with *water*; the sugar and water form about 50 parts in 100 of the article, the remainder consisting of cocoa and a small proportion of *potato-flour* and *sago-meal*.

56th Sample.—Purchased of W. J. Staniforth, 138. Oxford-street. Price in a jar, 1*s*.

"DUNN'S COCOA PASTE."

Analysis.—100 parts consist of a mixture of cocoa and *sugar*, made into a stiff paste with *water*; the sugar and water form about 58 parts in 100 of the article.

From the above analyses it appears—

1st. That *Eight* of the Fifty-six samples submitted to examination were *genuine*. The following are the articles, with the names, either of the dealers from whom they were obtained, or the parties by whom they were manufactured.

Kemper's Flaked Cocoa—Purchased of J. H. Kemper, 1. Waterloo-terrace, Commercial-road East.

Ridgway's Flaked Cocoa—Purchased of Messrs. Ridgway & Co., 4 & 5 King William-street, City.

Flaked Cocoa—Purchased of J. Lawrence, 51. High-street, Bloomsbury.

Handford and Davies' Granulated Cocoa—Purchased of Handford & Davies, 61. High Holborn.
Graham and Hedley's Roll Cocoa—Manufactured by Graham & Hedley, Liverpool.
Taylor Brothers' Roll Cocoa—Manufactured by Taylor Brothers, Brick-lane, Spitalfields.
Rock Cocoa—Purchased of J. Appleton, 174. Drury-lane.
Oakley's Rock Cocoa—Purchased of W. Oakley, 72. High-street, Whitechapel.

2nd. That *sugar* was present in *Forty-three* samples, the amount forming from five to in some cases as much as nearly fifty per cent. of the article.

3rd. That *starch* was detected in *Forty-six* of the samples, the quantity present varying from five to nearly fifty per cent., and consisting either of *wheat*, *potato-flour*, *sago-meal*, &c., or mixtures of these in various proportions.

(Since the above analyses were made, we have more than once met with samples of cocoa nibs adulterated with chicory: this is a frequent adulteration of cocoa in the state of nibs.)

It is curious to notice the kinds of fecula, and the combinations of these employed by some makers.

Thus Nicoll & Co., Cadbury Brothers, Gatti and Bolla, &c., make use of *wheat-flour.*

Steane, Davis, & Co., appear to give preference to *potato-flour.*

White employs *sago-meal*, which is met with in all his preparations of cocoa and chocolate.

Taylor Brothers, use chiefly a mixture of *potato and wheat flours.*

Fry & Sons prefer a mixture of *potato-flour* and *sago-meal*, a combination which occurs, as will be seen by reference to the analyses, in nearly all the articles bearing their names.

Dunn's cocoas all contain a mixture of *tapioca-starch, Maranta arrow-root, sago meal, Indian corn-flour* and *Curcuma arrow-root.*

The object of employing a mixture of several kinds of starch in the same preparation is by no means clear. It is perhaps explained by the fact that dock and warehouse sweepings, which consist of a mixture of various starches, are in some cases used by the manufacturers of cocoa.

We will now consider the purposes served by the admixture of starch and sugar with cocoa.

The coffee dealer assures us that chicory is a great improvement to coffee; the manufacturer of mustard that that substance cannot be eaten unless admixed with plenty of wheat-flour and turmeric powder; while the cocoa-maker asserts that starch is a great improvement to cocoa; that it renders it "soluble," forms an "emulsion" with it, and causes it to be more "digestible."

It is certain that starch does not exert the slightest solvent action on cocoa, and therefore this alleged advantage has no existence. Cocoa, as appears from the analyses previously given, contains a considerable quantity of nitrogenized matter, starch, and oil; when boiled in water, the oil is dissolved out, and the starch granules swell up and become broken. When starch foreign to cocoa is added, the same occurs, the additional starch undergoing a similar change, causing the decoction to become thick and gelatinized, thus imparting to it a greater *appearance* of body and strength. If the quantity of starch added be considerable, a portion of the oil of the cocoa, in place of rising to the surface, will remain diffused throughout the liquid, the globules of oil being held in suspension by means of the starch by which the whole fluid is thickened. The assertion that starch makes cocoa more "digestible" has no more foundation than that it renders it "soluble." When a decoction of cocoa and starch is partaken of, the starch has to be digested in addition to the cocoa. If it were asserted that some forms of starch are more digestible than cocoa, and that a beverage in which the two are combined is more digestible than one made from pure cocoa, there would be some show of reason for the assertion. In the case of the admixture of starch and sugar with cocoa, it should be distinctly borne in mind, however, that for every additional per-centage of these substances added, there is so much less of cocoa, with its oily and nitrogenized constituents.

As nature has provided the cocoa-bean with eleven per cent. of starch, we are the more disposed to question the accuracy of the position assumed by cocoa manufacturers that the addition of wheat, potato, and sago-flours, constitutes any real improvement. What nature does is doubtless done well and sufficiently, and we believe that the quantity of starch proper for cocoa is to be found in the kernels themselves.

The real secret of the almost constant use of starch and sugar is to be found in the cheapness of these articles, and not in any advantages supposed to be derived from their admixture with cocoa; this we shall now proceed to show.

Genuine cocoa, in the form of flake, rock, or roll, is sold at from 10*d.* to 1*s.* per pound; wheat-flour may be purchased at 1½*d.*, potato-flour and sago-meal at about 3*d.* or 4*d.* per pound; sugar at from 3*d.* to 5*d.* per pound. The mixtures of cocoa, starch, and sugar, are sold at from 6*d.* to 2*s.* 8*d.* per pound; let the reader compare these prices with the cost of wheat and potato flours, and he will then perceive what a field for imposition and extortion the admixture of these substances with cocoa affords.

The present wholesale price of raw cocoa varies from 25*s.* to 47*s.* per cwt., being about 3*d.* to 4½*d.* per pound. The manufacturer will tell us that for the sugar and starch added to the cocoa, he makes a corresponding reduction in the cost of the compounded article; this, however, is not in general the case, as will appear by a comparison of the prices with the composition of the samples analysed.

Setting aside, however, the question of price, and whether the admixture of starch with cocoa is attended with any advantages or not, on the same principle as we objected to the calling of the mixture of chicory and coffee—coffee, we also object to designating a compound of starch, sugar, and cocoa by the name of the latter only, no adjective being prefixed to the word cocoa, indicating the presence in the article of any other substances.

Cocoa is subjected to a small duty, and, like other excisable articles, its adulteration is in violation of the law. The duty is 1*d.* per pound, from whatever quarter imported; ½*d.* per pound on *husks and shells;* 2*d.* per pound on cocoa or chocolate *paste.*

The quantity entered for home consumption was, in 1852, 3,385,632 lbs.; in 1853, 4,126,687 lbs.; and in the first six months of 1854, 2,432,939 lbs.

"By 43 Geo. III. c. 129. s. 5. IT IS ENACTED—That if any burnt, scorched, or roasted peas, beans, or other grain or vegetable substance or substances prepared or manufactured for the purpose of being in imitation of, or in any respect to resemble coffee or cocoa, or to serve as a substitute for coffee or cocoa, or alleged, or pretended by the possessor or vendor thereof so to be, shall be made or kept for sale, or shall be offered or exposed to sale, or shall be found in the custody or possession of any dealer or dealers in, or seller or sellers of coffee or cocoa, or if any burnt, scorched, or roasted peas, beans, or other grain or vegetable substance or substances, not being coffee or cocoa, shall be called by the preparer, manufacturer, possessor, or vendor thereof, by the name of English or British coffee, or any other name of coffee, or by the name of American cocoa, or English or British cocoa, or any other name of cocoa, the same respectively shall be forfeited, together with the packages containing the same, and shall and may be seized by any officer or officers of excise, and the person or persons preparing, manufacturing, or selling the same, or having the same in his, her, or their custody or possession, or the dealer or dealers in or seller or sellers of coffee or cocoa, in whose custody the same shall be found, shall forfeit and lose the sum of One Hundred Pounds. See also 11 George I. c. 30. s. 9., &c."

The provisions of the 43rd of George III. c. 129., quoted by us above, have, however, been so far modified by the enactments of the 3rd of George IV. c. 53. as to render it *perfectly legal* for persons who are "duly licenced to deal in cocoa," and whose premises are properly "entered at the nearest excise office," and who shall—

"Not be scorchers or roasters of corn, peas, beans, or parsnips, or who have not in their possession such corn, peas, beans, or parsnips, to make and manufacture in such entered premises, and with the knowledge of the proper officer, Cocoa-paste, broma, and other mixtures and preparations of cocoa with *sugar* and *arrowroot-flour* or *other farinaceous powder*, such arrowroot-flour or other farinaceous powder not being baked, scorched, roasted, or otherwise disguised or altered from its natural state, except by being mixed with cocoa as aforesaid, and to sell and offer and expose to sale such cocoa-paste, broma, or other mixture or preparation as aforesaid."

Thus far, then, and under these provisions, an admixture of "sugar and arrowroot-flour, or other farinaceous powder," with *cocoa*, is strictly legal; but by the *same* enactment it is provided, that

"If any person or persons shall make or manufacture any cocoa-paste, broma, or other mixture or preparation of cocoa as aforesaid, without first making such entry as aforesaid, or shall mix with any cocoa any *baked, scorched, or roasted material whatsoever*, or *any ingredient whatsoever, except as aforesaid*," &c. &c.;

That is, "sugar and arrowroot-flour, or other farinaceous powder,"—every such person and persons, "in such cases respectively offending, shall for every such offence severally forfeit and lose the sum of *one hundred pounds*."

As already remarked, the substances employed to mix with and adulterate cocoa are various forms of starch, different qualities of sugar, chicory, animal oil, and earthy and other colouring matters. Except these, but few, if any other substances are employed, or have ever been detected.

If the above enactment, therefore, is to accomplish the purposes for which it has been expressly framed, it clearly ought to apply to those substances which are commonly and notoriously employed in the adulteration of cocoa, such as some of those we have mentioned; if it do not do that, then is it a complete nullity as regards cocoa and its adulterations.

CHOCOLATE AND ITS ADULTERATIONS.

Unlike cocoa, chocolate is, as is well known, a manufactured article; the French particularly excel in its preparation, making a variety of combinations of cocoa with other substances.

The more common additions are, however, sugar, and various kinds of starch; in the better descriptions of chocolate, Maranta arrow-root is employed.

For imparting flavour and scent, vanilla and cinnamon are chiefly used.

Occasionally a medicinal chocolate is prepared with salep, a fecula obtained from the bulbous root of an orchis. In some cases, also, chocolate is made the vehicle for the administration of various remedies, the taste of which is to a great extent concealed by the chocolate.

The nature of the substances of which any chocolate consists may, in most cases, be very satisfactorily determined by the microscope, by which the structures belonging to each particular substance may be recognised.

The points requiring particular attention in the manufacture of chocolate are—care in the selection and roasting of the kernels; the winnowing of the husk; the careful reduction of the kernels to a smooth and uniform paste; and the forming of this into cakes, in moulds so smooth as to impart a polished surface to the cakes.

In the chocolates manufactured by M. Lebaigue, these points have been all well attended to, and the superiority of these articles in flavour, smell, and appearance, over those usually met with in the shops, is very obvious.

We now subjoin analyses of a few of the chocolates in the forms of powder and cake, more commonly met with, and the composition of which it may be interesting to some to be made acquainted with.

Chocolate Powder.

1*st Sample.*—Purchased of Bodley & Co., 5. Portman-place, Edgware-road.

Placard.

"Genuine Unadulterated
CHOCOLATE POWDER,
By J. Dunn and Co.
1*s.* 2*d.* per pound."

Analysis.—100 parts consist of about 13 parts *sugar*, and the remaining 87 parts of a combination of cocoa and starch, the latter in the proportion of

Fig. 83.

DUNN'S GENUINE UNADULTERATED CHOCOLATE POWDER.
a a a, starch-granules and cells of cocoa; *b b b*, granules of *tapioca-starch; c c c, Maranta arrow-root; d, Indian corn meal; e e, potato-starch; f f, Curcuma arrow-root.*

about 25 parts to 100 of the former; the starch being a mixture of *tapioca-starch*, *Maranta arrow-root*, *Indian corn-flour*, and *sago-meal.*

2*nd Sample.*—Purchased of Gatti & Bolla, Holborn. Price 5*d.* per quarter-pound pentagon packet.

"GATTI & BOLLA'S
GENUINE
FRENCH CHOCOLATE
POWDER."

Analysis.—100 parts consist of about 35 parts *sugar*, and the remaining 65 parts of a mixture of *cocoa* and *wheat-flour*, the latter in the proportion of about 30 parts to 100 of the former.

3*rd Sample.*—Purchased of G. B. White, 147. Shoreditch. Price 2*d.* per quarter-pound packet.

"WHITE'S
CHOCOLATE POWDER,
147. SHOREDITCH."

Analysis.—100 parts consist of about 14 parts *sugar*, and the remaining 90 parts of a mixture of cocoa and *sago-meal;* the latter in the proportion of about 10 parts to 100 of the former.

4*th Sample.*—Purchased of Staniforth, 138. Oxford-street. Price 4*d.* per packet.

"UNADULTERATED
CHOCOLATE POWDER,
Manufactured by
DANIEL DUNN.

"This article, although manufactured expressly for invalids, is the best beverage for the healthy, as the indigestible oily substance existing in the cocoa-nut, and in most of the other preparations from it, is *neutralised* in this, and rendered highly nutritious."

Analysis.—100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a combination of cocoa and starch, the latter in the proportion of about 16 parts to 100 of the former; the starch being a mixture of *tapioca*, *Maranta arrow-root*, *sago-meal*, *Curcuma arrow-root*, and *Indian corn flour*.

Chocolate in Cake.

5th Sample. — Purchased of E. Bynner, 35. Newport-street, Soho; quarter-pound cake. Price 2*d*.

"SPANISH CHOCOLATE."

Analysis. — 100 parts consist of a mixture of cocoa and starch, the latter in the proportion of about 15 parts to 100 of the former; the starch consisting of *wheat*, with some *potato-flour*.

6th Sample. — Purchased of C. E. Back, 123. Tottenham-court-road. Price 4*d*. per cake.

"Stratton's Patent Compressed

TRINIDAD COCOA,

From which a cup of the most luxurious and aromatic flavoured cocoa can be produced in one minute, without the trouble of boiling.

EACH CAKE IS STAMPED WITH OUR NAME.

The Patent Compressed Trinidad Cocoa has hitherto been confined to the circles of the rich, and used only as a luxury; it is now reduced in price to meet the circumstances of most persons; it is recommended by eminent physicians as an elegant beverage for breakfast or supper, as it sits lighter on the stomach than animal or vegetable jellies; its mild and exquisite aromatic flavour renders it very pleasant to eat as a confection."

Analysis. — 100 parts consist of about 14 parts *sugar*, and the remaining 86 parts of a mixture of cocoa and *potato-flour*, the latter in the proportion of about 16 parts to 100 of the former.

7th Sample. — Purchased of G. B. White, 147. Shoreditch. Price 3½*d*. per cake.

"ROYAL NAVY CHOCOLATE."

Analysis. — 100 parts consist of a mixture of cocoa and *sago-meal*, in the proportion of about 14 of the latter to 100 of the former, with a very small quantity of sugar.

8th Sample. — Purchased of Abbiss & Co., 60. Gracechurch-street, City. Price 5*d*. per quarter-pound cake.

"CAPPER AND GRAY'S
SUPER-SOLUBLE
CHOCOLATE,
for Invalids, Convalescents,
and
Persons of Weak Digestion.
Recommended by the Faculty.

Invaluable in the nursery, as a most nutritious article of diet for invalids."

Analysis. — 100 parts consist of a mixture of cocoa and *sugar*, made into a cake with *water*, the cocoa forming about 56 per cent. of the article.

9th Sample. — Purchased of A. Teetgen, 154. Whitechapel-road. 4*d*. per quarter-pound cake.

"Purified Soluble
CHOCOLATE,
which requires no boiling.
Warranted by
Peek Brothers & Co."

Analysis. — 100 parts consist of a mixture of cocoa and *sugar*, made into a cake with water, the cocoa forming about 53 per cent. of the article.

10th Sample. — Purchased of Hall & Co., Edgware-road. Price 3*d*. per quarter-pound cake.

"TAYLOR BROTHERS'
SOLUBLE CHOCOLATE
WHICH REQUIRES NO BOILING."

Analysis. — 100 parts consist of a mixture of cocoa and *sugar*, made into a cake with water, the cocoa forming about 57 per cent. of the article.

11*th Sample.* — Purchased of J. Walton, 129. Bishopsgate-street Without. Price 3*d*. per cake.

"BARRY AND COMPANY'S
SOLUBLE CHOCOLATE,
WHICH REQUIRES NO BOILING."

Analysis. — 100 parts consist of a mixture of cocoa and *sugar*, made into a cake with water, the cocoa forming about 58 per cent. of the article.

12*th Sample.* — Purchased of I. Way & Co., 272. Oxford-street. Price 3*d*. per cake.

"FRY AND SONS'
SOLUBLE CHOCOLATE."

Analysis. — 100 parts consist of a mixture of cocoa, *sugar*, *potato-flour*, and *sago-meal*, made into a cake with *water;* the sugar and water form about 42 parts, the remaining 58 parts of the article consisting of cocoa, and a mixture of the potato-flour and sago-meal in the proportion of about 10 parts to 100 of cocoa.

To the presence of sugar and starch, then, in chocolate, no fair objection can be urged. The points to be considered are, the price of the article, and the proportions and quality of the ingredients of which it consists.

In the above analyses, our attention has been directed chiefly to the determination, approximately, of the percentages of starch and sugar present in the various samples of cocoa and chocolate examined, as well as to ascertain the kinds of starch employed. On an early occasion, we shall embody, in a distinct Report, the results of a further examination of the whole of the samples above referred to.

To the Editor of THE LANCET.

SIR, — Having had my attention called to last week's LANCET, in which my name appears most conspicuously, allow me to explain the reason of your finding a small portion of sugar and sago in my navy chocolate. Some few years since, when my attention was first engaged in the manufacture of cocoa and chocolate, I applied to Sir John Hill, the Commandant of the Victualling Yard at Deptford, for permission to view the works there, which he was kind enough to grant. In the course of my inspection, I observed that to about every seven pounds of cocoa, one and a half pound sugar was added. On my enquiring the reason, of the foreman, I was told that some short time ago Dr. Ure had been there making some experiments, by order of the Lords of the Admiralty, and the result was, that they found the chocolate keep much better with the proportion of sugar, and when made give greater satisfaction to the men; and the same proportion is still adhered to. I therefore thought I could not go on better data than the medical testimony of Dr. Ure, and the experience of the manager: therefore I had my machinery put up in a similar manner. This accounts for the sugar. Some time since, a friend suggested to me, that if I substituted half the quantity of fine sago-flour for the like quantity of sugar I should greatly improve the article. I did so, and consider that not only does it greatly improve it, but the public like it much better. You can at any time see the process at the dockyard, which I think will repay you; and if you can suggest anything in the manufacture that will improve the quality, I will be one of the first to avail myself of it, if you will allow me.

I have now a small complaint to make: I do not think you have treated me hardly fair—you have only tried my common chocolates, and not my best; if you had tried my best plain chocolate, at 1*s*. 4*d*. per pound, the result, I think, would have been to place me in the proud position of having the word genuine after my name. Allow me also to point out a slight error: you say nuts are bought at from 25*s.* to 47*s.* per cwt., which makes them cost from 3*d.* to 6*d.* per pound; you have forgotten the duty, which is 2*d.*, or 18*s.* 8*d.* per cwt., on foreign, and 1*d.*, or 9*s.* 4*d.* per cwt., on British possession; there is also a loss on roasting of from eight to ten per cent., also on the shells of about sixteen per cent.

I hope you will excuse me in pointing out these slight errors, for I think you would not wilfully mislead the public; and as far as your analysis of my article goes, I certainly was very much surprised at the exact proportion in which every article is given. And when I look at the difference in the price of my chocolate powder, at 8*d.*, and the different proportions in comparison with the French chocolate powder, at 1*s.* 8*d.*, I certainly am very much surprised; but I am young, and, I suppose, inexperienced. I hope you will excuse this long letter, and beg to remain, yours, &c.,

147. Shoreditch, June, 1851. G. B. White, Chocolate Manufacturer.

ON ERVALENTA, REVALENTA, &c.

THEIR COMPOSITION.

WARTON'S ERVALENTA.

(*Copied from Handbill.*)

"Warton's Ervalenta,

ENSURING

HEALTH WITHOUT MEDICINE.

TO INVALIDS AND CHILDREN.

"This agreeable, nutritious, farinaceous food radically cures habitual constipation (costiveness), indigestion, piles, and all diseases originating in a disordered state of the bowels and digestive organs, which it speedily restores to their natural vigour and action, *without the aid of medicine*, or any other artificial means. It is also recommended as a most suitable diet for children, aged persons, and invalids generally. The invaluable properties and extraordinary efficacy of this eminently curative dietetic have been acknowledged by the first physicians and analytical chemists of the day, in France, England, and other countries.

(*See Medical and Chemical Certificates, Testimonials, &c.*)

Prices of Warton's Ervalenta.

1 lb. canister - -	2*s.* 9*d.*	5 lbs. canister - -	11*s.* 0*d.*
2 lbs. ditto - -	4*s.* 6*d.*	8 lbs. ditto - -	16*s.* 6*d.*
12 lbs. canister - -	22*s.*		

WARTON'S MELASSE.

An agreeable syrup, to be taken with 'Warton's Ervalenta,' and particularly recommended in obstinate cases of constipation.

Prices of Warton's Melasse.

1 lb. bottle - -	1*s.* 0*d.*	4 lbs. bottle - -	3*s.* 0*d.*
2 lb. ditto - -	1*s.* 9*d.*	8 lbs. ditto - -	5*s.* 0*d.*

"When the Melasse is to be sent by a public conveyance, it is necessary to add 6*d.* or 1*s.* for the packing-case, according to the size of the bottle ordered. The packing-case is necessary to prevent accidents on the road.

WARTON'S ERVALENTA BISCUITS.

1 lb. canister - -	2*s.* 9*d.*	3 lbs. canister - -	7*s.* 0*d.*
5 lbs. canister - -	10*s.* 0*d.*		

Warton and Co., 68. Rue Richelieu, Paris.

LONDON DEPOT:

9. St. Martin's Place, Trafalgar Square.

Instructions for preparing 'Warton's Ervalenta.'

"The Ervalenta may be prepared with water, milk, milk-and-water, beef-tea, veal or mutton broth. The ordinary quantity for each meal is two ounces of Ervalenta to a pint of liquid. Mix the Ervalenta with a few spoonfuls of liquid, cold, until the powder is entirely diluted, then pour in by degrees the rest of the liquid; when the whole is well mixed, put it on the fire, and let it boil gently for ten minutes, stirring it continually with a spoon, that it may not burn. It should then be sweetened with 'Warton's Melasse,' which is an auxiliary to the effect of the Ervalenta; or fresh butter, with sugar or salt, may be used.

"N.B.—'Warton's Ervalenta' and 'Melasse' ought to be carefully preserved from damp and heat. The Ervalenta, if kept in a dry place and occasionally stirred, will remain good for years.

Important Caution.

"To avoid spurious imitations (often absolutely injurious) sold under similar names ('Revalenta Arabica,' 'Everlenta,' &c.) take notice that the canisters of 'Warton's Ervalenta' bear the seal of Warton, 68. Rue Richelieu, Paris (established 1841); they bear also the annexed signature. None others are genuine. *Warton.*

"N.B.—Persons having mistaken Lentil Flour for 'Warton's Ervalenta,' Warton & Co. inform the public that it is quite a different article.

Important Advice.

"1. Persons suffering from constipation ought to take 'Warton's Ervalenta' and 'Melasse' regularly *twice* a day—for breakfast and supper.

"2. They should for some time avoid, as much as possible, the use of *wheaten bread*, and of all preparations of wheaten flour, puddings, pastry, &c.

"3. Rice, overboiled eggs, omelets, &c., are objectionable.

"4. Well cooked green vegetables, especially cabbages, stewed prunes, roasted or baked apples, and ripe fruits (except hard and dry fruits, as walnuts), are especially recommended.

"5. The meat eaten should be tender, and cooked in the simplest way; roasted meat is the most nutritious and digestible, and the best adapted for weak stomachs.

"6. Salt may be freely used, according to the taste, as it greatly assists digestion.

"7. Spirits should be avoided, also pepper and other spices, and acids.

"8. Wine should be taken moderately.

"9. Walking exercise in the open air ought to be taken every day if possible.

"10. It is highly necessary for health to keep the feet always warm.

"11. It is important to observe, that medicine ought to be entirely avoided while taking the Ervalenta, unless it be expressly prescribed by the medical attendant. Should medicine, however, be taken, the use of the Ervalenta ought not to be discontinued.

"N.B.—Many persons with whom fruit and vegetables disagree, will find that by making use of the Ervalenta they will be enabled to digest them without difficulty.

Certificates and Testimonials from Eminent Physicians and Analytical Chemists, etc.

Dr. Ure's Certificate

Of the Analyses of 'Warton's Ervalenta,' and of a spurious imitation called 'Revalenta Arabica.'

"London, 24. Bloomsbury-square, 2nd December, 1847.

"I have analysed a sample of 'Warton's Ervalenta,' and find it to be a pure vegetable product, very nutritious, and easily digestible, possessing the very valuable property of removing and counteracting habitual constipation, and of establishing a regularity in the alvine discharge. The said 'Ervalenta' is, in my opinion, a perfectly wholesome dietetic.

"I have likewise analysed an imitation of 'Warton's Ervalenta,' lately exposed and advertised for sale under the parodied but unmeaning title of 'Revalenta Arabica.' I find it not to be a pure vegetable meal, but to be disguised with coloured powder, and to be mixed with a quantity of extraneous saline matter; additions which are most undesirable. The said 'Revalenta Arabica' is different, therefore, from the genuine ('Warton's') 'Ervalenta,' which is a pure vegetable product, of a much more agreeable taste, and lighter on the stomach than the imitation substance called 'Revalenta Arabica.'

ANDREW URE, M.D., F.R.S., &c. &c.,
Professor of Chemistry, and Analytical Chemist.

DR. RYAN'S CERTIFICATE

Of the Analyses of 'Warton's Ervalenta,' and of a spurious imitation called 'Revalenta Arabica.'

"Royal Polytechnic Institution, London, March 22, 1848.

"I hereby certify that I have analysed a sample of 'Warton's Ervalenta,' and find it to consist of pure vegetable matter. Its nutritious properties are of the very highest order; it forms an extremely pleasant article of food, and is easily digestible by the weakest stomachs.

"I find, also, from my own experiments, as well as from the evidence of numerous medical men who have recommended the 'Ervalenta' to their patients, that it possesses the invaluable property of removing habitual constipation, and of producing regular and healthy alvine evacuations, without the aid of any aperient medicine.

"I have also analysed a sample of a substance called 'Revalenta Arabica,' sold, I believe, ostensibly with the same object as 'Warton's Ervalenta.' I find that it does *not* consist, like the Ervalenta, of pure vegetable materials, but contains certain proportions of saline and artificial colouring matter, giving to it a medicated taste and character.

JOHN RYAN, LL.D., M.D., M.R.C.S.E.,
Formerly Lecturer on Materia Medica and Therapeutics at the Charlotte-street Schools of Medicine, Bloomsbury; Professor of Chemistry to the Royal Nava. College, Portsmouth, and to the Royal Polytechnic Institution, London.

CERTIFICATE OF PROFESSOR DR. MUSPRATT'S ANALYSIS OF 'WARTON'S ERVALENTA.'

"College of Chemistry, Liverpool, March 8th, 1850.

"On analysing a sample of 'Warton's Ervalenta,' I find it to consist of the farina of a leguminous plant, therefore purely vegetable in its origin.

"It yields 97·655 per cent. of organic matter, and 2·345 per cent. of inorganic salts, consisting principally of earthy phosphates. The amount of nutrition it contains is very large, and the vegetable matter is of such a nature as to relieve obstinate constipation; while the inorganic salts will minister to the formation of bone and muscle.

"I regard it as an effective and nutritious dietetic, and by its use, collaterally with proper regimen, the digestive functions may be completely re-established, and being brought into a healthy state—by the administration of so harmless and palatable a food—maladies will often be eradicated which have resisted the most severe medical treatments.

"We cannot enjoy perfect health unless the evacuations are regular and spontaneous. The 'Ervalenta' is suitable for delicate stomachs, and is far more nutritious than arrow-root and substances of a similar nature. If the constipation is very obdurate, a syrup of stewed prunes may be taken with the 'Ervalenta.'

"For giving a healthy tone to the stomach, salt, as a seasoning, should be used, as it greatly accelerates digestion. SHERIDAN MUSPRATT, F.R.S.E.
Professor of Chemistry.

CERTIFICATE OF THE ANALYSIS OF LLOYD BULLOCK, ESQ., OF 'WARTON'S ERVALENTA.'

"22. Conduit-street, London, March 25, 1848.

"Having been requested by a physician, who takes particular interest in all articles of diet, to examine a sample of 'Warton's Ervalenta,' I can with con-

fidence state that it is a pure vegetable production, suitable for delicate stomachs, far more nutritious than arrow-root, or the like substances, and I think it worthy of general adoption. LLOYD BULLOCK,
Analytical Chemist.

DR. PETTIGREW'S TESTIMONIAL OF 'WARTON'S ERVALENTA.'

"7. Chester-street, Belgrave-square, London, Oct. 5. 1849.

"I have much pleasure in recommending Mr. Warton's 'Ervalenta,' as an article of diet. It is decidedly more nutritious than most of the farinaceous foods, and I have found it in many cases remove habitual constipation.

W. VESALIUS PETTIGREW, M.D., F.R.C.S.E.
Lecturer upon Anatomy and Physiology at St. George's Hospital, London, &c.

DR. SIGMOND'S TESTIMONIAL OF 'WARTON'S ERVALENTA.'

"Baker-street, London, April 4. 1848.

"Having had opportunities of becoming acquainted, whilst in France, with the farinaceous fecula, 'Warton's Ervalenta,' I have recommended it as a dietetic of easy digestion, of very nutritive power, possessing a gently aperient effect, and have found it uniformly serviceable in the cases for which I have directed its use. G. G. SIGMOND, M.D.

TESTIMONIAL OF F. FENWICK, ESQ.

"Ulgham House, Morpeth, Northumberland, Jan. 8. 1849.

"DEAR SIRS,—I beg to thank you for your suggestions relative to my diet, &c., and for your very kind inquiries respecting my health. I am happy to inform you that I still continue to derive much benefit from the use of Ervalenta. In short, the astonishing effects which it has produced in restoring the digestive functions, and rendering the alvine evacuations regular, have indeed very far exceeded my most sanguine expectations. In a word, I may now say, I know what it is to enjoy the blessing of tolerable good health—I say *tolerable*, because, after suffering from indigestion and violent habital constipation of more than thirty years' standing, I could not expect ever to enjoy *perfect* health.

"Your London agent would, I have no doubt, inform you how grossly I had been imposed upon by Du Barry and Co., the proprietors of that *vile and spurious* article called *Re*valenta, (got up in imitation of your excellent farina, *Er*valenta,) a canister of which they sent me to try; on my objecting, however, to make use of it, unless they were prepared to show that it was perfectly free from admixture of drugs, they had the barefaced assurance to assert that it was '*a pure vegetable production free from any admixture whatever.*' Being thus assured, I was induced to give it a trial on three different occasions; but so violent were the effects which it produced, in griping and purging, that it made me exceedingly ill, and I thus discovered that their assertions were base and wicked falsehoods, framed to suit their own sordid designs. I now find that it has been analysed by Drs. Ure and Ryan, both of whom attest to the presence of drugs, &c.,—thus proving Du Barry and Co. to be a set of unprincipled fellows, which I have already told them in the most *direct terms.*

"I find that a lady, with whom I am acquainted, who wished to make use of your invaluable farina, Ervalenta, had, by mistake, procured a canister of *Revalenta*, which, after she had used it three or four days, produced a similar effect upon her, in consequence of which she was confined to her bed for some days.

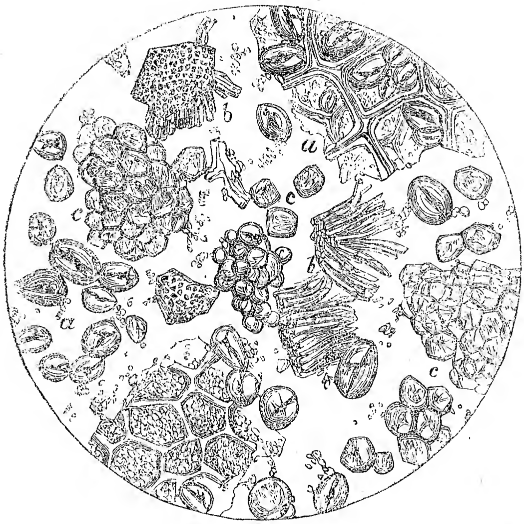
"Besides the mischievous effects produced by Revalenta, it is more costly, and requires more care and attention in cooking than Ervalenta, and, when prepared, is not, like that farina, an agreeable and pleasant food, but a nauseous and viscous preparation, more adapted for pig-wash.

"Should this, or any other communication of mine, be of any service to you, you are perfectly at liberty to make any use of them you may think proper.

I remain, dear sirs, very faithfully yours,
FRANS. FENWICK.

"To Messrs. Warton & Co.,
9. St. Martin's-place, Trafalgar-square, London."

Fig. 84.



Sample of WARTON'S ERVALENTA, as it appears under the microscope. *a a*, starch-corpuscles of the FRENCH LENTIL; *b b*, fragments of the husk; *c c*, starch-granules and masses of the substance resembling INDIAN-CORN MEAL.

ANALYSIS OF WARTON'S ERVALENTA.

(The sample analysed was purchased at the depôt, 9. St. Martin's-place, Trafalgar-square.)

This article consists of a mixture of the *French or German lentil*, ground and reduced to powder, including portions of the shells or husk, and of a substance very closely resembling in its microscopic characters *maize* or *Indian-corn meal.*

The French lentil, either whole or ground, is of a yellowish colour, and has the taste of peas.

It has been stated that the farina of a grass called "Dari," "Durra," &c., has been discovered in either Ervalenta or Revalenta.

We have succeeded in procuring a sample of this article, and find it so closely to resemble maize in structure, that it is nearly if not quite impossible to distinguish with certainty the one from the other, when ground and mixed with other articles.

"Dari" is occasionally imported into this country, and sold at about twenty-four shillings per quarter, that is, at the rate of rather more than one-halfpenny per pound.

It is therefore possible that the article which we have detected in Warton's Ervalenta may be the "Dari," or "Durra," &c., referred to.

We have received from Dr. Pereira the following information respecting "Durra."

"*Dari*, I suspect means *Durra*, also splelt *Doura*, *Dorv*, &c. It is a corn used by the Arabs, and is cultivated in the south of Europe. It is the *Holcus durra sativus* of Förskäl, the *Sorghum vulgare* of some other writers.

"Its meal is said to resemble that of Indian corn. Now it deserves notice, that a German microscopist recently stated that he found the meal of Indian corn in *ervalenta*, or *revalenta*, I forget which. Did he mistake it for the Sorghum?"

In the foregoing woodcut the several structures discovered with the microscope in Warton's Ervalenta, are accurately delineated.

The article sold in bottles at 1*s*. per lb., and recommended to be used in cases of obstinate constipation with the Ervalenta, appears to be nothing more than treacle, the name "Melasse" being derived from the word molasses.

DU BARRY'S REVALENTA ARABICA.

(*Copied from Circular.*)

" DIRECTIONS FOR THE USE OF DU BARRY'S
HEALTH-RESTORING FOOD,
FOR INVALIDS AND INFANTS.

THE REVALENTA ARABICA,
Discovered, exclusively grown, and imported by
DU BARRY & Co., 127. NEW BOND-STREET, LONDON,

" Sole owners of the Revalenta Estates, and of the Patent Machine by which *alone* the curative principles of the plant can be developed.

"This light delicious breakfast farina (without medicine of any kind, without inconvenience, and without expense, as it saves fifty times its cost in other more expensive remedies) speedily and permanently removes, dyspepsia, (indigestion,) constipation, acidity, cramps, spasms, fits, heartburn, diarrhœa, nervousness, biliousness, affections of the liver and kidneys, flatulency, distention, palpitation of the heart, nervous headache, deafness, noises in the head and ears, pains in almost every part of the body, chronic inflammation and ulceration of the stomach, eruptions on the skin, scrofula, consumption, dropsy, rheumatism, gout, nausea and vomiting during pregnancy, after eating, or at sea, low spirits, spleen, general debility, paralysis, cough, asthma, inquietude, sleeplessness, involuntary blushing, tremors, dislike to society, unfitness for study, delusion, loss of memory, vertigo, blood to the head, exhaustion, melancholy, groundless fear, indecision, wretchedness, thoughts of self-destruction, &c. The best food for infants and invalids generally, as it is the only food which never turns acid on the weakest stomach, but imparts a healthy relish for lunch and dinner, and restores the faculty of digestion and nervous muscular energy to the most enfeebled.

DU BARRY & Co., 127. NEW BOND-STREET, LONDON.

Analysis by the celebrated Professor of Chemistry and Analytical Chemist,
ANDREW URE, M.D., F.R.S., &c.

" London, 24. Bloomsbury-square, June 8. 1849.

"I hereby certify, that having examined Du Barry's Revalenta Arabica, I find it to be a pure vegetable farina, perfectly wholesome, easily digestible, likely to promote a healthy action of the stomach and bowels, and thereby to counteract dyspepsia, constipation, and their nervous consequences.

ANDREW URE, M.D., F.R.S., Analytical Chemist.

" London, Aug. 1. 1851.

" Dr. Harvey presents his compliments to Messrs. Du Barry & Co., and has pleasure in recommending their 'Revalenta Food;' it has been singularly useful in many obstinate cases of diarrhœa, as also of the opposite condition of the bowels, and their nervous consequences.

" DU BARRY'S REVALENTA ARABICA FOOD.

" In preparing it for breakfast for a person in general good health, mix one, two, or three ounces, like gruel, in a pint or more of water, good milk, or, better, cream and water, or beef-tea; boil and stir it over a slow fire, in an earthen or porcelain-lined saucepan, for fifteen minutes, adding salt to your taste whilst boiling, and best Jamaica moist sugar, or fresh butter, or cream, when placed on the table. It may also be flavoured with honey, vanilla, apricot, stewed prunes, raspberry, strawberry, or any other cooked fruit.

" For supper, say one or two hours before bed-time, mix one, two, or three ounces, for each person, in a pint or more of good milk, or water, cream and water, or beef-soup without grease, and boil it for fifteen minutes over a slow fire, stirring well to prevent its getting lumpy or burning at the bottom. Salt may be added to your taste, but no pepper nor any other stimulant. Delicate ladies, and children of three months and upwards, thrive best on two meals a day, of from one to two ounces each, of the super-refined quality. The quantity in all cases to be regulated so as to suit and rationally satisfy the appetite. No bread or other food to be eaten with it at any time, nor for an hour before or after.

"*Directions for the Cook.*—An ounce of the food is equal to a good tablespoonful. The Revalenta mixes best when treated like common flour—a small quantity of lukewarm water well stirred with the one, two, or three tablespoonfuls will dissolve the food quite smooth, when it may be poured into the larger quantity of warm water in which it is to be boiled. Let it be boiled thicker than a custard, but regulate the quantity of water you use in such a manner that it may boil fifteen minutes, stirring all the time, before it arrives at that consistency or thickness.

"N.B.—The 'Revalenta Arabica,' kept in a dry place, in its own canister, will retain its properties for years, and may also be sent into any climate.

"None genuine without our seal and signature, thus—

Du Barry & Co.

"The imitation of either is guarded against by the penal statutes. All counterfeiters will be rigorously prosecuted.

"Of all the popular delusions, there is none more generally received, or more productive of injury to invalids and weakly children, than the reliance placed on arrow-root for their nourishment. In our own days of delusion we have eaten loads of it, and acquired practically the firm conviction that so much sand would have benefited us as much. We consider it as inert matter, devoid of nourishment, harmless to rustic stomachs, but extremely injurious to weak and disordered ones; and for these latter its use cannot be too strongly deprecated, especially in the case of delicate children, many of whom are rendered miserable, and often sacrificed, by being fed on the above substances, or on tops and bottoms, the most indigestible and constipating food for infants of too tender age to assist digestion by bodily exercise.

"PRICES OF THE REVALENTA* ARABICA FOOD IN THE UNITED KINGDOM.

			£	s.	d.
In London, Canister at gross weight	1 lb.	- -	0	2	9
,, ,, ,,	2 lb.	- -	0	4	6
,, ,, ,,	5 lb.	- -	0	11	6
,, ,, ,,	12 lb.	- -	1	2	0
THE SUPER-REFINED QUALITY.					
,, Canister gross weight	5 lb.	- -	1	2	0
,, ,, ,,	10 lb.	- -	1	13	0

"Each canister is accompanied with full directions for use, and for the preservation of the virtues of the 'Revalenta' for years.

"N.B.—Children of three months and upwards, and delicate ladies, thrive best on two or three meals per day, of the super-refined quality, boiled in water, milk, beef-tea, or mutton-broth.

"For Consultations apply direct to Mr. Du Barry, stating minutely symptoms, origin, and date of ailment, age, occupation habit of body and mind, mode of life, usual diet, past treatment, &c."

(*Copied from second Handbill.*)

"IMPORTANT CAUTION!

"The common forger of Bank of England notes either imitates them boldly, or introduces an additional or modified appellative, thus:

* "The word 'Revalenta,' pronounced by the Arabs and Bedouins 'Reval-Yenta,' may be translated 'The Restorer.' or 'The Renovator.' Its origin may be traced in the Sanscrit, where it corresponds to the Latin verb Revalescere, sco. 'Ex capitali morbo revalescere.' OVID. 'To recover from a deadly complaint.' Philologists will find this note superfluous; but it may serve as an additional safeguard against trashy imitations, by which the unscrupulous are trying to impose upon the public under a variety of unmeaning names, such as Ervalenta, Relaventa, and all sorts of 'ventas,' the plain English of which would appear to be no other than that implied by a desire to raise the wind upon the unwary and illiterate."

BANK OF ELEGANCE NOTES!

'REAL' BANK OF ENGLAND NOTES!

or

'similar to' BANK OF ENGLAND NOTES!

(the words 'similar to' being in small type, so as to escape attention and assist the deception), which, neatly engraved, may deceive the unwary.

"A similar process of deception has been tried by FIFTY DIFFERENT GANGS OF SWINDLERS! who, too lazy to work honestly for their living, try to levy contributions on the credulous or superficial, by offering them trashy compounds of peas, beans, lentils, Indian and oat meal, worth about 1*d.* per lb., under some imitation of the name of

DU BARRY'S

INIMITABLE REVALENTA ARABICA FOOD.

"Messrs. Du Barry & Co. have taken the trouble to analyse these miserable imitations, and found them excellently adapted for PIGS, but, being respectively heavy, irritating, and heating, they would play sad havoc with the delicate stomach of an invalid or infant.

"Let the public examine carefully the exact spelling of Du Barry's Health-Restoring Food,

THE REVALENTA ARABICA;

and note that their seal and signature in full,

DU BARRY & CO.,

are attached to each canister, the imitation of either of which is a penal offence leading to TRANSPORTATION.

"Let, therefore, no one be deceived by having, instead of

Du Barry's 'Revalenta Arabica Food,'

thrust into his hands:—

'Real Evorlenta,'
'Real Ervalenta,'
'Real Relaventa,'
'Real Ravalenta,'
'Real Arabian Revalenta,'
'Lentil Powder, similar to Revalenta Arabica.'
'Pease-meal, similar to Revalenta Arabica.'
'Oatmeal, similar to Revalenta Arabica.'

Or any other of the fifty-six ''Ventas,' which knavery has already tried to thrust upon the public in imitation of Du Barry's inimitable Revalenta Arabica Food; and which have nothing to recommend them but the reckless audacity of their unscrupulous compounders, and their still more unscrupulous analytical *procuresses*—alias *professors*—who, for the sake of a guinea fee, would not hesitate to pollute or poison the whole United Kingdom, by *recommending to those who require our utmost solicitude that which is the most injurious to them.*"

"Cruel Deceptions on Invalids Exposed.

"The health of many invalids having been fearfully impaired by spurious compounds of peas, beans, lentil, Indian and oat meal, palmed off upon them under closely similar names, such as Ervalenta, Arabica Food, Lentil Powder, Patent Flour of Lentils, &c., and which are generally accompanied with a testimonial from Dr. Ure, or some unfortunate M.D. without name or practice, Messrs. Du Barry have taken the trouble of analysing all these spurious imitations, and find them to be harmless as food to the healthy, but utterly devoid of all curative principles; and being of a flatulent and irritating tendency, they are no better adapted to cure disease than oil to quenching a conflagration. They would, indeed, play sad havoc with the delicate stomach of an invalid or infant; and for this reason the public cannot too carefully avoid these barefaced attempts at imposture. Moreover, whilst Du Barry's Revalenta Arabica has obtained 50,000 testimonials of cures from parties of the highest respectability, these imitative impostors cannot show a single cure; nor is it likely they ever will, for the medicinal use of their compounds is calculated to produce no other but mischievous results. Dr. Ure errs considerably in the certificates he grants to lentil vendors. The Lentil is correctly described in Gray's Supplement to the *Pharmacopœia*, as follows—viz.,

" '*Ervum Lens* (*Linn.*) *difficult of digestion, astringent, hurtful to the eyes; indeed, the Ervum Ervilla produces weakness of the extremities; horses fed upon it become almost paralysed.*—In the *Gardeners' Magazine of Botany*, we find it stated that the Lentil, notwithstanding its nutritious nature, *is difficult of digestion and subnarcotic.*'

" These characteristics of the Lentil we have invariably observed in countries where this flour is mostly used; thus, in France, where the Lentil is a very common dish among all classes, dyspepsia, constipation, flatus, nervous complaints, &c. flourish more generally than in any other part of the world.

" Barley-flour, also, is difficult of digestion (see THE LANCET, p. 420.), and certainly devoid of curative properties. Nor have colouring and saline matters anything to recommend them as curative agents. Yet nearly all the imitators of Du Barry's 'Revalenta Arabica Food' publish certificates with the name of Dr. Ure at the bottom, setting forth the wonderful superiority of those imitations, and asserting in one of them that the original Du Barry's 'Food' contains colouring and saline matters; in another, 'Lentil-flour' and 'Barley-flour;' in the next they will probably add a little prussic acid, or some other variation. But in order to expose this absurd certificate-vending system, we got this same Dr. Ure to analyse our Food, and after he had already sold several certificates to imitators, in which he had declared it to contain saline and colouring matter, *the result of his analysis* was as follows: —

'London, 24. Bloomsbury-square.

" 'I hereby certify, that having examined "Du Barry's Revalenta Arabica," I find it to be a pure vegetable farina, perfectly wholesome, easily digestible, likely to promote a healthy action of the stomach and bowels, and thereby to counteract dyspepsia, constipation, and their nervous consequences.

'ANDREW URE, M.D., F.R.S. &c., Analytical Chemist.'

" We believe this is the only correct certificate Dr. Ure ever wrote about our Food.

" Now, for the purpose of exposing these attempted impostures, Messrs. Du Barry & Co. purchased in June, 1850, the sole licence of Nevill's patent for making and selling Patent Lentil-flour, and thus placed this article before the public at 6*d*. per packet, and enabled any one to make the comparison between this non-curative flour and the curative Revalenta Arabica Food. No sooner had Messrs. Du Barry & Co. purchased this licence, and thus exposed the deceptions hitherto practised, than a fresh attempt of a similar nature is made by Mr. A. H. Nevill, the same person from whom, for the purpose above-mentioned, we purchased the Lentil Patent. This misguided young man, having found it difficult to sell lentils at 2*d*. per lb., introduces an improvement upon the system hitherto pursued by other imitators of Du Barry's Revalenta Arabica Food, and certainly shows some ingenuity. He calls his lentils (which are simply Egyptian lentils) 'Arabian Lentils,' and the flour 'Arabica Food,' at 1*s*. per lb.; buys a certificate from Dr. Ure, declaring the Lentil-flour *perfectly wholesome, and counteracting a variety of complaints!* We think Dr. Ure would not, in case of illness, rely upon the pretended curative properties of lentils.

" We have quoted above, from works which are not open to bribes, the real character and nature of the Lentil; and in our report of cures effected by our Revalenta Arabica Food will be found many testimonials from parties who declare that they had been made very ill by the Lentil imitations. Dr. Ure's certificates, therefore, do not appear to improve the nature of these spurious and injurious imitations. But Mr. Nevill is not satisfied with backing his Lentil-flour with a fictitious name, and a certificate from Dr. Ure and some obscure M.D.—he goes farther: he declares that Messrs. Du Barry and Co. buy lentils from him, and pay him an annual sum for manufacturing the Revalenta Arabica! thus adding two more glaring untruths to the many he expects the public will swallow. The barefacedness of these untruths will be found in the following letter from our solicitors: —

'15. Furnival's-inn, London, April 30th, 1851.

"'Dear Sir, — The effect of the deed between Mr. Nevill and yourself, dated 15th June, 1850, is to give you the exclusive licence, upon certain terms, of making and selling lentil-flour, for which Mr. Nevill had obtained a patent, reserving to Mr. Nevill, personally, the use of his patent.

"'*No mention is made in the licence* of manufacturing the Revalenta Arabica, and from what we have learnt from you, we believe your object in taking the licence from Mr. Nevill was to prove the difference existing between Mr. Nevill's Flour of Lentils and the Revalenta Arabica.

'Jas. Taylor & Mason, Solicitors.'

The only lentils we ever bought of Mr. Nevill was a small quantity shortly after we took his patent; but the greater portion of them we had to sell for pig's food, as, upon an analysis, we found the article most undesirable for the use of invalids. This was towards the latter part of last year; since then we have not even seen lentils! So much for Mr. Nevill's insane fabrications, and Dr. Ure's absurd certificates! What credit can henceforth be attached to the statements of either?"

(*Copied from a third Circular.*)

"*From the Morning Chronicle.*

"'It is ever a pleasing duty of a journalist to introduce to his readers some new discovery calculated to benefit a vast portion of our fellow-creatures, which has the strongest claims upon our sympathies. It is with this feeling that we call the attention of invalids to "Messrs. Du Barry's Revalenta Arabica Food," a farina which careful analysis has shown to be derived from the root of an African plant, somewhat similar to our honeysuckle. It appears to possess properties of a highly curative and delicately nutritive kind; and numerous testimonials, from parties of unquestionable respectability, have attested that it supersedes medicine of every description, in the effectual and permanent removal of indigestion (dyspepsia), constipation, diarrhœa, &c.'

"An allusion to Du Barry's Revalenta Arabica Food having been made in Chambers's excellent Journal, which appeared liable to be misconstrued by the superficial reader, Messrs. Du Barry and Co. addressed a note to the Editor, and had the satisfaction of receiving the following polite reply: —

'Edinburgh, Dec. 12. 1849.

"'Sirs, — I am free to assure you that I have no ill will whatever to your preparation, which I have heard well spoken of in respectable quarters, and may very likely order for a trial on my own account ere long.

'I am, Sirs, your obedient servant,

'R. Chambers.'

"The high respectability of the Messrs. Chambers alone induced Messrs. Du Barry and Co. to apply for an explanation: of scurrilous and disreputable papers they take no notice."

Analysis of Du Barry & Co.'s Revalenta Arabica.

(The first sample analysed was purchased of J. Revell, 272. Oxford-street.)

This article was found to consist of a mixture of the *Egyptian* or *Arabian lentil* and *barley-meal.*

(The second sample was obtained from the depôt, 127. New Bond-street.)

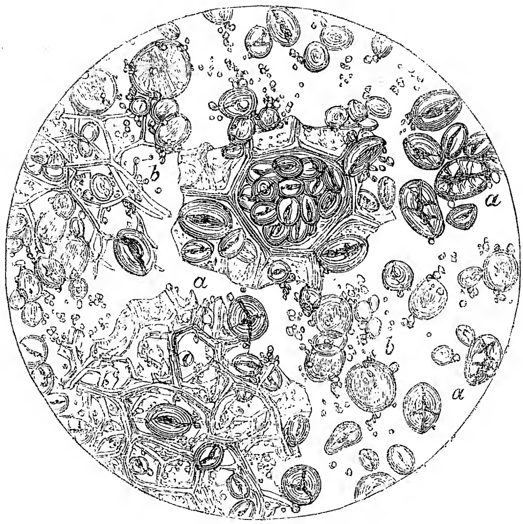
This sample was found to consist, like the first, of a mixture of the *red* or *Arabian lentil* and *barley-flour*, sweetened with *sugar*.

A *third* sample consisted of the *Arabian lentil* and *barley-flour*, with the addition of *saline matter*, principally *chloride of sodium* or common salt; it also possessed a peculiar taste, as though flavoured with *celery-seed.*

While Warton's Ervalenta is of a yellowish colour, Du Barry's Revalenta is of a pink or rosy hue; this arises from the different species of lentil employed, the German being yellow, and the Arabian lentil of a red colour.

The taste of the first of the three samples of Du Barry's Revalenta submitted to analysis could scarcely be distinguished from that of pea-flour; that of the second sample was much more agreeable, owing to the quantity of sugar which it contained; while in the third sample the salt and peculiar flavour already referred to as resembling that of celery-seed could be distinctly recognised.

Fig. 85.



Sample of Du Barry's REVALENTA ARABICA.
a a, starch-granules of the ARABIAN LENTIL, some loose, others lying in the cells of the cellulose; *b b*, starch-granules of BARLEY-FLOUR.

The structures detected in the first of the samples examined are faithfully exhibited in the engraving.

Du Barry & Co., as appears from the circulars quoted, sell, in canisters of not less than 5 lbs. each, price 22*s*., what they term a "super-refined quality" of Revalenta. Having, as we conceive, too just an appreciation of the value of money, we have not possessed ourselves of a canister of this description of the article, and therefore are unable to give an analysis of it.

They also sell a syrup, "carefully packed in 7*s*. bottles," and recommended to be employed in obstinate constipation. We preferred our money to the syrup, and therefore did not purchase any.

It will be observed that under the heading "Cruel Deception on Invalids Exposed," Du Barry & Co. make quotations condemnatory of lentils and barley-flour, and as these enter largely into the composition of their own article, by inference this is condemned even on their own showing.

BUTLER & M'CULLOCH'S PREPARED LENTIL-POWDER.

(*Copied from Handbill.*)

"BUTLER & M'CULLOCH'S
PREPARED LENTIL-POWDER,
for
INVALID'S FOOD.
Being an article similar to that vended as
REVALENTA ARABICA FOOD.

"Lentil-Powder, a light and nutritious diet for invalids, is a food above all others adapted for persons of weak digestion, and infants, as the following certificate of the well-known chemist, Dr. Ure, F.R.S., will testify.

Copy of the Certificate of the well-known Analytical Chemist,
DR. ANDREW URE, F.R.S.

"London, 24. Bloomsbury-square, Nov. 2. 1849.

"I hereby certify, that having examined a sample of Lentil Powder, manufactured and sold by you, I find it to be of the purest and finest quality, and well adapted, as that substance is known to be, for the relief of all ailments of the stomach and bowels caused by constipation.

ANDREW URE, M.D., F.R.S., &c.
Analytical Chemist and Professor of Chemistry.

" To Messrs. Butler and M'Culloch.

" This nutritious light, and agreeable food is confidently placed before the public upon its real merits, without resorting to any assumed or ambiguous terms, feeling confident, from its superiority, it will gain its way with the public. Its use entirely supersedes medicine in ordinary ailments, such as indigestion, flatulency, inflammation, congestion, biliary obstruction, fistula, water-brash, and sickness during pregnancy. It is the best food for children, as it never, like most other food, turns acid upon the stomach, and is proved by chemical analysis to contain more nutritious substance than any other farina; and being of such easy digestion, is most invaluable. It is offered to the public at a moderate price, in order to bring it within the reach of all, as by its use as a food, other more expensive articles are dispensed with .

" Packed in canisters of one lb., at 1*s.* 6*d.*; two lbs., 2*s.* 6*d.*; four lbs., 4*s.* 6*d.*; eight lbs., 9*s.*; and twelve lbs., 12*s.*

Prepared and sold genuine by
BUTLER AND M'CULLOCH,
Herbalists and Seedsmen, Covent-garden-market."

ANALYSIS OF BUTLER AND M'CULLOCH'S " PREPARED LENTIL-POWDER."

(The sample submitted to analysis was purchased of the proprietors.)

It was found to consist entirely of the *French* or *German lentil.*

EDWARDS BROTHERS' ARABIAN REVALENTA.

(*Copied from Label on Packet.*)

" Half-pound Sixpence.
ARABIAN REVALENTA,
A delicious food which supersedes medicine.

" Hitherto sold at from 2*s.* 9*d.* to 9*s.* per pound, but now offered at 1*s.* per pound, or three pounds for 2*s.* 6*d.*, in order that every class of the community may enjoy the benefit of its use.

" It is the produce of an Arabian plant, prepared as a farinaceous powder, and has obtained a wide celebrity for its valuable effects as a soft, healing, most nutritious, and wholesome

Diet for Invalids, as well as for Healthy Persons.

" It forms a very excellent breakfast or supper food, is valuable for soups, custards, puddings, children's food, &c., is easily prepared, and is agreeable to every palate.

" Purchasers are respectfully requested to observe that each packet is signed
Edwards, Bros.

ALBION MILLS,
Blackfriars'-road, London."

ANALYSIS OF EDWARDS, BROTHERS' " ARABIAN REVALENTA."

(The sample analysed was purchased of E. Nettleford, 3, New Church-street, Portman-market.)

The sample was ascertained to consist of *lentil-powder*, the colour being such as would be produced by a mixture of the two species of lentil, the red and the yellow, and the latter in the larger proportion.

NEVILL'S PATENT FLOUR OF LENTILS.

(*Copied from Wrapper.*)

" NEVILL'S
PATENT
FLOUR OF LENTILS.

" Lentils, as is well known, contain more nutriment, and possess those curative and healing properties that are not found in any other vegetable production.

Persons suffering from indigestion, constipation, or other derangement of the digestive organs, stomach, intestines, liver, &c., should persevere with the use of the 'Patent Flour of Lentils' for a short time, introducing animal food gradually as the stomach gains strength, carefully avoiding anything that subjects the digestive organs to excessive labour without yielding adequate nutriment."

ANALYSIS OF NEVILL'S PATENT FLOUR OF LELTILS.

(The first sample was purchased of Marshall & Co., 17. Adams-row, Hampstead-road.)

This article consists of a mixture of the *red* or *Arabian lentil*, with a proportion of *wheat-flour*.

(The second sample was purchased of J. Revell, 272. Oxford-street.)

The sample was found to consist of a mixture of the *Arabian lentil* and *barley-flour*, in the proportion of two-thirds of the former to one-third of the latter.

It will be observed that this article is analogous in its composition to Du Barry's Revalenta Arabica, and that it consists of a mixture of the *Arabian lentil* and *barley flour*. It appears to be carefully prepared, the hull being entirely removed; while the price, 1*s*. per pound, is little more than one-third the cost of either "Warton's Ervalenta," or "Du Barry's Revalenta."

Lentils belong to the natural family of plants, *Leguminosæ*, which includes the several kinds of beans and peas; they resemble, to a very great extent, in colour, structure, taste, and properties, the common pea; so great, indeed, is the similarity in organization, that it is difficult to discriminate between them, even by the aid of the microscope.

Lentils, peas, beans, &c., all contain a considerable amount of nitrogenized matter, in the form of *Legumine;* when taken as an article of diet, they are found by most to be somewhat difficult of digestion, to occasion distention and flatulency, and to be slightly aperient. These properties and effects are so similar in the case of each, that it is almost impossible to draw any decided line of demarcation between them.

"Purified lentils" are prepared under a patent, by Mr. Nevill, who formerly supplied Du Barry & Co. with the article, at 10*l*. per ton; that is, at about one penny and a fraction per pound.

The admixture of barley and other flours with lentil powder is not to be regarded in the light of an adulteration, since the cost of barley-flour exceeds that of the lentil, being about 13*l*. per ton.

The object of this mixture is chiefly to diminish the strong flavour of the lentils, and which is so disagreeable to many. Messrs. Du Barry and Co. still more effectually accomplish this object, in some cases, by the addition of sugar.

Extremes meet: lentils being somewhat cheaper than peas, are supplied to many of our workhouses, to be used in the preparation of soup, &c. Thus they are not only consumed by paupers, but by the rich, the chief difference being, that the latter frequently pay 2*s*. 9*d*. per pound for them.

As the cost of most of the prepared lentil powders—viz., 2*s*. 9*d*. per pound—forms a very serious obstacle to their use, supposing that in any respect it is desirable that they should be more generally consumed, we have framed the two following receipts, whereby a considerable saving of expense may be effected:—

1st Receipt.

Red or Arabian lentil-flour - - -	2 lbs.
Barley-flour - - - - -	1 lb.
Salt - - - - - -	3 oz.

Mix into a uniform powder.

The "directions for use" it is unnecessary to detail, as they have been already fully given in the prospectuses printed above.

The red lentil may be obtained of almost every corn chandler, at about 4*d*. per quart; the cost of a pound of *our* Ervalenta would be about 2*d*. per pound; and it is perfectly clear, from the analyses which we have given above, that whatever may be the advantages possessed by the much-vaunted Ervalentas, Revalentas, &c., that our article must contain them all.

2nd Receipt.

Pea-flour - - - - -	2 lbs.
Indian corn flour - - - -	1 lb.
Salt - - - - - - -	3 oz.

Mix as before.

Being satisfied that lentils and peas do not differ in their properties to any great extent, we have devised the above receipt to meet those cases in which any difficulty may be met with in procuring the red lentil, which however is now very commonly kept by corn chandlers.

Whatever may be the results of the experience of others as to the advantages derived from the use of lentil-powder, we ourselves are unable to say very much in its favour.

We recently partook of some of Du Barry's Revalenta Arabica, and found the flatulent effects so unpleasant that we should not readily be induced to repeat the experiment.

As treacle exerts a slightly aperient action when taken in considerable quantity, it may be used, if desired, with either of the ervalenta mixtures, the receipts for which we have given above; it has a great advantage over "Melasse" and "Purified Syrup" in price, costing only 4*d.* per pound.

In the course of our observations, we have had occasion to refer frequently to Du Barry and & Co. The name of the person who represents Du Barry is Christian Klug, said to be a German Jew.

A few observations on the subject of scientific testimonials will form not an inappropriate conclusion to this report.

Science is never so important as when applied to the welfare and happiness of mankind, and it ought to be the object of every scientific professor to apply to the utmost of his power his own individual knowledge and experience to the benefit of his fellow-men. We regret to observe that this rule is not always acted upon, but a practice almost the reverse, and that there are many men so forgetful of the true objects of science and of their own honour, as not to hesitate to give certificates, and lend the support of their names to all kinds of quackery and schemes calculated to impose upon the public.

This practice, indeed, has of late become very notorious, and deserves the severest condemnation; for not only do the public suffer, but science itself is brought into contempt.

No proposition is too gross or absurd, but that, by the aid of a few guineas, certificates bearing the names of apparently respectable authorities may be procured, whereby it may be palmed off upon the public.

A manufacturer wishing to bring before the world—under scientific recommendation—some article which he prepares, despatches samples of excellent quality to various professors and others, together with a fee, and the request to be furnished with testimonials; this request is in general readily complied with, and a certificate is drawn up in such terms as to inspire the public with confidence in the superior qualities and excellence of the article, whatever it may be. This course is radically and morally wrong; and we consider that certificates founded on the examination of a single sample emanating from interested parties, and capable from their wording of being applied to all subsequent samples of the same article however inferior they may be, ought not in any case be given.

ON FARINACEOUS FOODS,

THEIR COMPOSITION, ETC.

GARDINER'S ALIMENTARY PREPARATION.

(Copy of Label on Wrapper.)

"BY ROYAL LETTERS PATENT,

GARDINER'S ALIMENTARY PREPARATION.

"This valuable production, prepared, as it is, after the instructions of the celebrated Professor Liebig, with a due proportion of nitrogenous matter, indispensably requisite for nourishment, of which sago, arrowroot, tapioca, and other farinaceous substances introduced to the public, are utterly devoid, will not be the mere fashion of a day, but remain a standard article of food, from its nutritive qualities and remarkable delicacy of flavour.

"It is especially adapted for children from the earliest period; for invalids and all those who suffer from weak digestion or irritable stomach; while for the healthy it produces many palatable delicacies for the table, as enumerated with the directions.

"The proprietor has not ventured to bring this diet before the public until he had submitted it to the notice of very many families and to some of the first medical men, who have been most urgent to recommend its use.

Prepared at the
RANELAGH WORKS, THAMES BANK, PIMLICO.
Single canister 1*s.* 6*d.*; double canister, 2*s.* 6*d.*

"In cases of cholera and diarrhœa, this invaluable preparation has been found to afford immediate relief

"None other genuine, unless signed and sealed,

John Gardiner."

Analysis of Gardiner's Alimentary Preparation.
(Obtained from the Proprietor.)

This preparation consists entirely of rice, reduced to the state of an extremely fine powder, which crepitates, under pressure, in the same manner as do most of the arrowroots.

LEATH'S ALIMENTARY FARINA,
OR
HOMŒOPATHIC FARINACEOUS FOOD.

(*Copy of Label on Canister.*)

"LEATH'S ALIMENTARY FARINA, OR HOMŒOPATHIC FARINACEOUS FOOD.

"This preparation is recommended, on high medical authority, as a nutriment peculiarly adapted for the use of infants, invalids, and of those whose digestive powers are impaired.

"*Directions for Use.* — Mix thoroughly one tablespoonful of the farina, one teaspoonful of fine pounded loaf sugar, and one tablespoonful of milk; then pour thereon boiling water sufficient for half a pint, gently simmer it for two or three minutes, and it is ready for use. — The above ingredients and proportions may be made to suit the taste and appetite of each individual.

"Prepared and sold at the Homœopathic Pharmacy, 9 Vere-street, Oxford-street; and also at No. 5 St. Paul's Churchyard.

"In one pound tins, 1*s.* 6*d.* half-pound tins, 10*d.*"

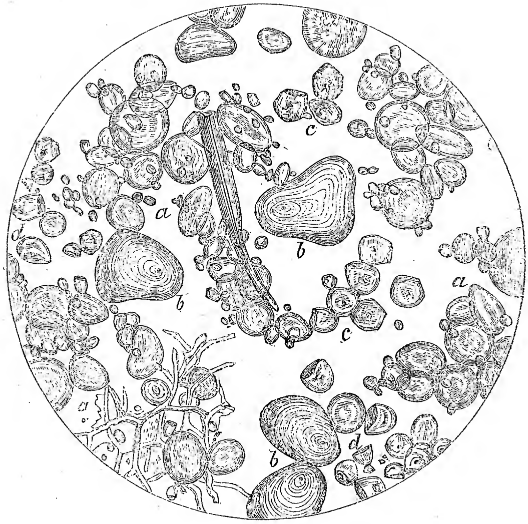
Analysis of Leath's Alimentary Farina, or Homœopathic Farinaceous Food.

(Purchased of J. Leath, 9. Vere-street, Oxford-street.)

This article consists principally of wheat-flour, slightly baked, and sweetened with sugar, together with potato-flour, and a very small quantity of Indian-corn meal and tapioca.

It will be observed that the quantity of the farina prescribed for a dose, as well as the price at which it is sold, are by no means infinitesimal or homœopathic. It is certainly a sad defect in "the system," that the same great principle (!) by which the doses of medicines are regulated by those consummate humbugs, homœopathists, is not applied by them to food, and that some such recipes as the following cannot be employed: — A crumb of bread, to be boiled for an hour in a gallon of water; one drop for a meal. One grain of beefsteak, to be boiled for the same length of time, in an equal bulk of water; one drop for dinner, every second day.

Fig. 86.



LEATH'S ALIMENTARY FARINA, OR HOMŒOPATHIC FARINACEOUS FOOD.
a a, starch granules of WHEAT; *b b*, starch-corpuscles of POTATO;
c c, ditto of INDIAN-CORN MEAL; *d d*, ditto of TAPIOCA.

SEMOLINA.

ANALYSIS OF SEMOLINA.

(Purchased of J. Revell, 272 Oxford-street.)

This preparation consists of the GLUTEN OF WHEAT, with a certain proportion of the STARCH, part of this having been removed.

Semolina resembles in appearance sago, but the little granules of which it is composed, in place of being round, as in sago, are angular.

When moistened, the water is rendered perceptibly opaque and milky by the starch still present, and the fragments swell up and become soft and glutinous.

Semolina is not a proprietary article; it is kept by most corn chandlers, and many grocers and oilmen.

BULLOCK'S SEMOLA.

(*Copy of Label on Package.*)

"BULLOCK'S SEMOLA,
A NEW
PREPARATION OF FOOD.
Highly Nutritious
And most Easily Digestible,
Adapted to
INFANTS
and
INVALIDS,

"Especially recommended to persons suffering from weak digestion or any kind of debility,—in the form of

GRUELS, PUDDINGS, SOUPS, &c.

"*Semola* contains five times the amount of the staminal principle of nourishment found in wheat-flour, and may be added in any proportion to other articles of diet for *infants* or *invalids*, so as to increase their nutritive power. Directions for preparing it are enclosed under the seal.

"22. Conduit-street. "*Lloyd Bullock.*"

Analysis of Bullock's Semola.

(Purchased of J. Sanger, 150. Oxford-street.)

Semola consists of the gluten of wheat, with a small proportion only of starch.

There is a very great resemblance in appearance between this preparation and Semolina, both consisting of granular fragments of the same size and form. No analysis was made to determine the amount of gluten present in either preparation.

PRINCE ARTHUR'S FARINACEOUS FOOD.

(*Copy of Label on Canister.*)

"PRINCE ARTHUR'S
FARINACEOUS FOOD,
For Infants and Invalids of all ages,
is superior to all others.

No mother, nurse, or family, should be without it. (See *Times*, May 4th.)
Patronized and recommended by medical men of the highest distinction.

Manufactured by
PALMER & CO.,
1. Montague-terrace, De Beauvoir-square, Kingsland.
In half-pound Canisters, price 6*d.*

PRINCE ARTHUR'S
FARINACEOUS FOOD.

"Directions for Use.

"Take a tablespoonful of the Food with a small quantity of cold water, mix to the consistency of cream, add half a pint of boiling water, constantly stirring, then boil it seven or eight minutes; add milk and sugar to taste.

"For grown persons equal parts of milk-and-water may be substituted for water. Sweeten and flavour to taste.

In half-pound Canisters, price 6*d.*"

Analysis of Prince Arthur's Farinaceous Food.

(Purchased of Haslett, 5. York-place, Commercial-road.)

This farinaceous food consists entirely of Wheat Flour slightly baked.

PRINCE OF WALES'S FOOD.

(*Copy of Label on Canister.*)

"By her Majesty's Royal Letters Patent.

THE
PRINCE OF WALES'S FOOD.
Patronised by the Faculty.

"This article is decidedly superior to arrow-root, tapioca, isinglass, &c., and is strongly recommended by the highest medical authorities as the most nutritious diet for invalids and children ever discovered.

"It never becomes acid on the most delicate stomach, and retains its properties for an unlimited period in all climates.

"It is particularly valuable for culinary purposes, for thickening soups and gravies, and making delicious puddings, blanc-mange, &c.

"Full directions for use are enclosed.

"Prepared only by the Patent Farina Company, and sold wholesale at their establishments, 14. Bucklersbury, London, and Seel-street, Liverpool. Sold wholesale at all the respectable medicine warehouses, and retail by all chemists and grocers throughout the kingdom.

"None is genuine unless signed by
J. Talbot.

Price 1*s.*"

(*Copied from Circular.*)

"PATRONISED BY THE MEDICAL PROFESSION.

"The researches of scientific men have long been directed to the production of an article of food containing the greatest possible amount of nutriment without the alloy of generating acidity on the stomach. This grand desideratum has at length been happily attained by this unrivalled preparation, which is justly considered one of the greatest triumphs of vegetable chemistry of which the present age can boast.

"The highest medical authorities concur in pronouncing it the purest and most nutritious diet for children and invalids ever discovered. It contains not a particle of mineral or animal matter; and being entirely freed from acidity by the peculiar mode of preparation, it is admirably adapted for the use of dyspeptic patients, affording an elegant method of combining valuable medicinal properties with the luxury of a delicious meal.

"It is esteemed by epicures and domestic economists the greatest delicacy for thickening soups and gravies, and the production of exquisite custards, puddings, blanc-mange, &c., entirely superseding the use of arrow-root and isinglass, and producing a firmer and more permanent jelly at less than one-fourth the cost.

"A striking characteristic of this article is, that it materially improves by keeping, and retains its properties unimpaired in all climates.

ANALYSIS OF THE PRINCE OF WALES'S FOOD.

(Purchased of Sanger, Oxford-street.)

This article consists entirely of POTATO-FLOUR.

HARDS' FARINACEOUS FOOD.

(*Copy of Label on Package.*)

"FARINACEOUS FOOD

For Infants and Persons with Impaired Digestion.

Manufactured by

JAMES HARDS,

DARTFORD,

Purveyor of the same, and Miller to her Majesty.

Highly approved and recommended by the Faculty.

"That only is genuine which bears the Royal Arms by authority, and is signed by *Jas. Hards.*

Directions inclosed."

ANALYSIS OF HARDS' FARINACEOUS FOOD.

(Purchased of J. Sanger, 150. Oxford-street.)

This preparation consists entirely of WHEAT-FLOUR, baked.

MAIDMAN'S NUTRITIOUS FARINA.

(*Copy of Label on Canister.*)

"None is genuine unless signed, *J. E. Maidman.*"

"J. E. MAIDMAN'S,

(Successor to J. Bright,)

NUTRITIOUS FARINA.

"For Invalids, Infants, or ordinary diet for those with weak digestive powers.

"Highly patronised and strongly recommended by the medical profession, as containing a large proportion of nutriment, being more economical, more sustaining, and easier prepared, than any other article of its kind ever yet offered to the public, AS IT REQUIRES NO BOILING, AND IS MADE IN TWO MINUTES.

"Its excellence is supported by numerous testimonials from medical gentlemen and public institutions, requiring only to be tried for its advantages over all other beverages for invalids and children, to be immediately discovered; and is also particularly adapted for hospitals, infirmaries, and large institutions, for its economy and the simplicity of its preparation for use.

"Sold in canisters at 1*s*., 1*s*. 6*d*., 3*s*., and 6*s*. each, with directions for use, testimonials, &c., which have been received in its favour.

Wholesale at the Manufactory,
No. 5. HOLLAND STREET, NORTH BRIXTON,
And retail by agents in town and country."

ANALYSIS OF MAIDMAN'S NUTRITIOUS FARINA.

(Purchased of J. Sanger, 150. Oxford-street.)

This "nutritious farina" consists of POTATO-FLOUR, artificially coloured of a pink or rosy hue, the colouring matter probably being ROSE PINK.

BRADEN'S FARINACEOUS FOOD.

(Copy of Label on Canister.)

"FARINACEOUS FOOD
FOR INFANTS
and Persons with Impaired Digestion.
Manufactured by
ALEXANDER BRADEN,
St. John-street, London.
Warranted.
Highly approved and recommended by the faculty."

ANALYSIS OF BRADEN'S FARINACEOUS FOOD.

(Purchased of Marshall, 17. Adams-row, Hampstead-road.)
This article consists of WHEAT-FLOUR baked.

JONES'S PATENT FLOUR.

(Copied from Wrapper.)

"BY SPECIAL APPOINTMENT,
Purveyor to Her Majesty in Ordinary.
H. JONES'S
PATENT FLOUR,
for Bread, Pastry, Puddings, Cake, &c.,
BLACKMORE and BROOKE,
(Sole Licensees for London and District,)
141 & 142. Old-street, Goswell-street.
Finest Quality $2\frac{1}{2}d.$ per Pound.

TESTIMONIAL.

"Berkeley-square, Bristol, June 2, 1846.

"I have partaken of various kinds of bread made from the 'Patent Flour,' as prepared by Mr. Henry Jones, the Patentee; and I have pleasure in giving my testimony of its value and importance as an article of wholeome diet adapted to all purposes of domestic use, but more especially for the convenience, health, and comfort of persons taking long voyages—merchants, captains of ships, and foreign countries—by enabling fresh bread to be had under all circumstances, where it would be impossible to procure yeast in a state fit for use.

"I believe the 'Patent Flour' to be perfectly free from any ingredient which is calculated to interfere with the most susceptible state of the digestive organs, and that there are many dyspeptic persons who are likely to be benefited by it.

"HENRY HAWKES FOX, M.D."

ANALYSIS OF JONES'S PATENT FLOUR.

(Purchased of J. Bodley & Co., Portman Place, Edgware Road.)

The above preparation consists of WHEAT-FLOUR, with TARTARIC ACID and CARBONATE OF SODA.

BASTER'S SOOJIE.

(Copied from Wrapper.)

"Take of the farinaceous food two very full high conical-dipped teaspoons, and mix it well in a quarter of a pint of COLD MILK, or MILK-AND-WATER—put another quarter of a pint of milk or milk-and-water on the first to simmer, stirring the first mixture into this till it thickens only, then sweeten it.

"After it is so done (if you wish to enrich it) add one or more well-beaten eggs to this, and again put it on a slow fire, keeping it stirring for a minute only. Care must be taken not to permit it to boil, or it will destroy the Vegetable properties of which it is partly composed.

"You must make it as before mentioned; to make it into pudding do not mix it dry as flour. When so done put it into a basin in a saucepan, with water half-way up it, and the steam will cook it in twenty minutes.

"Use a little of the CARRAWAY FLOUR inclosed if infants have spasms."

"Of the highest importance to all Mothers.

BASTER'S PRINCE AND PRINCESS'S FARINACEOUS FOOD.

FOR THE SAFETY OF INFANTS FROM THE HOUR OF BIRTH.

"It is suitably prepared for mothers, if used before and after their accouchement, and called

SOOJIE.

"It is of the highest importance for females verging on maturity, and all persons in sickness, and of the greatest consideration to the aged, and persons suffering from extreme debility, especially females who have improperly used the nothingless gelatines made from Isinglass, Arrow-root, &c., till consumption terminated existence. It relieves INDIGESTION, BILIOUS AND COSTIVE HABIT, and will make a restorative CUSTARD, LIGHT or PLUM PUDDING, in twelve minutes.

"Mr. Baster continues to make his

VITAL POTION,

"The which by consent of the medical attendant is especially compounded for persons in consumption, decline, debility, and otherwise. Also his very important

COMPOUNDED FARINA,

"That supersedes the dangerous application of oatmeal gruel (by the predominant acid in the oat during medical treatment). It is compounded of several descriptions of grain, germinated and otherwise prepared free of all acidity, as his farinaceous food afore-mentioned, and may be made with water without boiling in three minutes. It will not only serve for infants' food, but it will be found of the greatest consideration for captains of ships, and their passengers, should indisposition prevail whilst on the ocean or in tropical climates.

"*Caution.*—It being so that parents discontinue this food the instant the infant can masticate bread-and-butter, oatmeal, gruel, bread-and-milk, meat, &c., thereby causing an acidity, debility, and other diseases, ending in dissolution, which if continued twice a day onwards to maturity, especially with females, it will produce a healthy system and prevent the fatal consequences too often found in families. It is a cheaper beverage than common oatmeal for all persons for supper potion without bread."

ANALYSIS OF SOOJIE.

(Purchased of Aste, 165. Tottenham-court-road.)

Soojie consists of WHEAT FLOUR sweetened with SUGAR.

BASTER'S COMPOUNDED FARINA.

(*Copied from Wrapper.*)

"To be made with milk or water as approved.

"Take of the enclosed a very full dipped tablespoon, and mix it with water or milk into a thick batter; put half a pint of water or milk on the fire to boil; when so done, stir the batter well into it, and kept it stirring till it thickens, then add some salt or sugar as approved. If you would enrich it, add a small piece of good butter the instant it comes off the fire, and a well-beaten egg; but if so, return it on the fire for a minute only.

"BASTER'S
PATENT
COMPOUNDED FARINA,
For making with water or otherwise in three minutes, a nutritious, digestive, and restorative
GRUEL.

"It is prepared from wheat and other grain, as his Farinaceous Infant's Food, by a germinating process, thus divested of all acidity, of which the oat or common oatmeal cannot be dispossessed, and producing a rich gelatine; it will be found of the highest importance, and the only safe gruel potion for all persons in sickness and under medical treatment, especially for the safety of females, before and after birth, and for invalids, the aged, and the nursery."

Analysis of Baster's Compounded Farina.

(Purchased at 7. Orange-street, Bloomsbury.)

This article consists of Wheat-flour, sweetened with Sugar.

PLUMBE'S IMPROVED FARINACEOUS FOOD.

(*Copied from Wrapper.*)

"PLUMBE'S IMPROVED FARINACEOUS FOOD
For Infants, Invalids, and others,
3. Alie-place, Great Alie-street, Whitechapel.
1*s.* per pound.

" Strongly recommended by the faculty as a light, nutritious diet, suitable for breakfast, luncheons, suppers, &c., and may be used for puddings or custards, or ordinary purposes. Recipes accompany each tin.

'London, 24. Bloomsbury-square, Sept. 5th, 1850.

'I hereby certify that the Farinaceous Food, for Infants, Invalids, and others, as sold by Mrs. Plumbe, of 3. Alie-place, Great Alie-street, Whitechapel, is a perfectly pure vegetable product, agreeable to the palate, light on the stomach, easy of digestion, eminently wholesome and nutritious, and therefore deserving of general patronage and adoption for the dietetic regimen of weakly children and convalescents.

'Andrew Ure, M.D., F.R.S.,
'Professor of Chemistry and Analytical Chemist.'

"PLUMBE'S IMPROVED FARINACEOUS FOOD

Is a pure foreign vegetable production; strongly recommended by the faculty as being light and easy of digestion; free from the unpleasant flavour of the farinas now in general use, but containing equally as much nutriment. Invalids will find it a more delicious and restorative food, and mothers an indispensable adjunct to the nursery. To persons suffering from loss of appetite, this superior food will be found invaluable, and by its regular use dyspepsia and all disorders arising from indigestion are entirely eradicated and prevented. It imparts strength and energy to the most enfeebled constitution, invigorating the muscular and nervous system, and thereby completely establishing a healthy action of the stomach and bowels, so that the most delicate may partake with pleasure and benefit.

Sold by
A. S. Plumbe."

Analysis of Plumbe's Improved Farinaceous Food.

(Purchased at 3. Alie-place, Whitechapel.)

This preparation consists principally of Bean or Pea-flour, most probably the former, with a little Tacca Arrow-root, some Potato-flour, and a very little Maranta Arrow-root.

PALMER'S VITAROBORANT.

(*Copy of Label on Wrapper.*)

"VITAROBORANT.

A New and Health-Restoring
Royal
FARINACEOUS FOOD.
Prepared by PALMER & Co.,
1. Montague-terrace, De Beauvoir-sq., Kingsland, London.
SIXPENCE.
Directions inside the Packet.

None are genuine unless they bear the Royal Arms, and the Signature of
Wm. Palmer & Co."

ANALYSIS OF VITAROBORANT.

(Purchased at 1. Montague-terrace, De Beauvoir-square, Kingsland).

This article consists of a mixture, sweetened with SUGAR, of the RED or ARABIAN LENTIL and WHEAT-FLOUR, the latter in considerable amount.

"*Vitaroborant*" bears considerable resemblance to Du Barry's Ravelenta, and is sold at 2*s.* per pound.

The public are now in a position to judge of the degree of relation which exists between the high-sounding titles bestowed on many of the preparations noticed in this Report, their actual composition, and the properties, so loudly vaunted, alleged to be possessed by them; they will also be able to judge somewhat of the extent to which the pocket is made to suffer through their health-restoring, life-prolonging, easily-digestible articles and compounds.

COCOA, AND ITS ADULTERATIONS.

FURTHER REPORT.

IN our previous Report on Cocoa and its Adulterations, we described the structure of the seeds, quoted the statements of various writers, respecting the substances employed either to admix with or adulterate cocoa, gave, approximately, the percentages of starch and sugar contained in a great variety of proprietary preparations, and made known the kinds of starch or flour, and the mixtures and combinations of these, employed by different makers. In the present article, we publish the results of a further examination of the whole of the samples previously referred to, a scrutiny undertaken with the view of ascertaining whether any of them contained mineral or earthy colouring matters and ingredients.

It will be recollected that many of the preparations examined were ascertained to contain very large quantities of starch and sugar, and that in some instances these constituted more than half the article. Now, the admixture in large amount of such substances with cocoa, could not but produce an article of a much lighter colour than any preparation of genuine cocoa—a difference so great, in many cases, as to be calculated to excite suspicions of its genuineness. It might therefore be surmised, *à priori*, that some manufacturers would have recourse to colouring matter, to conceal the poverty of many of their preparations, and to impart to them a greater appearance of strength and richness. We will now proceed to determine whether such a surmise be well founded.

It is a well-established fact that all vegetable colours are destroyed by a red heat, and consequently that the ash which remains after the incineration of any coloured vegetable substance is itself free from colour.

On the other hand, it is equally certain that the majority of earthy colouring matters, however much they may be altered and modified by incineration, are rarely altogether destroyed.

In the knowledge of these facts, we have then a ready and most satisfactory means of ascertaining whether any sample of cocoa, or other vegetable substance, is either free from, or admixed with, coloured mineral ingredients.

When the ash of cocoa, therefore, is greyish-white or even blackish-white, according to the degree and method of incineration, the sample may be pronounced to be free from coloured earthy substances.

When, however, the ash is distinctly coloured, it is very certain that the cocoa contains a coloured mineral ingredient.

It must be borne in mind, however, that the absence of colour in the ash is not, in all cases, to be taken as sufficient evidence of its freedom from admixture with mineral substances, as some of these are themselves colourless, as carbonate and sulphate of lime, and therefore yield a colourless ash. In such cases the weight of the residue should be ascertained. 480 grains of genuine cocoa furnish an ash which usually weighs about twenty-four grains. When the weight *much exceeds* this, there will be reason to suspect the presence of a colourless earthy substance.

It should be known also that effervescence on the addition of a mineral acid is no proof of adulteration with an earthy carbonate, as the ash of genuine cocoa effervesces strongly on being thus treated, in consequence of its containing a considerable amount of alkaline and earthy carbonates.

Results of the Further Examination of Numerous Samples of Flake, Rock, Granulated, Soluble, Dietetic, Homœopathic, and other Cocoas.

In order to become thoroughly acquainted with the appearances and characters of the ash of genuine cocoa, we incinerated a variety of samples of the entire kernels, as well as several samples of cocoa and chocolate prepared and manufactured from these. In every case we obtained a *greyish-white* residue.

Flake Cocoa.

1*st Sample.*—Purchased of J. H. Kemper, 1. Waterloo-terrace, Commercial-road East.
Ash, greyish-white.

2*nd Sample.*—Purchased of Owen Sparrow & Co., No. 1. Aldgate.
Ash, of a light brown colour.

3*rd Sample.*—Purchased of Messrs. Ridgway & Co., 4 & 5. King William-street City.
Ash, greyish-white.

4*th Sample.*—Purchased of J. Lawrence, 51. High-street, Bloomsbury.
Ash, greyish-white.

5*th Sample.*—Purchased of Hall, South-row, Golden-square.
Ash, of a yellow colour.

6*th Sample.*—Purchased of Stevenson & Co., 55. Strutton-ground, Westminster.
Ash, of a light yellowish-brown colour.

7*th Sample.*—Purchased of H. Reeves, 6. Great Chapel-street, Broadway, Westminster.
Ash, of a light brown colour.

8*th Sample*—Purchased of Waller & Co., 80. Charlotte-street, Tottenham-court-road.
Ash of a dark fawn colour.

9*th Sample.*—Purchased of W. Harper, 24. James-street, Lisson-grove.
Ash, of a fawn colour.

10*th Sample.*—Purchased of W. Strugnell, 109. Edgware-road.
Ash, greyish white.

Granulated Cocoa.

11*th Sample.*

J. & S. FRY & SONS'
GRANULATED COCOA.
Ash, of a light-brown colour.

12*th Sample.*

HANDFORD & DAVIES'
PURE
GRANULATED COCOA.
Ash, greyish-white.

Broma.

13th Sample.
STRICKLAND'S BROMA.
Ash, greyish-white.

14th Sample.
FRY'S BROMA.
Ash, of a bright and rusty-yellow colour.

15th Sample.
STRATTON'S BROMA.
Ash, of a dark-brown colour.

Soluble Cocoa.

16th Sample.
DUNN'S SOLUBLE COCOA.
Ash, greyish-white.

17th Sample.
TYLER & ESSEX'S.
BEST SOLUBLE COCOA.
Ash, of a yellowish-brown colour.

18th Sample.
STRATTON'S
IMPROVED SOLUBLE COCOA.
Ash, of a golden-yellow colour.

19th Sample.
GRAHAM & HEDLEY'S
GENUINE SOLUBLE COCOA.
Ash, of a yellowish-fawn colour.

20th Sample.
DEPUYTREN'S
CELEBRATED SOLUBLE COCOA.
Ash, of a bright ferruginous-yellow colour.

21st Sample.
STEANE, DAVIS, & Co.'s
SUPERIOR SOUBLE COCOA.
Ash, of a light-brown colour.

22nd Sample.
TAYLOR BROTHERS'
SOLUBLE COCOA.
Ash, of a fawn colour.

23rd Sample.
HAWTHORNE & Co.'s
CELEBRATED SOLUBLE COCOA.
Ash, of a light fawn colour.

24th Sample.
BARRY & Co.'s
SUPERIOR SOLUBLE COCOA.
Ash, of a fawn colour.

Homœopathic Cocoa.

25th Sample.
SPARROW'S
IMPROVED DIETETIC COCOA.
Ash, greyish-white.

26th Sample.
LEATH'S
HOMŒOPATHIC COCOA.
Ash, of a fawn colour.

27th Sample.
HEADLAND'S
HOMŒOPATHIC COCOA.
Ash, greyish-white.

28th Sample.
CADBURY BROTHERS'
HOMŒOPATHIC COCOA.
Ash, of a salmon-red colour.

29th Sample.
GRAHAM & HEDLEY'S
HOMŒOPATHIC COCOA.
Ash, greyish-white.

30th Sample.
J. S. FRY & SONS'
HOMŒOPATHIC COCOA.
Ash, of a fawn colour.

31st Sample.
STEANE, DAVIS, & Co.'s
PREPARED HOMŒOPATHIC COCOA.
Ash, of a brown colour.

32nd Sample.
NICOL & Co.'s
HOMŒOPATHIC COCOA.
Ash, greyish-white.

33rd Sample.
TAYLOR BROTHERS'
HOMŒOPATHIC COCOA.
Ash, greyish-white.

34th Sample.
EPPS' HOMŒOPATHIC COCOA.
Ash, greyish-white.

35th Sample.
BARRY & Co.'s
HOMŒOPATHIC COCOA.
Ash, greyish-white.

36th Sample.
RELFE'S HOMŒOPATHIC COCOA.
Ash, greyish-white.

37th Sample.
TAYLOR BROTHERS'
DIETETIC COCOA.
Ash, greyish-white.

38th Sample.

WHITE'S HOMŒOPATHIC COCOA.

Ash, of a dull yellowish-brown colour.

Roll Cocoa.

39th Sample.

GRAHAM & HEDLEY'S ROLL COCOA.

Ash, greyish-white.

40th Sample.

TAYLOR BROTHERS' ROLL COCOA.

Ash, greyish-white.

Rock Cocoa.

41st Sample.—Purchased of R. H. Feltoe, 298. Oxford-street.
Ash, of a golden-yellow colour.
42nd Sample.—Purchased of Houle & Co., 282. Oxford-street.
Ash, of a yellowish-brown colour.
43rd Sample—Purchased of Holland & Co., 78. Lamb's Conduit-street.
Ash, of a light-brown colour.
44th Sample—Purchased of J. Appleton, 174. Drury-lane.
Ash, greyish-white.
45th Sample—Purchased of G. B. White, 174. Shoreditch.
Ash, of a rusty-yellow colour.
46th Sample—Purchased of William Oakley, 72. High-street, Whitechapel.
Ash, greyish-white.
47th Sample—Purchased of Rodgers & Co., 97. Crawford-street, Edgware-road.
Ash, of a light-fawn colour.
48th Sample—Purchased of H. Williams, 92. Crawford-street, Bryanstone-square.
Ash, of a light-fawn colour.
49th Sample—Purchased of A. Andrews & Co., 57. Tottenham-court-road.
Ash, of a fawn colour.

Soluble Cocoa.

50th Sample.

J. S. FRY & SONS'
CELEBRATED SOLUBLE COCOA.

Ash, of a bright-fawn colour.

51st Sample.

TAYLOR BROTHERS'
CELEBRATED SOLUBLE COCOA.

Ash, of a fawn colour.

52nd Sample.

DUPUYTREN'S
EXHIBITION COCOA.

Ash, of a golden-yellow colour.

53rd Sample.

TYLER & ESSEX'S
BEST SOLUBLE COCOA.

Ash, of a ferruginous-yellow colour.

54th Sample.
J. S. FRY & SONS'
SOLUBLE COCOA.
Ash, of a ferruginous-yellow colour.

COCOA PASTE

55th Sample.
J. S. FRY & SONS'
BEST COCOA PASTE.
Ash, of a light-yellow colour.

56th Sample.
DUNN'S COCOA PASTE.
Ash, greyish-white.

RESULTS OF THE FURTHER EXAMINATION OF THE VARIOUS SAMPLES OF CHOCOLATE.

1st Sample.
DUNN'S
GENUINE UNADULTERATED
CHOCOLATE POWDER.
Ash, greyish-white.

2nd Sample.
GATTI & BOLLA'S
GENUINE
FRENCH CHOCOLATE POWDER.
Ash, greyish-white.

3rd Sample.
WHITE'S CHOCOLATE POWDER
Ash, of a deep rusty yellow colour.

4th Sample.
DUNN'S
UNADULTERATED CHOCOLATE.
Ash, greyish-white.

5th Sample.
SPANISH CHOCOLATE.
Ash, greyish-white.

6th Sample.
STRATTON'S PATENT
COMPRESSED TRINIDAD COCOA.
Ash, of a light-brown colour.

7th Sample.
WHITE'S ROYAL NAVY CHOCOLATE.
Ash, of a yellowish-brown colour.

8th Sample.
CAPPER & GREY'S
SUPER SOLUBLE CHOCOLATE.
Ash, greyish-white.

9th Sample.
PEEK BROTHERS & CO.'s
SOLUBLE CHOCOLATE.
Ash, greyish-white.

10th Sample.
TAYLOR BROTHERS'
SOLUBLE CHOCOLATE.
Ash; greyish-white.

11th Sample.
BARRY & Co.'s
SOLUBLE CHOCOLATE.
Ash, greyish-white.

12th Sample.
J. S. FRY & SONS'
SOLUBLE CHOCOLATE.
Ash, of a light-yellow colour.

From an examination of the above Table, it appears,—

1st. That out of the ten samples of *flaked cocoa* which were incinerated, six contained earthy colouring matter.

2nd. That one of the two samples of *granulated cocoa* yielded a coloured ash.

3rd. That two of the three *Bromas* contained earthy colouring matter.

4th. That out of fourteen samples of *soluble cocoa*, earthy colouring matter was discovered in thirteen.

5th. That five of the fourteen *homœopathic cocoas* contained coloured earth.

6th. That the two *roll cocoas* were free from earthy colouring matter.

7th. That earthy colouring matter was present in seven of the nine samples of *rock cocoa* examined.

8th. That the ash in one of the two *cocoa pastes* incinerated was coloured.

9th. That of the twelve samples of *chocolate* in *powder* and in *cake* examined, earthy colouring matter was present in four.

10th. That of sixty-eight samples of cocoa and chocolate submitted to examination, *twenty-nine* were free from admixture with earthy colouring matter, while the remaining *thirty-nine* samples all contained coloured earthy substances, in greater or less amount.

It appears further,—

That the preparations contained in the packages labelled with the names of Handford & Davies, Strickland, Henry Sparrow, W. Headland, Nicol and Co., J. Epps, J. Relfe, Gatti & Bolla, Capper & Grey, and Peek Brothers & Co., *were entirely free from earthy colouring matter.*

That the packages bearing the names of J. Leath, Hawthorne and Co., and Cadbury Brothers, *contained earthy colouring matter.*

That of the samples of three different preparations of cocoa, labelled with the names of Graham & Headley, *coloured earthy matter was found in one.*

That *both* of the samples bearing the names of Tyler & Essex *contained coloured earthy matter.*

That *earthy colouring matter* was present *in the three packages* labelled J. W. Stratton & Co.

That the *two* preparations of cocoa to which the name of Baron Dupuytren was affixed, *were largely adulterated with red earthy matter.*

That the *two* samples labelled Steane, Davis & Co., *furnished coloured ashes.*

That of the *three* packages to which the names of Barry and Co. were affixed, *one* yielded a *coloured ash.*

That *the ashes of the whole of the seven preparations of cocoa contained in the packages to which the names of J. S. Fry & Sons were attached, were coloured to a greater or less extent.*

That *two* of the six preparations of cocoa, labelled Taylor Brother, *contained earthy colouring matter.*

That the *four* preparations purchased of the manufacturer, G. B. White, *were highly coloured.*

Lastly, that *the samples of cocoa, four in number, manufactured by D. Dunn, and submitted to examination, were ascertained to be entirely free from any admixture with coloured earthy matter.*

We have now to make a few observations respecting the substances employed for the purpose of colouring cocoa and chocolate.

In the several preparations purchased of Mr. G. B. White, in "Cadbury Brothers' Homœopathic Cocoa," "Stratton's Improved Soluble Cocoa," "Dupuytren's Exhibition and Superior Soluble Cocoas," "Fry's Soluble Cocoa," "Fry's Broma," and Tyler & Essex's Best Soluble Cocoa," the colouring matter used was unquestionably either red ochre, (which is a compound of oxide of iron with silica, and sometimes alumina, or clay,) or some earthy substance analagous in composition; this conclusion is based on the following facts and observations:—

The tints presented by several of the above cocoas could be exactly imitated by mixing different proportions of red ochre with cocoa. The ashes obtained from the incineration of these mixtures, closely resembled those of the adulterated samples.

The chemical composition of these ashes was found to correspond with that of red ochre.

An analysis by Dr. Letheby of the ash procured by the incineration of G. B. White's rock cocoa, gave the following results. It must be borne in mind, however, that the salts proper to cocoa are included in this analysis.

Carbonate of Potash	0·05
Phosphate of Potash	0·10
Sulphate of Lime	0·43
Phosphate of Magnesia	0·50
Carbonates of Magnesia and Lime	0·20
Oxide of Iron and Silica	2·23
Unconsumed Carbon	0·06
Silica	1·00
Chlorides (Alkaline)	0·20
Water	0·23
	5·00

The above analysis was accompanied with the following remark by Dr. Letheby:—

"The analysis of the red ash proves that the cocoa was largely adulterated with oxide of iron and silica, two substances which are found in the common red ochre of commerce."

It should be known that the colour of the ash obtained by the incineration of preparations of cocoa, adulterated with red ochre, is subject to considerable variation, dependent on the manner in which the incineration has been conducted, whether in an open or covered crucible, and according to the degree to which the ash has been heated, and the length of time it has been subjected to the process. Thus the ash of cocoa so adulterated may be made to assume different colours, varying from dark brown, light brown, fawn, yellow, ferruginous yellow, up to rust-red, according to the method of incineration.

Many of the other preparations of cocoa, not referred to by name, are doubtless coloured with the same substance.

In some of the samples clay and plaster of Paris were detected; it is right, however, to mention that in no case were these substances used for the sake of adding bulk or weight to the cocoa, the quantity present being too small; but they no doubt entered into the composition of the earthy colouring matters employed.

The whole of the samples of cocoa and chocolate purchased of Mr. G. B. White were remarkable for their high and evidently artificial colour. In a letter which was printed in "The Lancet" of June 21, and which will be found at p. 236, Mr. White complained that we had used him "hardly fair" in subjecting his "common" articles only to examination. As our analyses included his "Pure Homœopathic Cocoa" and "Royal Navy Chocolate," we are tempted to ask, does Mr. White class these as amongst his common preparations? In the same letter Mr. White professes a willingness to adopt any suggestion which we might make for the improvement of his cocoas. We would simply suggest that for the future he use no red ochre.

OATMEAL, AND ITS ADULTERATIONS.

The subject of this Report may excite some degree of surprise in the minds of many, as from the cheapness of the article, it would hardly be supposed that sufficient inducement could exist for its sophistication. It appears, however, from the following analyses, that such a supposition is not correct; and that the food given to the horse in grain, is not always to be procured in a genuine state, by man, in the form of oatmeal.

Results of the Microscopic Examination of Various Samples of Oatmeal Purchased at the Establishments of Different Corn-Chandlers and Bakers in the Metropolis.

1*st Sample.* — Purchased of Armstrong, 31. Chapel-street, Somers-town.
Adulterated—consisting to a very large extent of *barley-meal.*

2*nd Sample*—Purchased of F. Ambridge, 65. Brewer-street, Somers-town.
Genuine.

3*rd Sample*—Purchased of J. Brook, 31. Lisson-grove North.
Genuine.

4*th Sample.*—Purchased of J. Willsher, 35. Grove-place, Lisson-grove.
Adulterated—containing a large proportion of *barley-meal.*

5*th Sample.*—Purchased of Nettlefold & Co., 33. New Church-street, Paddington.
Adulterated—containing a considerable quantity of *barley-meal.*

6*th Sample.*—Purchased of W. Strohm, 11. New Church-street, Paddington.
Genuine.

7*th Sample.* —Purchased of J. Gibbs, 5. New Church-street, Paddington.
Adulterated—containing a large admixture of *barley-meal.*

8*th Sample.*—Purchased of H. C. Helffenstein, 135. St. Alban's-place, Edgware-road.
Genuine.

9*th Sample.* —Purchased of H. Waters, 134. St. Alban's-place, Edgware-road.
Genuine.

10*th Sample.*—Purchased of Z. Pratt, 96. Edgware-road.
Genuine.

11*th Sample.*—Purchased of J. S. Wall, 132. Edgware-road.
Genuine.

12*th Sample.*—Purchased of J. Muggeridge, 16. Adams-street West, Portman-square.
Adulterated—containing some *barley-meal.*

13*th Sample.*—Purchased of M. Staner, 16. Hinde-street, Manchester-square.
Adulterated—containing very much *barley-meal.*

14*th Sample.* — Purchased of A. Michie, 33½. Edward-street, Portman-square.
Genuine.

15*th Sample.*—Purchased of M. Schlarb, 61. Marylebone-lane.
Adulterated—largely admixed with *barley-meal.*

16*th Sample.*—Purchased of W. Schafer, 49. James-street, Oxford-street.
Genuine.

17*th Sample.*—Purchased of G. Keable, 40. James-street, Oxford-street.
Genuine.

18*th Sample.*—Purchased of T. Robinson, 19. Barbican.
Adulterated—containing a large proportion of *barley-meal.*

19*th Sample.*—Purchased of the Free Trade Bread Company, 197. Whitecross-street.
Adulterated—containing a considerable quantity of *barley-meal.*

20*th Sample.*—Purchased of W. Bate, 5. Clare-street, Clare-market.
Adulterated—containing a large proportion of *barley-meal.*

21*st Sample.*—Purchased of —. Rivere, Charles-street, Drury-lane.
Genuine.

22*nd Sample.*—Purchased of B. Sahley, 110. Drury-lane.
Adulterated—containing a very large quantity of *barley-meal.*

23*rd Sample.*—Purchased of W. Edwards, 49. New-cut, Lambeth.
Genuine.

24*th Sample.*—Purchased of J. Manning, 42. Lambeth Lower Marsh.
Genuine.
25*th Sample.*—Purchased of M. Ohler, 14. Lambeth Marsh.
Genuine.
26*th Sample.*—Purchased of S. Hudson, 113. High-street, Marylebone.
Adulterated—containing a considerable quantity of *barley-meal.*
27*th Sample.*—Purchased of F. Westley, 12. South-street, Manchester-square
Adulterated—containing a proportion of *barley-meal.*
28*th Sample.*—Purchased of W. Jobbins, 3. Thayer-street, Manchester-square.
Adulterated—containing a large admixture of *barley-meal,* apparently in much larger proportion than the oatmeal.
29*th Sample.*—Purchased of E. Oram, 5. Davies-street, Berkeley-square.
Adulterated—containing a considerable quantity of *barley-meal.*
30*th Sample.*—Purchased of W. Bryan, 34. Gilbert-street, Oxford-street.
Adulterated—Admixed to a considerable extent with *barley-meal.*

It appears, from the above analyses, that *Sixteen, or more than one-half of the Thirty samples submitted to examination, were adulterated* by admixture with large quantities of BARLEY-MEAL. But oatmeal frequently suffers deterioration in other ways besides by admixture with barley-flour. One of these consists in adding to it the investing membranes, &c. of the oat and barley, technically termed "rubble," and which are rejected in the preparation of the purer sorts of oatmeal, grits and groats, Scotch and pearl barley.

On referring to the present market prices of oat and barley meals, we find that while the first is 16*s.* per cwt., the latter is only 8*s.* per cwt., that is, just one-half. We thus perceive that the inducement to adulterate oatmeal is very great, greater, indeed, it appears, than many bakers and cornchandlers can resist.

The following information, furnished us by a correspondent, whose name for obvious reasons we withhold, shows that this article is subject to systematic adulteration. He writes:—

"Since your able analyses have taken place, it has struck me that I may be able to give you a little information as to an article of food which is adulterated to a most *awful* extent,—viz. *oatmeal.* I will first mention oatmeal *as sent into workhouses, prisons,* and *charitable institutions,* which are generally taken at contract prices. I enclose one for the parish of —— for 1848, where I find the oatmeal was taken at 14*s.* per cwt. by ——; and by reference to my stock-book, I find the market price was 17*s.* 6*d.* per cwt.; thus the oatmeal was reduced 3*s.* 6*d.*, and then left an excellent profit. Well, at that time I was trying for all the contracts in London, and could not succeed, my *prices* being generally about 4*s.* dearer than any one's else: this was a *mystery* to me. By accident I found out oatmeal was adulterated with barley-flour which is bought at about 7*s.* per cwt.; this being mixed with the oatmeal, of course reduced the *price.* I then, being as wise as my competitors, tried, and have served the above workhouse since.

"Now, the fault lies here. If the workhouses were to take the contracts at a per-centage on market value, then they would get *good* oatmeal; but they always *cut down* the price, and thus get an adulterated article.

"You will see the prices are 14*s.*, 15*s.* 6*d.*, 16*s.*, and 17*s.*; thus if a man wants to be *honest* with them, *they will not let him.* I have again and again wished to supply at a per-centage on market value; the answer I get is, '*Well, we are very well satisfied, and have no complaints.*'"

We have ourselves been at some pains to verify the statements made above, and for that purpose have procured samples of oatmeal as supplied to some of our unions and charitable institutions; these, without exception, we have found on examination to be largely adulterated with *barley-meal,* as described.

The adulteration of oatmeal is not merely important in a pecuniary, but is of some consequence in a sanitary point of view.

The properties of oatmeal are thus described in Pereira's Materia Medica:—
"Oatmeal is an important and valuable article of food. With the exception of maize or Indian corn, it is richer in oily or fatty matter than any of the other cultivated cereal grains, and its proportion of protein compounds exceeds that of the finest English wheaten-flour. So that both with respect to its heat-and-fat making, and its flesh-and-blood making principles, it holds a high rank."

In the same work we meet with the following account of barley-meal as an article of diet:—"Barley is a valuable nutritive. Considered in relation to wheat, it offers several peculiarities. In the first place it contains much less protein matter; in other words, less of the flesh-and-blood making principle; though Count Rumford considered barley-meal in soup three or four times as nutritious as wheat-flour. Secondly, its starch offers more resistance to the action of the gastric juice, in consequence of its more difficult solubility in water. Thirdly, its husk is slightly acrid, and therefore this should be removed from barley intended for dietetical purposes, as in Scotch and pearl barley. Fourthly, barley-meal is more laxative than wheat-meal."

Contrasting the two, it appears that oatmeal possesses considerable dietetic advantages over barley-meal.

It may be in the recollection of some of our readers, that at the inquest held by Mr. Wakley on the bodies of some of the poor children who fell victims in the pest-house at Tooting, the fact transpired that the oatmeal which formed so considerable a part of their food, was extensively adulterated with barley-meal.

TEA, AND ITS ADULTERATIONS.

Growth and Preparation of Tea.

The tea-plant is a hardy, evergreen, and leafy shrub, which attains the height of from three to six feet, and upwards; it belongs to the natural family Columniferæ (Ternstromiaceæ of Lindley), which includes the Camellias. It is generally propagated from seed, and the plant comes to maturity in from two to three years, yielding, in the course of the season, three, and, in some cases, four crops of leaves.

The first gathering takes place very early in the spring, a second in the beginning of May, a third about the middle of June, and a fourth in August. The leaves of the first gathering are the most valuable, and from these, Pekoe tea, which consists of the young leaf-buds, as well as black teas of the highest quality, are prepared. Those of the last gathering are large and old leaves, and, consequently, inferior in flavour and value.

The leaves vary considerably in size and form: the youngest leaves are narrow, convoluted, and downy; those next in age and size have their edges delicately serrated, with the venation scarcely perceptible; in those of medium and large sizes the venation is well marked, a series of characteristic loops being formed along each margin of the leaf, and the serrations are stronger and deeper, and placed at greater intervals.

The principal varieties of black tea are Bohea, which is the commonest and coarsest description, Congou, Souchong, Caper and Padre Souchong, and Pekoe, which are of the highest quality, the last consisting of the very young and unexpanded leaves, and which, when clothed with down, constitute flowery Pekoe.

The principal varieties of green tea are Twankay, Hyson-skin, Young Hyson, Hyson, Imperial, and Gunpowder, which, in green tea, corresponds with flowery Pekoe in black. Imperial, Hyson, and Young Hyson, consist of the second and third gatherings, while the light and inferior leaves, separated from Hyson by a winnowing machine, constitute Hyson-skin, a variety in considerable demand amongst the Americans.

There is, according to most writers, but one species of the tea-plant, from which the whole of the above, and many other varieties of tea, are obtained, the differences depending upon soil, climate, weather, age of the leaves, and mode of preparation.

The plants from which black teas are prepared are grown chiefly on the slopes of hills and ledges of mountains*, while the green tea-shrubs are cultivated in manured soils. Upon this circumstance many of the differences between the two varieties depend.

Other differences are occasioned by the processes adopted in the preparation and roasting of the leaves. Thus, while black tea is first roasted in a shallow iron vessel, called a *kuo*, and secondly in sieves, over a bright charcoal fire,

* There is a range called the Bohea-mountains, from which Bohea tea takes its name.

green tea does not undergo the second method of roasting, but only the first —that in the *kuo*.

An important part of the manufacture of tea consists in the *rolling* the leaves, so as to impart to them their characteristic twisted shape. This is effected by subjecting the leaves to pressure, and rolling by the hands in a particular manner. The first effect of the application of heat to the leaves in the *kuo*, is to render them soft and flaccid; when in this state, they are removed from the vessel, and submitted to the first rolling—an operation which, after the renewed action of the *kuo* on each occasion, is three or four times repeated, with superior teas, before the process is considered to be complete.

Scenting of Tea.

The following observations on the scenting of tea are extracted from Mr. Ball's "Account of the Cultivation and Manufacture of Tea in China:"—

"The Chinese seem universally to agree, in ancient as in modern times, that no factitious scent can be given to tea which at all equals its natural fragrance; in short, they say, 'that only common tea requires scenting.' Those persons who have had the opportunity of drinking some of the finest kinds of Souchong tea will perhaps agree with the Chinese in this opinion. There are, however, many scented teas, which, so far from being inferior, are even costly, and much esteemed, both in China and in Europe. Of these the *Chu Lan*, or Cowslip Hyson, may be considered the best.

"The tea about to be scented must be taken hot from the last roasting (which immediately precedes the packing), and poured into a Hyson chest, so as to form a layer of two inches in height from the bottom; a handful or more of the fresh flowers (already separated from the stalks) is then strewed over the tea. In this manner the tea and flowers are placed in layers, until the chest is quite full. The mouth of the canister is then closed, and thus the tea remains for twenty-four hours. The proper proportion is three catties of flowers to one hundred catties of tea. The next day, the chest is emptied, when the tea and flowers are mixed together; they then undergo the process of *Poey**, about three catties being put into one sieve. The *Poey Long* is completely closed, and the tea and flowers are thus roasted about from one to two hours, or rather, until the flowers become crisp. The flowers are then sifted out, and the tea packed. If the tea requires any further scenting, fresh flowers must be used, and the process repeated as before. The tea thus prepared is then mixed with other tea, in the proportion of one part of scented tea to twenty of plain. The whole is then slightly heated in a *kuo* (*chao*), and when packed, constitutes the description of tea denominated in England Cowslip Hyson. Tea may be scented at any time with this kind of tea, but it must be previously heated or roasted about two hours.

"The mode of scenting black tea differs from that of green, and so far as I understand, there are two or three methods of performing this process. The Souchong or Caper teas, the Tet Siong, and other teas of the cowslip flavour, are also scented with the *Chu Lan* flower (*Chloranthus inconspicuus*).

"After gathering, the flowers are separated from the stalks as before, when some people dry them in the sun; but the best mode is to dry them in a Poey Long, over a slow fire, taking care not to change the yellow colour of the petals. When dried they are put aside to cool, and are afterwards reduced to powder. If this powder, the scent of which is very powerful, be sprinkled over the leaves previously to the last or two last roastings and rollings, in the process of Poey, the tea will be highly scented; but this is an expensive mode, on account of the additional quantity of flowers required, and therefore is seldom practised. The usual mode is by sprinkling a small quantity of this powder over the tea during the last process of Poey, which takes place previous to packing. A small white powder, frequently found in black teas of the caper flavour, cannot have escaped the observation of the tea-dealers in England; this powder is that of the Chu Lan flower, whose colour has been changed to white in the process of Poey.

"There is another scented tea, of excellent flavour, which is made in small quantities, and occasionally sent to foreigners as presents. This is a Souchong tea, scented with the flower of the Pac Sheem (*Gardenia florida*).

* The roasting of the leaves in a sieve over a charcoal fire.

"There are two other scented teas, also of fine flavour, both Souchong teas, the one scented with the Quy-fa, or Kuey-hoa (*Olea fragrans*), and the other with the Moo-Ly-Hoa (*Jasminum Sambac*). Some people say that these three last teas are mixed with the flowers, as the Hyson tea is mixed with the Chu Lan, and are scented in the same manner. But others say that two sieves are placed in the Poey Long, the lower one containing the flowers, and the upper one the tea. The latter is the mode in which the Pac Sheem tea, to which I have previously alluded, is scented. These are all the flowers with which I am acquainted, which are employed to scent tea; but in the Keun Fang Pu, and Quang Tong Chy (or Canton Geographical History), many others are enumerated as eligible for that purpose. These works also observe that flowers so used should be full blown."

M'Culloch, in his "Commercial Dictionary," draws an interesting parallel between the vine and the tea-plant: —

"Considered as an object of agricultural produce, the tea-plant bears a close resemblance to the vine. In the husbandry of China, it may be said to take the same place which the vine occupies in the southern countries of Europe. Like the latter, its growth is chiefly confined to hilly tracts, not suited to the growth of corn. The soils capable of producing the finest kinds are within given districts, limited and partial. Skill and care, both in husbandry and preparation, are quite as necessary to the production of good tea as to that of good wine.

"The best wine is produced only in particular latitudes, as is the best tea, although perhaps the latter is not restricted to an equal degree. Only the most civilised nations of Europe have as yet succeeded in producing good wines, which is also the case in the East with tea; for the agricultural and manufacturing skill and industry of the Chinese are there unquestionably pre-eminent. These circumstances deserve to be attended to in estimating the difficulties which must be encountered in any attempt to propagate the tea-plant in colonial and other possessions. These difficulties are obviously very great, and perhaps all but insuperable. Most of the attempts hitherto made to raise it in foreign countries were not indeed of a sort from which much was to be expected. Within the last few years, however, considerable efforts have been made by the Dutch government of Java to produce tea on the hills of that island; and having the assistance of Chinese cultivators from Fokien, who form a considerable part of the emigrants to Java, a degree of success has attended them beyond what might have been expected in so warm a climate. The Brazilians have made similar efforts, having also, with the assistance of Chinese labourers, attempted to propagate the tea-shrub near Rio de Janeiro, and a small quantity of tolerably good tea has been produced; but owing to the high price of labour in America, and the quantity required in the cultivation and manipulation of tea, there is no probability, even were the soil suitable to the plant, that its culture can be profitably carried on in that country. It may, perhaps, succeed in Assam, where its culture is now being attempted; for labour is there comparatively cheap, and the hilly and table lands are said to bear a close resemblance to those of the tea districts of China; but we are not sanguine in our expectations as to the result."

"All the black teas," says M'Culloch, "exported (with the exception of a part of the Bohea grown in Woping, a district of Canton) are grown in Fokien, a hilly, maritime, populous, and industrious province, bordering to the north-east on Canton. Owing to the peculiar nature of the Chinese laws as to inheritance, and probably, also, in some degree, to the despotic genius of the government, landed property is much subdivided throughout the empire; so that tea is generally grown in gardens or plantations of no great extent. The leaves are picked by the cultivator's family, and immediately conveyed to market, where a class of persons, who make it their particular business, purchase and collect them in quantities, and manufacture them in part; that is, expose them to be dried under a shed. A second class of persons, commonly known in the Canton market as the 'tea-merchants,' repair to the districts where the tea is produced, and purchase it in its half-prepared state, from the first class, and complete the manufacture by garbling the different qualities; in which operation, women and children are chiefly employed. A final drying is then given, and the tea packed in chests, and divided according to quality in parcels of from 100 to 600 chests each. These parcels are stamped with the name of the district, grower, or manufacturer, exactly as is practised with the wines of Bordeaux and Burgundy, the indigo of Bengal, and many other commodities; and from this circumstance get the name of *chops*, the Chinese term for a seal or signet.

"The greater part of the tea is brought to Canton by land carriage, or inland navigation, but chiefly by the first: it is conveyed by porters; the roads of China, in the southern provinces, not generally admitting of wheel carriages, and beasts of burden being very rare. A small quantity of black tea is brought by sea, but probably smuggled; for this cheaper mode of transportation is discouraged by government, which it deprives of the transit duties levied on inland carriage. The length of land-carriage from the principal districts where the green teas are grown, to Canton, is probably not less than 700 miles; nor that of the black tea, over a mountainous country, less than 200 miles. The tea merchants begin to arrive in Canton about the middle of October, and the busy season continues until the beginning of March, being briskest in November, December, and January."

There is another particular to which the comparison between the vine and tea-plant, made by Mr. M'Culloch, may be extended, namely, the not less general use of the infusion made from the leaves of the tea-plant by the people of various nations of both the old and new worlds.

In China, as appears from the following extract, tea is the common beverage of the people. The late Sir George Staunton informs us "that tea, like beer in England, is sold in public-houses in every town, and along public roads, and the banks of rivers and canals, nor is it unusual for the burdened and weary traveller to lay down his load, refresh himself with a cup of warm tea, and then pursue his journey." *

"The wealthy Chinese simply infuse the leaves in an elegant porcelain cup, which has a cover of the same material; the leaves sink to the bottom of the cup, and generally remain there without inconvenience, though occasionally some may float or rise to the surface. To prevent this inconvenience, sometimes a thin piece of silver, of filagree, or open work, is placed immediately on them. Where economy is necessary to be studied, the teapot is used. The wealthy Japanese continue the ancient mode of grinding the leaves to powder; and after infusion in a cup, 'it is whipped with a split bamboo, or denticulated instrument, till it creams, when they drink both the infusion and powder, as coffee is used in many parts of Asia.' "†

Analysis of Tea.

The infusion made from tea contains gum, glucose or saccharine matter, a large quantity of tannin, and a peculiar nitrogenised principle called *theine;* this is identical with *caffein*, and upon its presence many of the properties of tea depend.

The amounts of gum and tannin contained in a given sample of tea afford data by which its quality may, to some extent, be determined.

The per-centage of these substances may be obtained in the following manner: —One hundred grains of tea, dried by means of a water-bath, are to be boiled for some time in about a quart of distilled water; this dissolves out the gum and tannin, but does not affect the lignin, which, re-dried in the same way at a temperature of 212° Fahr., and weighed, gives the amount of that substance present in the hundred grains, and shows, by the loss of weight, the combined quantities of the gum and tannin. The decoction is now to be evaporated, and the residuum treated with alcohol; this will take up the tannin and colouring matter, but leave the gum, the weight of which being ascertained, after drying, gives the per-centage of tannin.

Should it be desired to estimate the quantity of tannin separately, this may be effected either by evaporating the alcoholic solution and drying the residue in the ordinary way, or else by the precipitation of the tannin from the decoction, by a solution of gelatine. The precipitate being washed and dried at a steam heat, indicates the quantity of tannin, 100 grains of the precipitate being equal to 40 grains of tannin.

* Lord Macartney's Embassy to Pekin, vol. ii. p. 96.
† Ball on the Cultivation and Manufacture of Tea, p. 15.

The determination of the amount of nitrogen in any tea should form part of a rigid analysis; for this purpose, 100 grains, dried in a water-bath until it ceases to lose weight, is to be incinerated with soda-lime, and its contents in nitrogen then ascertained.

While the average amount of nitrogen in tea exceeds five per cent., that in sloe, hawthorn, and elder leaves but seldom exceeds three per cent., and in the first two is nearly always much under this.

The following are the methods of proceeding adopted by different chemists for obtaining the active principle of tea, theine, and for estimating its amount:—

Mulder obtains it from tea by heating the evaporated extract by hot water, with calcined magnesia, filtering the mixture, evaporating to dryness the liquor which passes through, and digesting the residuum with ether. This solution being distilled, the ether of course passes over, and the theine remains. This principle may be extracted in the same way from raw ground coffee.

Dr. Stenhouse obtains theine by adding acetate of lead to a decoction of tea, evaporating the filtered liquid to a dry extract, and exposing this extract to a subliming heat in a shallow iron pan, whose mouth is covered flatly with porous paper, luted round the edges as a filter to the vapour, and surmounted with a cap of compact paper as the receiver. According to this method, Dr. Stenhouse obtained only 1·37 per cent. of theine.

M. Peligot, remembering that the quantity of nitrogen contained in tea leaves frequently amounted to 6 per cent., was hence led to believe that much more theine existed in them than had hitherto been separated, and he adopted the following improved method of extraction:—

To the hot infusion of tea, subacetate of lead and then ammonia were added; the liquid was filtered, and the lead separated by means of sulphuretted hydrogen; after a second filtration, the clear liquid being evaporated at a gentle heat, afforded, on cooling, an abundant crop of crystals. By re-evaporation of the mother liquid more crystals were procured, amounting altogether to from 5 to 6 per cent.

According to Mulder's analyses, 100 parts of tea consist of—

	Green.	Black.
Essential oil (to which the flavour is due)	0·79	0·60
Chlorophyle	2·22	1·84
Wax	0·28	—
Resin	2·22	3·64
Gum	8·56	7·28
Tannin	17·80	12·88
Theine	0·43	0·46
Extractive	22·30	19·88
Do., dark-coloured	—	1·48
Colourable matter, separable by hydrochloric acid	23·60	19·12
Albumen	3·00	2·80
Vegetable fibre	17·08	28·32
Ash	5·56	5·24
	100·0	100·0

The theine is obviously much underrated in the above analyses.

Theine, when pure, crystallises in fine glossy needles, like white silk; the crystals lose, at 212°, 8 per cent. of their weight, or two atoms of water of crystallisation; they are bitter; they melt at 350° F., and sublime at 543° without decomposing; dried at 350°, they dissolve in 98 parts of cold water, 97 of alcohol, and 194 parts of ether. Theine is a feeble base, and is precipitable by tannin alone from its solutions.

Properties of Tea.

Lo-Yu, a learned Chinese, who lived in the dynasty of Tang, A.D. 618 to 906, gives the following agreeable account of the qualities and effects of the infusion of the leaves of the tea-plant:—

"It tempers the spirits, and harmonises the mind; dispels lassitude, and relieves fatigue; awakens thought, and prevents drowsiness; lightens or refreshes the body, and clears the perceptive faculties."

In Pereira's "Materia Medica" we find the following remarks relating to the properties of tea:—"Its astringency is proved by its chemical properties. Another quality possessed, especially by green tea, is that of diminishing the tendency to sleep. Tea appears to possess a sedative influence with regard to the vascular system. Strong green tea, taken in large quantities, is capable, in some constitutions, of producing most distressing feelings, and of operating as a narcotic."*

THE ADULTERATION OF TEA.

A very considerable amount of skill and ingenuity are displayed, as we shall hereafter perceive, both at home and abroad, in the adulteration of tea, as well as in the manufacture of spurious articles in imitation of it. The devices resorted to by the Chinese in the preparation of many descriptions of tea, arise out of the high prices which several of these command, while the enormous duty exacted by the legislature on all descriptions of tea imported into this country, operates as a strong inducement to adulteration after its arrival in this country.

We propose to treat first of BLACK TEA and its adulterations.

The chief adulterations to which black tea is subject consist in the use of leaves other than those of tea, in the re-preparation of exhausted tea-leaves, and in the employment of substances, either for the purpose of imparting colour and astringency to the infusion of the leaves, or to glaze and face the surface of the dried leaves, so that they present an improved appearance to the eye.

On the Use and Detection of Leaves other than those of the Tea-plant.

It has been stated that the Chinese not unfrequently make use of the leaves of other plants besides those of tea, and in particular the leaves of *Camellia sasanqua* and *Chloranthus inconspicuus*.

Dr. Dickson† writes,—"The Chinese annually dry many millions of pounds of the leaves of different plants to mingle with the genuine, as those of the ash, plum, &c.; so that all spurious leaves found in parcels of bad tea, must not be supposed to be introduced into them by dealers in this country. While the tea-trade was entirely in the hands of the East India Company, few of these adulterated teas were shipped for this country, as experienced and competent inspectors were kept at Canton to prevent the exportation of such in the Company's ships; but since the trade has been opened, all kinds find a ready outlet; and as the demand often exceeds the supply, a manufactured article is furnished to the rival crews."

It has been repeatedly ascertained that the leaves of various British plants are sometimes used in this country in the adulteration of tea.

The leaves of the following species have been detected from time to time in samples of tea of British fabrication:—beech, elm, horse-chesnut, plane, bastard plane, fancy oak, willow, poplar, hawthorn, and sloe.

The leaves are dried, broken into small pieces, and usually mixed up with a paste made of gum and catechu; afterwards they are ground and reduced to a powder, which, when coloured with rose-pink, is mixed either with the dust of genuine tea, or with inferior descriptions of black tea.

Before the observer is in a position to detect the presence of foreign leaves in tea, it is necessary that he thoroughly acquaint himself with the characters of the tea and other leaves used to mix with tea, in the various stages of their growth; thus he must note well the size and form of the leaves, the condition of the edges, but especially the arrangement and distribution of the bundles of woody fibre and vessels of the leaves—*veins*, as they are commonly termed.

All these particulars are well exhibited in the following engravings, by the aid of which the observer will be able to distinguish, not merely the leaves of many of the different plants resorted to, when entire, but very frequently even when broken into fragments.

But by the microscope it is indeed in many cases possible to do much more than this, and to ascertain, by observing the size and form of the epidermic and

* For some interesting observations on Tea, see Dr. Sigmond's works on Tea, its Effects, Medicinal and Moral.

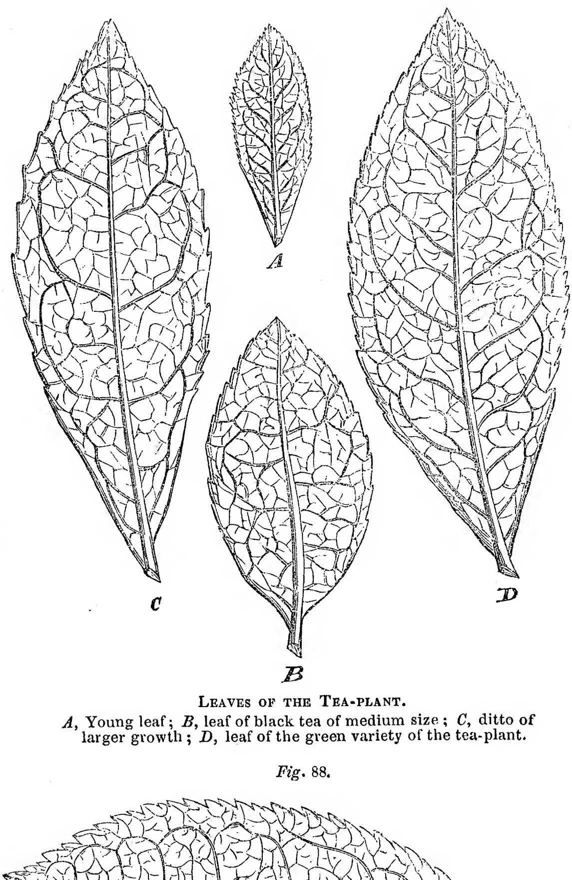
† Article "Tea" in Penny Cyclopædia.

chlorophylle cells, the stomata, and other particulars, the species to which many of the leaves belong, even when these are ground and reduced to powder. This is an important fact, not only as it relates to the adulteration of tea, but also many other articles.

We shall hereafter produce conclusive evidence of the value of the microscope in determining differences of structure in the leaves of many plants.

Chemists have endeavoured to discriminate the leaves of one plant from those of another by the manner in which their infusions have been affected on the addition of re-agents. This method is difficult in its application, and, in general, not satisfactory in its results.

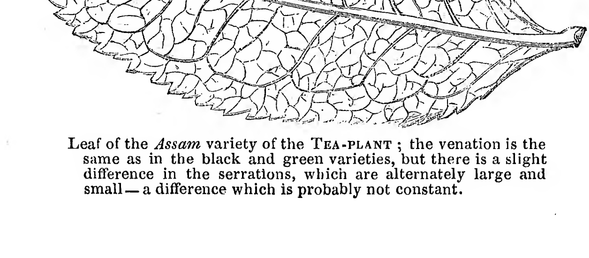
Fig. 87.



Leaves of the Tea-plant.

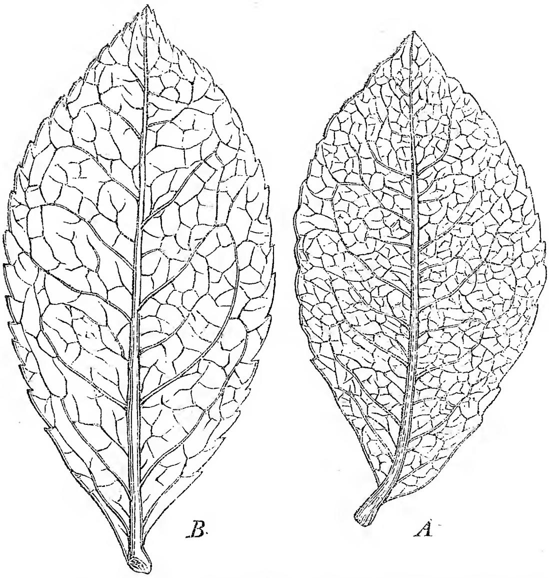
A, Young leaf; *B*, leaf of black tea of medium size; *C*, ditto of larger growth; *D*, leaf of the green variety of the tea-plant.

Fig. 88.



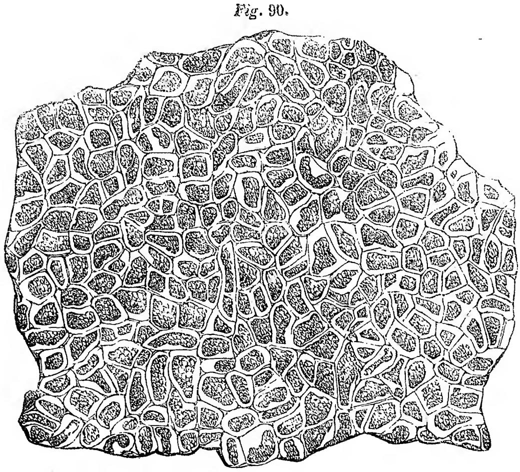
Leaf of the *Assam* variety of the Tea-plant; the venation is the same as in the black and green varieties, but there is a slight difference in the serrations, which are alternately large and small — a difference which is probably not constant.

Fig. 89.



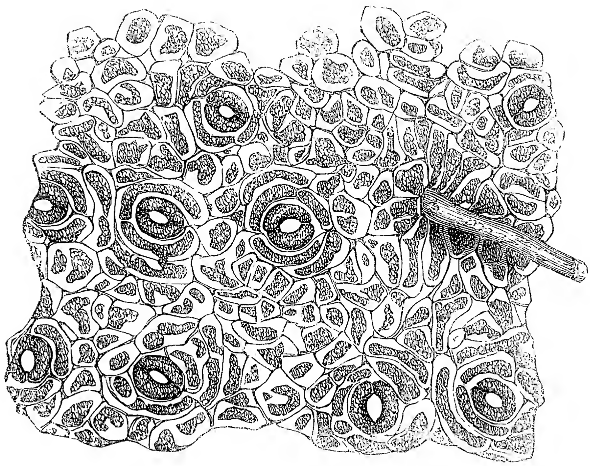
A, Leaf of CHLORANTHUS INCONSPICUUS; *B*, ditto of CAMELLIA SASANQUA; leaves used to adulterate tea.

Fig. 90.



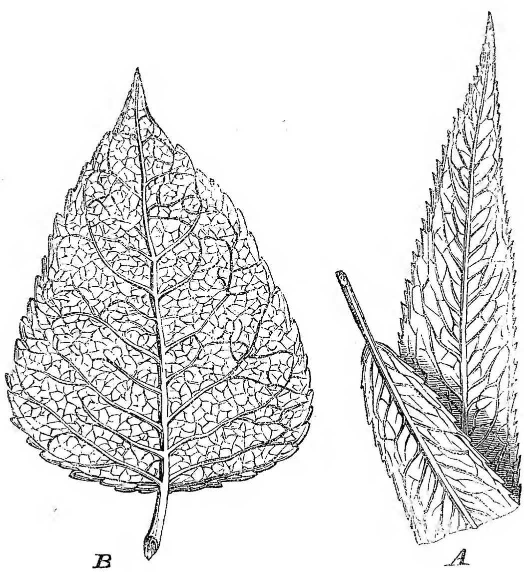
Upper surface of TEA-LEAF, showing its structure. Magnified 350 diameters.

Fig. 91.



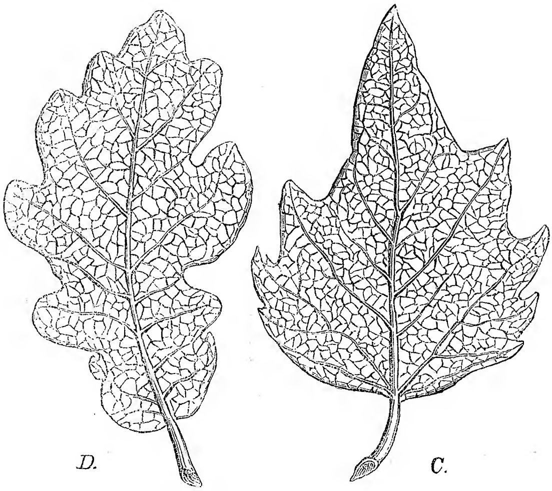
Under surface of TEA-LEAF, showing the stomata and cells of this portion of the leaf, as well as a part of one of the hairs by which this surface is clothed. Magnified 350 diameters.

Fig. 92.



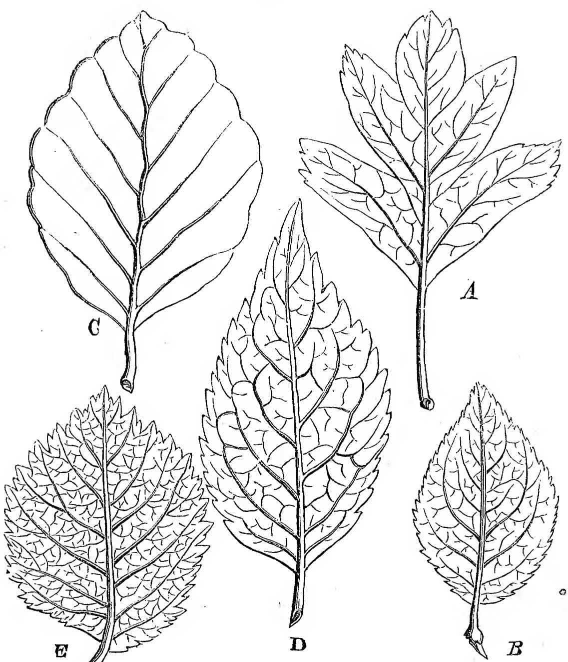
A, Leaf of WILLOW ; *B*, ditto of POPLAR.

Fig. 93.



C, Leaf of PLANE ; *D*, ditto of OAK.

Fig. 94.



A, Leaf of the HAWTHORN ; *B*, ditto of the SLOE, or WILD PLUM ; *C*, ditto of the BEECH ; *D*, ditto of the ELDER ; *E*, ditto of the ELM.

*** The whole of the leaves, except that of the camellia, are figured on their under surfaces. The elm, plane, and oak leaves, from which the sketches were prepared, were of small size.

On Exhausted Tea-leaves.

We have been favoured with the following observations, by Mr. George Phillips, of the Inland Revenue Office, on the employment of exhausted tea-leaves :—

"In the year 1843, there were many cases of re-dried tea-leaves, which were prosecuted with vigour by this board, and the result was, so far as we could ascertain at the time, the suppression of the trade. It was supposed, in 1843, that there were eight manufactories for the purpose of re-drying exhausted tea-leaves in London alone, and several besides in various parts of the country. The practice pursued was as follows :—Persons were employed to buy up the exhausted leaves at hotels, coffee-houses, and other places, at $2\frac{1}{2}d.$ and $3d.$ per pound. These were taken to the factories, mixed with a solution of gum, and re-dried. After this, the dried leaves, if for black tea, were mixed with rose-pink and black-lead, to face them, as it is termed by the trade."

The best method of detecting this fraud is by chemical analysis.

The following are the results of the analysis of *unused* black tea obtained by Frank (Gmelin, Handbuch der Chemie, ii. 1252):—

Black Tea.

Tannin - - - - -	40·6
Gum - - - - - -	6·3
Woody fibre - - - - -	44·8
Glutinous matter - - - -	6·3
Volatile matter and loss - - -	2·0
	100·0

The analysis below is by Mr. George Phillips :—

Black Tea of fair quality.

Lignin - - - - -	46·8
Gum - - - - - -	5·9
Tannin - - - - -	42·5
Albumen and colouring matter - -	4·8
	100·0

Genuine black tea, according to Mr. Phillips, "contains about the same proportion of gum as green tea, but varies greatly in the amount of tannin and lignin. Thus some good black teas will afford 45·0 per cent. of tannin ; while those of an inferior description will not contain more than 30."

The annexed are analyses of samples of black tea manufactured from *exhausted* tea-leaves, and seized at various periods by the excise authorities. They have been furnished to us by Mr. Phillips, with the sanction of the Board of Inland Revenue.

Seized in London, 24th August, 1843.

Black Tea.

Lignin - - - - -	78·6
Gum - - - - - -	15·5
Tannin and colouring matter - - -	5·9
	100·0

	Seized in London, March 2. 1843. *Black Tea.* No. 1.	No. 2.	*Seized in London, Feb.* 15. 1843. *Black Tea.* No. 3.	No. 4.
Lignin	81·3	72·9	80·1	78·1
Gum	18·0	19·9	15·5	20·5
Tannin & colouring matter	0·7	7·2	4·4	1·4
	100·0	100·0	100·0	100·0

Seized May 15. 1843.

Black Tea.

	A.	*B.*
Lignin	72·0	84·9
Gum	10·0	11·6
Tannin and colouring matter	16·9	1·0
Carbonate of lime and vegetable red dye	1·1	2·5
	100·0	100·0

These samples were bloomed with a colour composed of a vegetable red, mixed with carbonate of lime. *A* was mixed with 37 per cent. of *B*, and *B* was composed of re-dried tea-leaves, that had been exhausted, and made up with gum.

Seized May 15. 1843.

Black Tea.

Tannin	91·1
Gum	7·2
Tannin and colouring matter	1·7
	100·0

Seized June 20. 1843.

Black Tea.

Lignin	84·8
Gum	15·2

This sample consisted of exhausted black tea-leaves *mixed with a few green*, re-dried and adulterated with gum.

Black Tea seized.

	No. 1.	No. 2.
Lignin	86·7	92·8
Gum	13·3	7·2
	100·0	100·0

These leaves contained no tannin. They were *completely* exhausted black leaves, adulterated with gum.

Contrasting the analyses of the exhausted and adulterated tea-leaves with those of genuine tea, it is seen that while the amount of tannin in the former is very much reduced, the quantity of lignin and also of gum, where this substance has been employed, as it generally is, to make up the leaves, is greatly increased. Thus, by chemical analysis, this fraud may be detected in the most satisfactory and decisive manner.

The methods by which the amount of tannin and gum in tea may be determined, have already been pointed out.

There is reason to believe that the manufacture of spurious tea, both black and green, from exhausted tea-leaves, prevails extensively at the present time; and we trust that one good result of our disclosures will be the detection and punishment of parties engaged in a practice so wicked and fraudulent.

On Catechu, Terra Japonica, or Japan Earth, in Tea.

This substance, which consists principally of tannin, is sometimes had recourse to when exhausted tea-leaves are used, or when other leaves than those of tea are employed.

It imparts increased astringency and colour to the infusion made from such leaves, and supplies the place of the tannin which has been abstracted from the exhausted tea-leaves, and of which some of the other leaves used are deficient.

The leaves of the sloe are astringent, and contain a considerable quantity of tannin; it is on this account they are so frequently employed.

LA VENO BENO.

An article which may be noticed in this place is now very commonly sold, under the above attractive title, to mix with tea.

The nature and alleged virtues of *La Veno Beno* are thus set forth in the handbill given below.

"GREAT ECONOMY TO TEA DRINKERS.
LA VENO BENO,
THE CHINESE TEA IMPROVER,

Is the essential part of the Leaf of a Tree, which grows in the East, and is imported through the East Indies to this country.

"The virtues of the Leaf were discovered in the year 1842, and now introduced to the British Public; the discoverer first having proved the great utility and efficacy, by Testimonials from numerous personages of distinction and science.

"The Natives of the East eat or masticate it, keeping it in the mouth till it dissolves, esteeming it for its strengthening properties.

"It is four times the strength of the strongest Teas, its flavour equally delicate, its properties more healthful, proved by Physicians and Chemists of high standing. (*See Testimonials.*)

"It is very strengthening to the nerves.—It does not prevent sleep.—It is useful on retiring to rest.—It is recommended to the debilitated for its pleasant and invigorating qualities, to the aged for its strengthening properties, and to the public generally for its economy and excellence.

"It will strengthen the Voice.—It is useful to Singers and Public Speakers.

"A Threepenny Packet will make One Quarter of a Pound of Tea last as long as a Half-Pound.

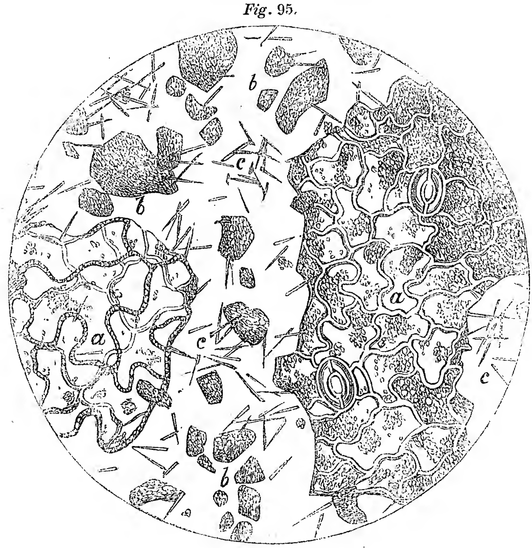
One shilling Packet contains $4\frac{1}{2}$ Threepenny Packets.
NO LICENCE REQUIRED.
SOLD IN PACKETS, AT 3*d*., AND 1*s*., EACH.
THOMAS LEITCH, Wholesale Dealer."

The directions for use are as follows:—

"Put a quarter of a teaspoonful into the tea-pot, with two teaspoonfuls of tea, and it will doubly increase the strength, and improve the flavour."

La Veno Beno consists of a coarse powder, of a reddish-brown colour, intermixed with small fragments of a leaf which is stated to be that of *sumach;* to the taste the powder is astringent and bitter, and on analysis it is ascertained to be composed in great part of coarsely-powdered *catechu.*

Fig. 95.



LA VENO BENO.
a a, fragments of the *Sumach leaves;* *b b*, particles of gum *catechu;* *c c*, *crystals* usually present in catechu. Magnified 350 diameters

According to Dr. Normandy, the leaves are broken tea-leaves, but this statement is clearly erroneous, as shown by the circumstance that the leaves in question exhibit a structure under the microscope totally different from those of the tea-plant. "But by whatever name called," writes Dr. Normandy, "La Beno Veno is neither plant nor leaf, but simply a mixture of a very small portion of tea-powder (broken tea-leaves) with an excessively large quantity (upwards of 90 per cent.) of pulverized catechu."

On stating to Mr. Philips that the broken leaves in this article were not those of tea, that gentleman furnished us with the following analysis : —

Sumach leaves - -	24·0
Catechu - - -	76·0
	100·0

Now catechu consists principally of tannin, which, from its astringent action, would be extremely apt, when taken in the quantity in which it exists in *La Veno Beno*, to produce constipation, with the manifold evils which result from such a condition.

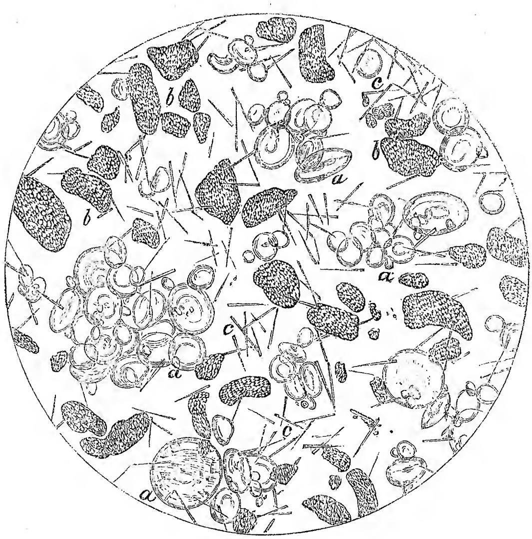
It is therefore evident that, on sanitary grounds alone, *La Veno Beno* is condemned, for in place of being a safe and pleasant drink, it is a potent medicine.

Now although we do not believe that very much of this article is sold, or that it interferes to any serious extent with the consumption of tea, yet seeing that it is recommended to be mixed with tea, and to be employed as a substitute for it, it appears to us that it falls under the operation of the Excise laws, and that the authorities would deserve well of the public if they were to cause proceedings to be taken, whereby the sale of this deleterious compound might be effectually stayed.

"CHINESE BOTANICAL POWDER, or CHINESE ECONOMIST."

This preparation appears to be got up in imitation of *La Veno Beno*, and is sold for the same purpose as that article — viz., to mix with tea.

Fig. 96.



THE CHINESE BOTANICAL POWDER.
a a, starch corpuscles of *wheat*; *b b*, fragments of *catechu*; *c c*, *crystals*.
Magnified 350 diameters of same.

It is stated on the wrapper of the packages that it is

"USED in EASTERN CLIMATES for IMPROVING in STRENGTH and FLAVOUR EVERY DESCRIPTION of TEA."

The directions for use are—

"Take half a teaspoonful of the powder to two teaspoonfuls of tea, and it will produce a strength equal to four teaspoonfuls of tea."

Like *La Veno Beno*, it is put up in packages, and sold at the same price; it consists of a coarse powder, of a reddish-brown colour and astringent taste, and is made up of *a mixture of catechu and wheat-flour*, the latter ingredient being added to reduce the strength of the catechu.

Its use is open to the same objections, sanitary and others, as *La Veno Beno*.

GUM AND STARCH.

The great difficulty experienced in the re-preparation of exhausted tea-leaves, is to cause them to resume the twisted form imparted by the Chinese method of rolling and drying the leaves.

For this purpose the leaves are steeped in a strong solution of gum; this, in drying, occasions the contraction of the leaves, and causes them to assume, to a certain extent only, their original appearance; the solution at the same time imparts a polished surface to the leaves. The forms of the greater number of the leaves, even after this preparation, are still very different to those of tea as originally prepared; the leaves are more broken, and agglutinated into small flattened or rounded masses. This circumstance, and the shining appearance of the leaves, are sufficient to enable the experienced eye to detect samples of tea manufactured from exhausted leaves, even when mixed with a proportion of unused tea.

While gum is chiefly employed in this country, the Chinese sometimes make use of a solution of rice-starch to impart a particular form to the leaves, as well as for another purpose to be noticed hereafter.

It is not black tea only which is manufactured from exhausted tea-leaves, but also green tea, the leaves undergoing the same preparatory process of gumming and drying; and although, in the case of green tea, the difficulty of detection, apart from chemical analysis, is increased, yet the accurate observation of the form of the leaves is, in many cases, sufficient for the discovery even of this fraud.

SULPHATE OF IRON.

When a solution of sulphate of iron is brought into contact with a solution of tannin, or one of tea (which contains a large amount of tannin), the liquid becomes deeply coloured. Of this fact the fabricators of spurious tea are well aware; for they avail themselves of it, and frequently add to the gum-water to be used in making up exhausted tea-leaves, a proportion of sulphate of iron. We have now in our possession samples of tea recently manufactured from exhausted tea-leaves, with a solution of gum-water and sulphate of iron.

ROSE-PINK.

As will have been perceived from one of the analyses given, this substance is occasionally used by adulterators to give a colour and bloom to the surface of black tea fabricated from exhausted tea-leaves; it is not, however, very frequently had recourse to.

Rose pink consists of the colouring matter of logwood in combination with carbonate of lime. An infusion of the wood is first prepared, through which the lime is diffused, and this, in subsiding, carries with it the characteristic colour, which, incorporated with the lime, forms rose pink.

LOGWOOD.

In Dr. Normandy's work, entitled "The Commercial Handbook of Chemical Analysis," are the following observations on the employment of logwood in the adulteration of tea:—

"Besides the substances which have been named before, black tea is also mixed sometimes with pulverised extract of logwood. This is immediately detected by moistening a small portion of the tea-leaves of the sample with water, and rubbing it gently about upon a sheet of white paper, which, in that case, will be stained bluish-black; moreover, if a portion of the tea, being thrown in cold water, imparts immediately to the liquid a pinkish or purplish colour, which is rendered red by the addition of a few drops of sulphuric acid, it is a sign of the presence of logwood; for genuine black tea produces only after a time a golden brown liquor, which is not reddened by sulphuric acid. This addition of logwood to black tea is for the purpose of simulating strength by the high colour of the infusion, something like the addition of chicory to coffee. I have met with this kind of adulteration in teas represented as Souchong and Pekoe."

Graphite, Plumbago, or Black Lead.

It is generally supposed that the use by the Chinese of colouring matters and other substances for imparting brilliancy of surface and hue, is confined to green teas; we shall, however, hereafter produce evidence to show that several of the black teas also, as imported into this country, are adulterated, or faced, as it is termed.

One of the substances resorted to for this purpose is plumbago, which consists of carbon and iron, usually in the proportion of ninety-five per cent. of the former to five of the latter.

Plumbago gives to the surface of the leaves a black, shining, and metallic or leaden appearance, so characteristic, that when once seen, it may be again readily recognised. Apart from the evidence of the presence of this substance afforded by the eye alone, it may be detected in other ways.

If a thin slice be removed from the surface of one of the leaves faced with this substance, and placed under the microscope, it will be seen to be thickly studded with numerous minute black particles.

Again, if one or two teaspoonfuls of such tea be infused in boiling water, the liquid, after a time, will, in many cases, where the quantity of facing is considerable, acquire a blackish hue, and on evaporation, the bottom of the vessel containing it will be found to exhibit the dark, shining, and characteristic coating of black lead.

Talc, China Clay, and Soap-stone.

Various statements have been made as to the use of powdered talc by the Chinese, but we are not aware that up to this time it has actually been detected in any sample of tea.

It is quite certain, however, that either this or some analogous substances, as *soap-stone* and *China clay*, are employed for the purpose of imparting a bloom or lustre to the surface of the leaves.

The evidence of the use of either mica or soap-stone, even in some of their black teas, as will presently appear, is conclusive.

On examining closely with the eye the surface of the leaves of certain descriptions of black tea, minute fragments, shining with a silvery lustre, could plainly be discerned. On placing these under an achromatic microscope they all refracted light, and appeared more or less irridescent — an effect which became much more strongly marked on the application of the polariscope.

The presence of fragments of these substances, sufficiently large to be visible to the naked eye, is explained by the difficulty experienced in reducing them to powder.

In order to detect the larger particles it is necessary that the leaves should be expanded in hot water, redried, and the surfaces then attentively examined. A simple lens will be found to afford assistance in the examination.

Talc, or *mica*, is met with in plates, which possess a laminated structure, the laminæ refracting the light, and exhibiting a considerable amount of irridescence. It consists of silicate of alumina, with ter-silicate of potassa.

China clay, or *Kaolin*, is prepared from decaying granite, being the result of the decomposition of the felspar and mica of that mineral; it therefore consists to a large extent, of mica, and, of course, possesses many of the same characters.

Felspar is composed of single equivalents of the neutral silicates of potash and alumina.

Steatite, or *soap-stone*, is a silicate of magnesia, and, like mica, is laminated and irridescent, the lamellæ exhibiting a crystalline structure.

Indigo.

Indigo is a vegetable substance obtained from several species of plants of the genus *Indigofera*, especially *I. tinctoria*. It does not exist ready formed in the plant, but is deposited from the juice, as a feculent matter, during fermentation. Its colour, like that of all vegetables, is destroyed by chlorine.

Under the microscope it appears as minute granules and irregular fragments, many of which reflect a blue or greenish colour, its appearance being sufficiently characteristic to enable the observer to distinguish it from the only substance with which it is likely to be confounded, viz. Prussian blue.

It is not only extensively used in the manufacture of *green* teas, as will be explained hereafter, but we have detected it in small quantities entering into the composition of the colouring matters employed by the Chinese to "face" certain descriptions of *black* tea.

The quantity used in the facing of these black teas is very small, and were it not for the microscope this adulteration would altogether escape detection.

Indigo is possessed of medicinal properties, and we meet with the following account of its effects in "Pereira's Materia Medica."

"Its physiological effects, according to Dr. Roth (*Diss. Inaug. de Indigo*, 1834, Berol, and *British and Foreign Medical Review*, vol. ii. p. 244.), are as follows:—" Shortly after taking it, the patient experiences a sense of constriction of the fauces, and the impression of a metallic taste on the tongue. These are followed by nausea, and frequently by actual vomiting. The intensity of these symptoms varies in different cases. In some the vomiting is so violent as to preclude the further use of the remedy. The matter vomited presents no peculiarity, except in its blue colour. When the vomiting has subsided, diarrhœa usually occurs; the stools are now frequent, liquid, and of a blue or blackish colour. The vomiting and diarrhœa are frequently accompanied by cardialgia and colic. Occasionally these symptoms increase, and the use of the remedy is, in consequence, obliged to be discontinued. Dyspepsia and giddiness sometimes succeed. The urine has a brown, dark, violet colour; but Dr. Roth never found the respiratory matter tinged with it. After the use of indigo for a few weeks, twitchings of the muscles were sometimes observed, as after the use of strychnia. It has been employed principally in spasmodic affections, viz. epilepsy, convulsions of children, chorea, and hysteria. In epilepsy it has been tried by Von Stahly, Leuhossek, Grossheim, Ideler, Wolf, Leineweler, Doepp (*Roth. op.* Dierbach, op. cit. *Neust. Entd. in d. Mat. Med. Bd.* 1, § 222, 1837), and Noble (*Lond. Med. Gaz.*, vol. xvii. p. 1038), with good effect. Some of the successful cases were of very long standing. Roth says that at the commencement of the treatment, the frequency of the paroxysms was invariably increased. Idiopathic epilepsy is said to have been more benefited by it than the symptomatic epilepsy. The dose of indigo should be as large as the stomach can bear. At the beginning it may be a few grains; afterwards the quantity should be increased to drachms."

Turmeric Powder.

We have already, under the head of Mustard and its Adulterations, described the nature and structure of turmeric powder, and showed that it possesses an organisation sufficiently distinctive to allow of its being readily detected by means of the microscope. To this description it is sufficient on the present occasion simply to refer.

It also is one of the many substances employed by Chinese, and other fabricators of adulterated tea, to add colour and bloom to the surface of the leaves. It is usually used in combination with either indigo or Prussian blue, and powdered talc, soap-stone, or some other analogous powder; and although employed principally in the preparation of artificial green teas, we have yet detected turmeric powder in small quantity in the glazing of some few samples of black tea, it being met with in the same descriptions in which the indigo was discovered.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL EXAMINATION OF NUMEROUS VARIETIES OF BLACK TEA AS IMPORTED INTO THIS COUNTRY.

1.
ASSAM BOHEA.
Genuine.

2.
COMMON JAVA CONGOU.
Genuine.

3.
GOOD COMMON CONGOU.
Genuine.

4.
COMMON CONGOU.
Genuine.

5.
FINEST CONGOU.
Genuine.

6.
CONGOU.
Genuine.

7.
FINEST CONGOU.
Genuine.

8.
SOUCHONG.
Genuine.

9.
ASSAM SOUCHONG.
Genuine.

10.
VERY FINE REAL SOUCHONG.
Genuine.

11.
PADRÆ SOUCHONG.
Genuine.

12.
TETSONG.
Genuine.

13.
FINE OOLONG.
Genuine.

14.
SPIDER-LEAF OOLONG.
Genuine.

15.
PEKOE OOLONG.
Genuine.

16.
FINE HYSON-FLAVOURED OOLONG.
Genuine.

17.
FLOWERY PEKOE.
Genuine.

18.
FINEST FLOWERY PEKOE.
Genuine.

19.
ASSAM PEKOE.
Genuine.

20.
FINEST ASSAM PEKOE.
Genuine.

21.
FINEST JAVA FLOWERY PEKOE.
Genuine.

22.
FINEST FLOWERY PEKOE.
Genuine.

23.
COMMON SCENTED ORANGE PEKOE.

Adulterated—Leaves faced, after rolling, with *black-lead*, and bloomed with powdered *mica*, or *some other analogous irridescent powder*.

The leaves are straight, thin, wiry, and much twisted, with a black and somewhat shining surface. When carefully viewed in the dry state through a lens, and with a strong light, minute irridescent particles may commonly be observed; placed in cold water, the leaves gradually unfold, and present a dark appearance in those parts which formed the surfaces when dry; a thin section of one of these dark surfaces, viewed under the microscope, appears studded with numerous minute and perfectly black particles, which are those of plumbago, or black-lead. These results may be obtained on a larger scale, but not more satisfactorily, by agitating, for a few minutes, a drachm or so of the tea, in a cylindrical glass, with distilled water; this removes a part of the coating, which, after a time, falls as a blackish sediment, in which, with the microscope, both the black-lead and the talc-like particles may be detected; these last, when the sediment is allowed to dry on a slip of glass, exhibiting their characteristic lustre.

24.
COMMON SCENTED ORANGE PEKOE.

Adulterated—Leaves faced with the same substances as those discovered in the previous sample.

25.
FINEST SCENTED ORANGE PEKOE.

Adulterated—Leaves blacker, more polished, thinner, more wiry than those of sample 23, and glazed with the same substances.

26.

FINEST SCENTED ORANGE PEKOE.

Adulterated — In the same manner as sample 23.

27.

FINEST SCENTED ORANGE PEKOE.

Adulterated — In the same manner as sample 23.

28.

GOOD CAPER.

Genuine.

29.

FINE SCENTED CAPER, OR CHULAN.

Adulterated — Leaves *broken*, and formed, by means of a *solution* of *starch*, into *little masses or nodules;* the surfaces of these are bright, and shine with a blackish or bronze-like lustre. Examined in the same manner as the scented orange pekoe (sample 23.), they are discovered to be faced with the same substances, — namely *black-lead* and *the irridescent powder*.

30.

MEDIUM SCENTED CAPER, OR CHULAN.

Adulterated — Leaves *more highly faced* than in the last sample, and with the same substances; shining, in fact, with a strong metallic lustre.

31.

COMMONEST SCENTED CAPER.

Adulterated — Highly, but *more coarsely glazed* with the same materials as the previous samples of scented caper or chulan; many of the mica-like particles being so large as to be plainly visible to the unaided sight, shining like minute spangles. In addition, there were present in this sample little masses (to be described hereafter) formed of *tea-dust*, as well as fragments of *rice* or *paddy* and other *husks*, glazed in the same manner as the tea-leaves themselves.

Of this highly adulterated article 220 boxes were sold on the 13th of June last, at public sale, for 11*d*. per lb.

32.

SCENTED CAPER, OR CHULAN.

Adulterated — Faced in the same manner as the previous samples, and *largely admixed* with *the masses or nodules* prepared from *tea-dust*.

33.

FINEST SCENTED CHULAN,

Sometimes called

BLACK GUNPOWDER.

Adulterated — Leaves much broken, and formed into *smaller fragments than those of ordinary caper-teas*, but coated with the same substances.

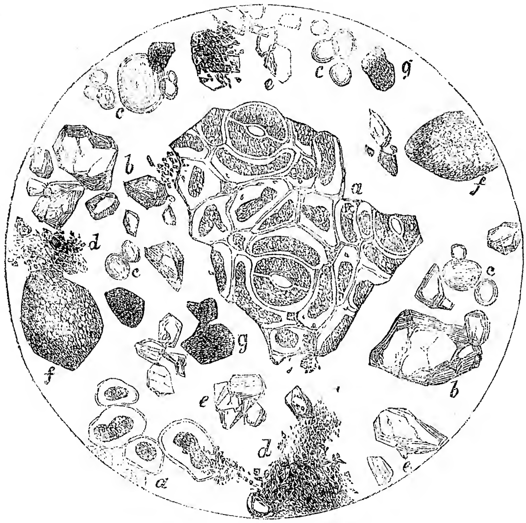
34.

SCENTED CAPER.

(Overland Samples.)

Adulterated — This article consists of *little rounded particles of various sizes*, of a brownish-black and dull-metallic hue; moistened with water, these readily crumble down into minute fragments. On careful examination with the microscope, the following substances were detected in each mass: numerous minute and *dust-like fragments of the tea-leaf;* altered *starch-corpuscles*, probably those of *rice;* with much *starch*, in a *granular* and *amorphous form;* a considerable quantity of *sand or grit; irridescent* and *mica-like particles; black granular matter; yellow vegetable cells;* and *granules* or *fragments*, reflecting a *bluish* or *greenish-blue colour*. The irridescent particles are evidently those of the powder to which we have so often referred; the black granular matter is *plumbago;* the yellow vegetable cells are those of *turmeric powder;* and the blue granules or fragments consist of *indigo*. The masses consist, therefore, of tea-dust and sand, made up into nodules with starch, and faced with black-lead, the mica-like powder, and a very small quantity of turmeric and indigo. The general appearance presented by the little lumps of which this article is formed, is not unlike that of the dung of silkworms, with which, as tea (it has been stated), the Chinese occasionally favour us.

Fig. 97.



IMITATION CAPER OR GUNPOWDER.

a a, fragments of the *tea-leaf* or *tea-dust; b b*, particles of *sand; c c, starch-corpuscles; d d*, groups of granules of *black-lead; e e*, particles of *mica-like substance; f f*, cells of *turmeric; g g*, fragments of *indigo*. Magnified 350 diameters.

The sample upon which the above observations were made was one of many forwarded to this country. in the hope of procuring purchasers, these samples being portions of articles made in China in large quantities, in imitation of black and green teas of different qualities. They were offered for sale in this country at a very low price.

The nature of this article, we have been given to understand, is known to the excise authorities, the large quantity of tea lately destroyed by them was, we believe, of this character.

As we have seen, it is frequently mixed with caper or chulan and black gunpowder teas, and in this state, it is clear, eludes the vigilance of the excise, although the fraud is one not difficult of detection.

35.

SCENTED CAPER.

(Overland Sample.)

Adulterated—This article is *essentially the same as the foregoing*. Greater care has evidently been bestowed on its preparation, it being manufactured to represent black gunpowder tea of higher quality. The lumps are much less broken, and more highly faced.

In a recent number of the *Merchant*, we notice the following observations:—

"In the *Friend of China*, we read, under the head of 'Scented Caper,' 'about 7000 ten-catty boxes have been taken at taels 14½ to 16 for spurious kinds, and taels 16½ to 22 for common to fine;' and, referring to Canton Greens, they advise purchases of 500 half and 1200 ten-catty boxes, at 13 to 16 taels for spurious, and 17 to 22 taels for common to good. We regret to find that this mischievous and nefarious trade is not yet abandoned."

The spurious Caper and Canton Greens, sometimes called "*lie tea*," referred to in the above paragraph, are probably identical in composition with Samples 34 and 35.

The conclusions to be deduced from the above analyses will be given hereafter.

Results of the Microscopical and Chemical Examination of Samples of Spurious Tea of British Fabrication.

Seized by the Excise, July, 1851.

1*st Sample.*— *Characters.*—Tea-leaves broken, misshapen, agglutinated, glossy, and, when slightly moistened, sticky to the touch; infusion only very slightly coloured.

From these characters it is evident, independent of analysis, that the above sample consists of *exhausted tea-leaves re-dried and adulterated with gum.* Chemical analysis showed an excess of gum, but a great deficiency of tannin and colouring matter. As tea the article is completely worthless.

2*nd Sample.* — *Characters.* — Many of the tea-leaves in this sample present their natural forms and appearances, being twisted and without gloss; others of the leaves, however, are more or less broken or misshapen, with shining surfaces; infusion coloured, but not highly so.

The examination of this sample with the eye alone is sufficient to show that it consists of *exhausted tea-leaves made up with gum, and mixed with a proportion of genuine tea.*

3*rd Sample.* — *Characters.* — Tea-leaves much broken, but few twisted, many occurring as rounded or irregular masses, of a dark colour, with but little gloss; examined with a lens and the microscope, many of the leaves are ascertained to be faced with *black lead* and the *mica-like powder;* infusion coloured, but not deeply so, and containing *sulphate of iron.*

For the above sample we are indebted to Mr. Bland. It was labelled, "Re-dried, damaged, and spent leaves."

The following samples have been furnished us by Mr. Phillips. They were seized by the Excise on the premises of John Stevens, of Liverpool, on the 18th of December, 1850. The penalty inflicted in this case was 250*l.*

4*th Sample.* — This sample consisted of a mixture of the entire dried leaves of the *sycamore* and *horse-chestnut.* From their condition it is evident that the leaves had been collected in the green state.

5*th Sample.* — The leaves in this sample were so much broken down that it was scarcely possible to identify them without the aid of the microscope.

6*th Sample.* — This sample consisted of large lumps of irregular shape, formed of the broken leaves, including even the stalks, agglutinated with some dark-coloured gummy substance. By tasting a small fragment of one of these masses, as well as by making an infusion with it, the fact was at once ascertained that the substance in question was *catechu.*

7*th Sample.* — This sample consisted of a large lump of the *catechu* used in making up the leaves, and which was seized on the premises in the occupation of John Stevens, in which the manufacture of spurious tea was carried on.

8*th Sample.* — The leaves, agglutinated with catechu, were in this sample broken down into small pieces, which, however, *were destitute of lustre.*

9*th Sample.* — In this case the fragments were still more reduced, corresponding in size with those of gunpowder-tea, and in place of being dull and lustreless, as in the previous sample, they appeared bright and *glossy*, most probably from having received a coating of *gum;* the article was now ready either for mixing, in the form of dust, with genuine black tea, or for being "faced" and coloured, in imitation of green gunpowder tea.

The identification of the leaves in this case, without the aid of the microscope, was completely impossible: with that instrument their determination was effected in the most satisfactory manner.

For this sample we are indebted to Dr. Muspratt, of Liverpool.

To the above analyses we now add the following account, extracted from the *Times* of May 27th, 1851: —

"Clerkenwell.—Edward South, and Louisa, his wife, were placed at the bar, before Mr. Combe, charged by Mr. Inspector Brennan, of the G division, with being concerned in the manufacture of spurious tea.

"It appeared from the statement of the inspector, that in consequence of information that the prisoners and others were in the habit of carrying on an extensive traffic in manufacturing spurious tea on the premises situate at 27½. Clerkenwell-close, Clerkenwell-green, on Saturday evening, at about seven o'clock, the witness, in company with Sergeant Cole, proceeded to the house, where they found the prisoners in an apartment, busily engaged in the manufacture of spurious tea. There was an extensive furnace, before which was suspended an iron pan, containing sloe-leaves, and tea-leaves which they were in the practice of purchasing from coffee-shop keepers, after being used. On searching the place, they found an immense quantity of used tea, bay-leaves, and every description of spurious ingredients, for the purpose of manufacturing illicit tea, and they were mixed with solution of gum and a quantity of copperas. The heat of the place was so excessive, that the officers could scarcely remain in it, but the prisoners did not seem at all oppressed by it. The woman was employed in stirring about the bay-leaves and other compositions with the solution of gum in the pan; and in one part of the room there was a large quantity of spurious stuff, the exact imitation of genuine tea. In a back room they found nearly 100 lbs. weight of re-dried tea-leaves, bay-leaves, and sloe-leaves, all spread on the floor drying. The inspector told the prisoners that he was a police-officer, and also an inland revenue officer, and he must take them into custody, together with the whole of the ingredients and apparatus for making the spurious tea. Mr. Brennan added that the prisoners had pursued their nefarious traffic most extensively, and were in the habit of dealing largely with grocers, chandlers, and others, especially in the country. The various articles produced, prior to their completion, had the most disgusting appearance, and were evidently prejudicial to health. He had communicated with the Excise authorities, who considered it a case of such importance to the public, that they requested the withdrawal of the present charge, in order that they might prosecute the prisoners under the Excise laws; being determined, if possible, to put a stop to such abominable proceedings.

"Mr. Brennan was complimented by the court for his exertions.

"Proceedings will be immediately instituted against the prisoners by the authorities of the Excise."

Results of the Examination of numerous Samples of Black Tea purchased at the Establishments of different Tea-Dealers and Grocers resident in the Metropolis.

1*st Sample.* — Purchased of Mr. Dolamore, Westminster-bridge-road.
Genuine.

2*nd Sample.* — Purchased of Mr. Farmar, Westminster-road.
Adulterated — Being mixed with a small quantity of *Scented Caper*, or *Chulan*, which, like other samples of this tea, is faced with *black-lead* and a *mica-like powder*. There were also detected in this tea a few of the little masses made up with *tea-dust*, *starch*, &c., already described, and with which the Caper had no doubt been adulterated by the Chinese.

3*rd Sample.* — Purchased of Mr. Goodman, Westminster-road.
Genuine.

4*th Sample.* — Purchased of Mr. Hopson, New-cut, Lambeth.
Genuine.

5*th Sample.* — Purchased of Mr. Stevenson, 159. Whitecross-street.
Genuine.

6*th Sample.* — Purchased of Mr. Roberts, Barbican.
Genuine.

7*th Sample.* — Purchased of Mr. Hart, 21. Holborn-hill.
Genuine.

8*th Sample.* — Purchased of Mr. Belchem, Drury-lane.
Genuine.

9*th Sample.* — Purchased of Mr. Stanbury, 2. Portman-place, Edgware-road.
Genuine, but containing a large quantity of tea-dust.

10*th Sample.* — Purchased of Bodley & Co., 5. Portman-place, Edgware-road.
Genuine.

11*th Sample.* — Purchased of Salmon & Goatley, 19. Edgware-road.
Genuine.

12th Sample.—Purchased of Mr. Andrews, 57. Tottenham-court-road.
Genuine.

13th Sample.—Purchased of Strugnell & Co., 109. Edgware-road.
Genuine.

14th Sample.—Purchased of Mr. Stubbs, 140. Edgware-road.
Genuine.

15th Sample.—Purchased of Martin & Co., 147. Edgware-road.
Genuine.

16th Sample.—Purchased of Mr. Hall, 135. Edgware-road.
Genuine.

17th Sample.—Purchased of Mr. Horne, 124. Edgware-road.
Genuine.

18th Sample.—Purchased of Hawthorn & Co., 38. Tottenham-court-road.
Genuine.

19th Sample.—Purchased of Mr. Back, 123. Tottenham-court-road.
Genuine.

20th Sample.—Purchased of Mr. Clark, 135. Tottenham-court-road.
Genuine, containing a good deal of tea-dust.

21st Sample.—Purchased of Mr. Belcher, Holles-street, Oxford-street.
Adulterated.—This sample is one of *scented Orange Pekoe*, and is adulterated and faced in the manner usually practised by the Chinese with this description of tea—viz., with *black-lead*, and a powder resembling *mica*.

22nd Sample.—Purchased of Mr. Staniforth, Oxford-street.
Adulterated.—This also is a sample of *scented Pekoe.*

23rd Sample.—Purchased of Sydney, Manduell, & Wells, Ludgate-hill.
Adulterated.—This is a sample of *scented Caper or Chulan*, and is faced in the manner usually practised by the Chinese with this particular kind of tea—that is, with *black lead* and a *mica-like powder*.

24th Sample.—Purchased of Sparrow & Co , Oxford-street.
Adulterated.—This also is a sample of *scented Caper*, glazed in the usual manner.

From a consideration of the First of the Three Tables of Analyses above given, it appears—

1st. That *not one* of the *Thirty-five* samples of black tea, as imported into this country, *contained any other leaf than that of the tea-plant.*

2nd. That out of the above number of samples, *Twenty-three* were genuine, and *twelve* adulterated. The genuine teas were the *Congous* and *Souchongs*, &c., and the adulterated teas, samples of *Scented Pekoe* and *Scented Caper, Chulan or black gunpowder*, as well as *imitations of these made from tea-dust.*

3rd. That the adulterations detected consisted in facing, so as to improve the appearance of the teas, the surfaces of the leaves with *black-lead*, *an irridescent powder resembling mica*, *indigo*, and *turmeric*, and in the manufacture of imitation tea out of *tea-dust*, *sand*, *&c.*

The Second table affords conclusive evidence—

1st. That the fabrication of spurious black tea is extensively carried on at the present time in this metropolis, and in other towns of the kingdom.

2nd. That two processes of fabrication are adopted. In the first, *the exhausted tea-leaves* are made up with *gum*, and re-dried; *black lead*, and the *mica-like powder*, *rose-pink*, and *carbonate of lime* being sometimes added to bloom or face the leaves, as well as *sulphate of iron* to darken the colour of the leaves, and to give astringency. In the second, *leaves other than those of tea* (the kind matters but little) are used. These, after being dried, are broken down, mixed with gum *catechu*, and made into a paste; the leaves are then re-dried, and further broken down, and sometimes coated with *gum.* The spurious tea made from exhausted leaves is seldom sold alone, but is used either for mixing with genuine black, or is converted into green tea in the manner to be described hereafter; while that made from British leaves and catechu is either mixed with black tea in the form of dust, or else is faced and bloomed, until it is made to resemble green tea.

From the Third table it appears,—

1st. That out of the *twenty-four* samples of black tea purchased of tea-dealers and grocers resident in the metropolis, *Twenty* were *genuine*, and *Four adulterated;* the former being *Congous* and *Souchongs*, and the latter samples of *Scented Pekoe* and *Scented Caper*.

In reference to the four adulterated samples of tea, it is right to state, that not the slightest blame is attached to the dealers from whom they were purchased, they being in all probability wholly unaware of the fact of these particular descriptions of tea being adulterated or faced in the manner described. The samples were introduced, in order to show that these teas do really reach the consumer in an adulterated condition.

It thus appears, that while the great bulk of the black tea used in this country —viz., Congou and Souchong — as delivered to the consumer, is in a genuine state, the scented teas — viz., the Pekoes and Capers—are invariably adulterated.

Lastly, that from the extensive fabrication of spurious black tea in this country, it is necessary that the purchaser should be constantly on his guard.

GREEN TEA, AND ITS ADULTERATIONS.

According to most writers there is but one species of tea-plant from which the whole of the numerous varieties of tea, both black and green, are obtained, the differences in colour, quality, &c., resulting from soil, climate, age of the leaves, and mode of preparation.

We have already pointed out, in a very brief manner, the principal differences in the cultivation and preparation of black and green teas.

The plants from which black teas are prepared are grown chiefly on the slopes of hills and ledges of mountains: the leaves are obtained in three, and, in some cases, even four gatherings, those of medium size and age being chiefly used for the great bulk of the black tea—viz., the congous and souchongs: they are dried either under covered sheds, open at the sides, which is the best method, or else by exposure to the sun. This process is a somewhat lengthened one, and during it, a degree of fermentation is set up, which is intimately associated with the colour, scent, and flavour of the leaves. Lastly, the leaves are subjected to a double process of roasting; first in a shallow iron pan, termed a *kuo*, an operation which is repeated two or three times, as may be necessary; and second, in sieves called *poey longs*, over a bright charcoal fire.

The shrubs which furnish the leaves from which green tea is prepared are cultivated in manured or garden soils; the leaves are greener, more tender, and juicy, and two gatherings of them only are made: "the first begins between the 20th of April and the 5th of May, and lasts for about ten or fifteen days; and the second at the summer solstice." After gathering, the leaves should be dried and roasted as soon as possible, in fact the same day, that is, before the slightest fermentation has had time to set in, all exposure to the air being unnecessary, and to the sun injurious. During the roasting, which is repeated once or twice in the *kuo* only, the second method — viz., that in the *poey long* — not being practised, the leaves are at the same time fanned, to hasten the drying, by dissipating the moisture which rises during the operation.

Such is a general statement of the cultivation and preparation of black and green teas. The same distinctions and care are not always, however, observed; frequently the same shrubs, and even the same leaves, are made to furnish both black and green teas of different qualities.

The development of the characteristic colour of the leaves of green tea is stated to take place during the third roasting in the *kuo*, the leaves at the end of the second roasting being of "a dark olive colour, almost black."

"In the third roasting," says Mr. Ball, "which is, in fact, the final drying, the heat of the fire was again diminished, and reduced to the degree which the hand can bear for some seconds without much inconvenience; the quantity put into the *kuo* was greatly increased, and the time of roasting regulated by means of the instrument denominated a *che kiang*. The fanning and the mode of roasting were the same as in the final part of the second roasting. It was now curious to observe the change of colour which gradually took place in the leaves for it was in this roasting that they began to assume that bluish tint, resembling the bloom on fruit, which distinguishes this tea, and renders its appearance so agreeable.

Thus it is obvious that the peculiar colour of green tea does not properly arise from the admixture of colouring matter with the leaves, but naturally out of the process of manipulation." *

Mr. Jacobson writes,—

"Now the colour becomes greener and brighter; but, properly speaking, the infused leaf only is green, the dry leaf is bluish. As the drying progresses, the leaves assume a light blue tinge, resembling the bloom of grapes." †

The principal varieties of green tea are Twankay, an inferior description, Hyson, Young Hyson, Hyson Skin, Gunpowder, and Imperial; all these, except the Twankay, are obtained from unsorted Hyson, or Mao Cha, in the manner described by Mr. Ball and Tien Hing.

"In this state (that is, after the third roasting, and the production of the requisite colour)," continues Mr. Ball, "the tea is usually packed in chests in the tea country, and called Mao Cha, from its being unsorted. The Ching Cha is the Hyson tea, after the Hyson Skin, Young Hyson, and Gunpowder have been separated from it. Both kinds are sold in the tea country, though it is commonly sold by the farmers and peasantry in its gross or unsorted state of Mao Cha; and from the samples of this tea which I have seen at Canton, I imagine that many Hysons are sold to foreigners in this state, without any further sifting or separation."

"In about a fortnight," Tien Hing observes, "every farm has completed its harvest, and sends its tea to market; at the same time the numerous factors attend the different villages to make their purchases. There are all the various kinds of tea sold — the Mao Cha, the Ching Cha, the picked, the unpicked, the garden, and the hill tea, and the different kinds of Singlo tea; so that it requires a complete acquaintance with the leaf and colour to be enabled to make a judicious selection. When the factors have concluded their purchases, they carry their tea home, where it is sifted, winnowed, and assorted into different kinds suited to the foreign markets.

"The large closely-twisted leaves, of nearly equal size and brightness of colour, form the Hyson tea.

"The large, open, or coarsely-twisted leaves, and also the large, round, knobby leaves, of nearly equal colour, form the superior Hyson Skin teas; and the thin twisted leaves, of good colour, with the yellow and broken leaves, the middling kinds.

"The small round, closely-curled leaves, which are bright in colour, form the round Gunpowder; the still smaller and more closely-curled leaves, the Chè Ma, the hemp-seed, or small imperial Gunpowder.

"The broken leaves, which are very thin and small, and of a wiry nature, form the U Chien, or Young Hyson. The fine dust, and part of a kind of chaffy dust, is sold in the tea country; also at King-te-ching, the celebrated town for the manufacture of porcelain, and other places. The remainder of the dust is mixed with common Hyson Skin."

Twankay tea is grown in the province of Kiang Nan; its manipulation does not differ essentially from that of Hyson tea, but is performed with less care.

Tien Hing ‡ gives the following account of its preparation:

"The Senglo tea is grown in all parts of Kiang Nan, but Hoang Shan and Tuon Ky produce the best. The leaves begin to bud every year, about the 5th of April (Tsing Ming), and are gathered about the 20th of April (Ko Yu). It is gathered by whole branches at a time, and the leaves and stalks are afterwards stripped off rudely with the hands. It is then roasted in a *kuo*, and rolled indifferently with the hands or feet. It is gathered and roasted every day, and sold as soon as made. The factors who purchase it carry it home, and roast it again two or three hours, when it is sifted (to take away the dust) and packed in canisters. Some of the factors use charcoal, others wood; and there are some petty dealers, who do not roast it immediately, but pile it up in their houses, and afterwards roast and pack it."

* Ball on the Cultivation and Manufacture of Tea, p. 220. † Handbook, p. 456.
‡ Ball, loc. cit. p. 236.

ADULTERATION OF GREEN TEA.

Although, as appears from the evidence quoted, there is good reason for believing that there really is such a thing as a genuine *green* tea, yet there are also conclusive facts to show that the green colour is very frequently imparted by artificial means.

Before adducing any observations of our own, we will cite the remarks and statements made by various writers on this point.

In Dr. Horsfield's translation of a Dutch work on the subject of the cultivation of tea in Java, the following dialogue occurs:—

" *Visitor.*—Is it indeed the case that tea is so much adulterated in *China?*

" *Superintendent.*—Unquestionably, but not in the interior provinces, for there exist rigid laws against the adulteration of tea; and all teas, as they come out of the plantations, are examined on the part of the government, to determine whether they are genuine; but in Canton, which is the emporium of teas, and especially at Honân, many sorts, indeed most teas, are greatly adulterated, and that with ingredients injurious to health, especially if too much of these ingredients be added. This is especially the case with the *green* tea, in order to improve the colour, and in this manner to add to the value of the teas in the eyes of the common consumers.

" *Visitor.*—Are these ingredients known?

" *Superintendent.*—Most of them are certainly known; they have been communicated to government (the Dutch government,) while at the same time the privilege has been requested that they might not be employed here; and although this occasions loss, the request has been granted, and it has been ordered by government, that not the least admixture should take place, either to improve the colour or taste of the tea, even in such cases where this might be desirable." *

Dr. Royle writes †, " The Chinese in the neighbourhood of Canton, are able to prepare a tea which can be coloured and made up to imitate various qualities of green tea, and large quantities are thus yearly made up."

" Young Hyson," states Mr. Davis ‡, " until spoiled by the large demand of the Americans, was a delicate genuine leaf, and as it could not be fairly produced in any large quantities, the call for it on the part of the Americans was answered by cutting up and sifting *other* green teas through sieves of a certain size, and as the Company's inspectors detected the imposture, it formed no portion of their London importation. But the abuse became still worse of late, for the coarsest *black* tea-leaves have been cut up, and then *coloured* with a preparation resembling the hue of green teas."

" But this was nothing," continues Mr. Davis, " in comparison with the effrontery which the Chinese displayed in carrying on an extensive manufacture of *green teas* from *damaged black leaves*, at a village or suburb called Honân.

" The remission of the tea-duties in the United States occasioned, in the years 1832 and 1833, a demand for green teas at Canton, which could not be supplied by arrivals from the provinces. The Americans, however, were obliged to sail with cargoes of green teas within the favourable season; they were determined to have the teas, and the Chinese were determined that they should be supplied. Certain rumours being afloat concerning the manufacture of green tea from old black leaves, the writer of this became curious to ascertain the truth, and with some difficulty persuaded a Hong merchant to conduct him, accompanied by one of the inspectors, to the place where the operations were carried on. Entering one of these laboratories of fictitious Hyson, the parties were witnesses to a strange scene. The damaged black tea-leaves, after being dried, were transferred to a cast-iron pan, placed over a furnace, and stirred rapidly with the hand, a small quantity of turmeric, in powder, having been previously introduced. This gives the leaves a yellowish or orange tinge, but they were still to be made green. For this purpose some lumps of fine blue were produced, together with a substance in powder, which from the names given to them by workmen, as well as their appearance, were known at once to be *Prussian blue* and gypsum. These were triturated finely together with a

* Essay on the Cultivation and Manufacture of Tea in Java. Translated from the Dutch.
† Tea, Medicinal and Dietetical.—*Penny Cyclopædia.* ‡ Davis' Chinese, vol. ii. p. 464.

small pestle, in such proportions as reduced the dark colour of the blue to a light shade; and a quantity equal to a tea-spoonful of the powder being added to the yellowish leaves, these were stirred as before over the fire, until the tea had taken the fine bloom colour of Hyson, with very much the *same scent*. To prevent all possibility of error regarding the substances employed, samples of them were carried away from the place. The Chinese seemed quite conscious of the real character of the occupation in which they were engaged; for on attempting to enter several other places where the same process was going on, the doors were speedily closed upon the party; indeed, had it not been for the influence of the Hongist who conducted them, there would have been little chance of seeing as much as they did."

Mr. Bruce states, that " in the last operation of colouring the green teas, a mixture of sulphate of lime and indigo, very finely pulverised, and sifted through fine muslin, in the proportion of three of the former to one of the latter, is added: to a pan of tea, containing seven pounds, about half a tea-spoonful of this mixture is put, and rubbed and rolled along with the tea in the pan for about an hour. The above mixture is merely to give it a uniform colour and appearance. The indigo gives it the colour, and the sulphate of lime fixes it. The Chinese call the former *youngtin;* the latter, *acco*." *

But valuable and conclusive evidence, in relation to the artificial colouring of green tea, was obtained by Mr. Warrington, from whose paper, communicated to the Chemical Society, in 1844, we shall now make several extracts.

" In examining lately some samples of tea which had been seized from their being supposed to be spurious, my attention was arrested by the varied tints which the sample of green tea exhibited, extending from a dull olive to a bright greenish-blue colour. On submitting this to the scrutinising test of examination by the microscope with a magnifying power of one hundred times linear, the object being illuminated by reflected light, the cause of this variation of colour was immediately rendered apparent, for it was found that the curled leaves were entirely covered with a white powder, having in places a slightly glistening aspect, and these were interspersed with small granules of a bright blue colour, and others of an orange tint; in the folded and consequently more protected parts of the curled leaves these were more distinctly visible. By shaking the whole of the sample mechanically for a short time, a quantity of powder was detached, and from this a number of the blue particles were picked out under a magnifying glass, by means of the moistened point of a camel's-hair pencil. On being crushed in water between two plates of glass, they presented, when viewed by transmitted light, a bright blue streak. This change in the method of illuminating the object was necessary for the purpose of seeing the action of the following tests. A minute drop of a solution of caustic potash was introduced by capillary action between the glass plates, and the blue tint was immediately converted to a dark bright brown, and the original blue colour again restored by the introduction of a little dilute sulphuric acid. It was therefore evident that these particles consisted of the ferrocyanide of iron, or Prussian blue. The orange granules on examination proved to be some vegetable colouring substance.

" To ascertain if possible the nature of the white powder observed in this sample, I separated some of the dust, and heated it to redness, with free exposure to the air; the whole of the vegetable matter and Prussian blue were thus destroyed, and a white powder with a shade of brown was obtained. This dissolved by boiling in dilute hydrochloric acid, and when tested with solution of chloride of barium, gave indications of sulphuric acid; it was then evaporated to dryness, and again acted on by very dilute hydrochloric acid; a trace of silica remained undissolved: solution of ammonia being added, threw down a little alumina and oxide of iron, and the ammoniacal solution treated with oxalic acid gave a precipitate of oxalate of lime. A second portion of the powder, after calcination, was boiled for some time in distilled water, and yielded a solution containing sulphate of lime. This latter substance, therefore, and some other substance containing silica, alumina, and perhaps lime formed the white powder observed. This substance I believe to be kaolin or powdered agalmatolite, the

* Report on the Manufacture of Tea, and on the Extent and Produce of the Tea Plantations in Assam. By C. A. Bruce, Superintendant of Tea Culture. Presented to the Tea Committee, August, 1839.

figure stone of the Chinese; I should venture this conjecture, not only from the ingredients found, but from the gloss which the rubbed parts of the curled leaves always assume, and which these materials would be well fitted to produce."

Mr. Warrington then proceeds to state the results derived from the examination of several samples of green tea, as imported, and the whole of which he found to be artificially coloured. In reference to unglazed teas the following observations occur:—

"On detailing what I had thus found to the friend who had favoured me with the preceding samples, he inquired if I had examined any *unglazed teas*. This appellation immediately arrested my attention, and I requested to inspect some of them, and found that they possessed externally a totally different aspect; indeed, as far as their colour was concerned, not to be like green teas. They were of a yellow-brown tint, without a shade of green or blue, but rather tending on the rubbed part to a blackish hue. I afterwards received two samples of unglazed teas specified as of a very fine quality, accompanied by two others of the ordinary, or as they were called, in contradistinction, glazed varieties, also of a very superior quality. These were, therefore, immediately submitted to examination. No. 6. Unglazed Gunpowder: It presented the same colour under the microscope as when viewed by the unassisted eye; was filamentous, and covered with a white powder, inclining to a brown tint, but no shade of blue was visible. No. 7. Unglazed Hyson: The same as No. 6. No. 8. Gunpowder: Glazed, filamentous, covered with a powder of a very pale blue, and the blue granules being but rarely seen. No. 9. Hyson: The same as No. 8."

Mr. Warrington thus sums up the conclusions to be derived from his investigations:—

"It appears, therefore, from these examinations, that all the green teas that are imported into this country are faced, or covered superficially, with a powder consisting of either Prussian blue and sulphate of lime or gypsum, as in the majority of samples examined, with occasionally a yellow or orange-coloured vegetable substance; or of sulphate of lime, previously stained with Prussian blue, as in Nos. 8 and 9, and one of those first investigated; or of Prussian blue, the orange-coloured substance, with sulphate of lime, and a material supposed to be kaolin, as in the original sample; or of sulphate of lime alone, as in the unglazed varieties.

"It is a curious question, what the object for the employment of this facing can be? Is it simply added as an absorbent of the last portion of moisture, which cannot be entirely dissipated in the process of drying? or whether, is it only, as I believe, to give that peculiar bloom and colour so characteristic of the varieties of green tea, and which is so generally looked for by the consumer, that the want of the green colour, as in the unglazed variety, I am informed, affects the selling prices most materially? This surely can only arise from the want of the above facts being generally known, as it would be ridiculous to imagine that a painted and adulterated article—for such it must really be considered—should maintain a preference over a more genuine one."

In Mr. Ball's valuable work, already so frequently quoted, we meet with the following observations relating to the artificial or factitious colouring of certain descriptions of green tea:—

"The latter—viz., The Singlo Hysons and 'Superior Twankay,' have frequently a glazed appearance, as also the Singlo Gunpowders, which I imagine may formerly have arisen more from the quality of the leaf than from any factitious means employed to produce the colour. Still in some cases a small quantity of colouring matter may have been used. It has also been shown that the tea made from the Honân leaves had a glazed appearance. It nevertheless is true, that when the leaf is deficient in the requisite colour, the Chinese do not hesitate to employ colouring matter to improve it.

"Again, so far as the characteristic colour of green tea is concerned, the mode of producing it has been explained and established. If factitious means are now generally or almost universally adopted to imitate or increase the effect of the natural colour, it may be considered as a great and novel abuse, and ought to be discouraged by brokers and dealers. It is injurious to flavour. Whether the Chinese do employ colouring matter or not for the teas they use themselves, there can be no doubt that the bulk of the Hyson teas of the present day, and indeed all descriptions of green tea, are now glazed to a degree which would have insured their rejection by the East India Company." *

Tien Hing, described by Mr. Ball as a respectable tea merchant and factor, in his account of the method of making Twankay tea, writes,—

"In the seventh or eighth moon (August and September) each parcel is compared together, when such as correspond in quality and colour are formed into one pile, roasted three *che hiang*, the dust sifted, and the tea packed (hot) in chests for Canton. The leaves of the second gatherings have no juices, are light, thin, and of no substance; the infusion weak and tasteless, the colour red, and the infused leaves black. If very common and old colouring matter is then used, and the tea is kept in the †. The factitious colour is produced by a mixture of Ma Ky Hoey ‡, Tien Hoa (indigo), and She Kao powder (calcined foliated gypsum). The smallest quantity put into the *kuo* at one time is one or two teaspoonfuls, and the largest three or four. The colour then changes to a light blue. The fire must be made of charcoal, and much attention paid to the roasting. Now, if the chests be not in readiness, it is to be feared the tea may be mixed with false leaves, the smell thereby injured, and the tea rendered unhealthy. But I must refer you to abler men than myself for instruction on that point. I have no information on such practices."

Mr. Ball then goes on to state "that most other merchants or factors agree with the foregoing account of the Twankay teas, and particularly as to the circumstance of their being partly glazed or coloured by artificial means, and also that some chops are mixed with leaves that are not tea-leaves."

It is then clearly proved, by the above evidence, that many of the green teas imported into this country owe their colour to factitious means, and are, therefore, adulterated, and have been so for many years past. We shall hereafter give analyses of numerous samples of green tea, when we shall be able to estimate more exactly the extent and character of the adulterations practised.

In the article on black tea we described several substances, employed either for the purpose of facing and colouring the surface of the leaves or to impart astringency to the exhausted leaves.

The substances described were—

STARCH	BLACK LEAD
GUM	TALC
CATECHU	CHINA CLAY
SULPHATE OF IRON	SOAP-STONE
ROSE PINK	INDIGO
LOGWOOD	TURMERIC

In addition to the above, it has been ascertained that many other substances are employed, and these we will now notice.

The colours used in the facing of green tea are usually three: yellow, blue, and white. The yellow and blue colours, when mixed, form a green, and white is added, either to lessen the intensity of the former colours, or else to give polish to the surface of the leaves.

PRUSSIAN BLUE.

Prussian blue is a *ferrocyanide of iron*, and is the blue substance most frequently employed in the facing of spurious green tea.

It is distinguished from indigo by the iron which enters into its composition, and which may be detected by the ordinary tests, as well as by the non-effect of chlorine in bleaching it.

Under the microscope it may be recognised by the form and colour of the particles of which it consists, as also by the action of liquor potassæ and dilute sulphuric acid; the first turns the fragments of a reddish hue, and the latter restores the colour.

Although not absolutely poisonous, yet when introduced into the system, even in minute quantities, it is in some cases capable of exerting an injurious action.

* Loc. cit. p. 234.

† Here follows some obscure expression, which has an allusion to the mode practised by petty dealers, mentioned before.

‡ The name of a plant.

Mineral Green.

"When a salt of copper is precipitated by an alkaline carbonate, *a hydrated sub-carbonate* is produced, containing two equivalents of oxide of copper, and one equivalent of carbonic acid. It is a pale blue, bulky precipitate, which becomes denser and green when treated with boiling water. It is used as a pigment, and is known as *mineral green.* The beautiful native green *carbonate of copper*, *Malachite*, is of the same composition." (*Graham.*) It is a poisonous substance.

Verdigris.

Verdigris is a *sub-acetate of copper*, formed by placing plates of the metal in contact with the fermenting juice of the grape, or by wrapping them in cloths wetted with vinegar. It is of a highly poisonous nature.

Arsenite of Copper.

This substance also is highly poisonous.

Dutch Pink.

Although called *Dutch pink*, this substance is if a bright yellow colour; it consisis of a vegetable dye in combination with chalk or carbonate of lime. It is the yellow pigment most frequently used in this country in the facing of spurious green tea.

Chromate of Potash.

This salt is of a bright yellow colour; its properties are thus described in Pereira's "Materia Medica:"—

"The local action of chromate of potash is irritant and caustic; swallowed in large doses it acts as an irritant and caustic poison. In smaller does it occasions vomiting, and is used as an emetic instead of tartarized antimony, than which it less frequently purges. After its absorption it acts specifically on the mucous surfaces, (especially the conjunctiva and the bronchial and nasal mucous membranes, which it irritates, and even inflames, and whose secretions it augments,) and also on the nervous system, causing paralysis and convulsions. Dose, as an emetic, from two to four grains for adults, and from a grain to a grain and a half for children.

Bichromate of Potash.

This is of an orange-red colour. "Its topical action is that of an irritant and caustic. Its solution irritates the skin. In workmen who habitually employ it, it occasions an eruption of papulæ, which after a little time become pustular; and if the use of it be continued, the pustules degenerate into sloughs, and painful ulcers are in this way formed. Introduced into the stomach, or applied to wounds of animals, it causes vomiting, difficulty of respiration, paralysis, convulsions, and death. In the human subject several fatal cases of poisoning by it have occurred. Bichromate of potash has been used as an external agent only."—*Pereira.*

Chrome Yellow.

This substance is a *chromate of lead*, and although insoluble in water, yet when introduced into the stomach, is dissolved by the acids contained in that organ.

Chalk.

Chalk, or *carbonate of lime*, enters, as already stated, into the composition of Dutch pink; we have also met with it in one of the blue dyes used by the Chinese to colour spurious green tea.

Gypsum.

Gypsum, or *sulphate of lime*, as we have seen from some of the accounts previously quoted, is very commonly used by the Chinese in blooming the leaves.

Carbonate of Magnesia.

This substance has been occasionally used in this country for the same purpose as soap-stone, China clay, mica, &c., viz. to bloom the leaves.

Steatite, Soap-stone, or French Chalk.

Since the short notice and description which we gave of this substance appeared, the following observations relating to it have been brought under our notice. They were published in the "Household Words" under the title of "Death in the Tea-pot":—

"By the help of Mr. Slivers, we were enabled in a recent number to expose to an injured public some of the ingredients of metropolitan milk—'London Genuine particular.' A correspondent now makes a further revelation of how our tea-pots are defiled when it is innocently supposed that a pure beverage is in course of concoction.

"'A short time since,' he says, 'a friend of mine, a chemist in Manchester, was applied to for a quantity of French chalk, a species of talc, in fine powder; the party who purchased it used regularly several pounds a week. Not being an article of usual sale in such quantity, our friend became curious to know to what use it could be applied; on asking the wholesale dealer who supplied him, he stated his belief, that it was used in '*facing*' tea (the last process of converting black tea into green), and that within the last month or two, he had sold in Manchester upwards of a thousand pounds of it. Our friend the chemist then instituted a series of experiments, and the result proved that a great deal, if not all the *common* green tea, used in this country is coloured artificially. The very first experiment demonstrated fraud. The plan adopted was as follows:—A few spoonfuls of green tea at five shillings a pound, were placed on a small sieve, and held under a gentle stream of cold water flowing from a tap for the space of four or five minutes. The tea quickly changed its colour from green to a dull yellow, and upon drying with a very gentle heat gradually assumed the appearance of ordinary black tea. On making a minute microscopic examination of the colouring matter washed from the leaf, and which was caught in a vessel below, it appeared to be composed of three substances, particles of yellow, blue, and white. The blue was proved to be Prussian blue,—the yellow thought to be turmeric, and the white, French chalk. If the two former be mixed together in fine powder, they will give a green of any required shade. It is made to adhere to the tea-leaf by some adhesive matter, and then it is 'faced' by the French chalk, to give it the pearly appearance so much liked.

"'This simple experiment any one can perform. A gentleman assured me that a friend of his a short time since happened—though quite unintentionally on his part—to walk into a private room connected with the establishment of a wholesale tea-dealer, and there he saw the people actually at work converting the black tea into green; the proprietor soon discovered his presence in the room, and before him, in no measured terms, severely reprimanded the workmen for having permitted a stranger to enter.'"

Chinese Tea Dyes.

Through the kindness of Mr. Smith, of the Royal Botanic Gardens, Kew, we have received portions of three different colours or dyes—a yellow, blue, and white—just brought over to this country from China, and taken from a factory, in which the manufacture of spurious green tea was in actual progress.

The *yellow dye* was compounded in nearly equal proportions of both vegetable and mineral ingredients. The vegetable matter was ascertained by the microscope to be *turmeric;* while the earthy matter consisted of numerous glistening particles of *mica*, visible to the naked eye, but still better seen with a lens, as well as of a finely-powdered substance, of a yellow colour, and which, when viewed with an object-glass of a quarter-inch focus, presenting a broken, crystalline structure. This fine powder was probably also *micaceous*; the colour with which it was stained was vegetable, as shown by the circumstance that it was destroyed by chlorine, and was most likely derived from the turmeric by absorption.

The object of the admixture of the powdered mica with the turmeric was, no doubt, first, to lessen the intensity of the colour of that substance; and, second, to assist in the blooming of the leaves.

The *blue dye*, when spread out on a slip of glass, was seen either with the eye, or, better still, with a lens, to be made up of two substances, the one white, the other blue; the latter was insoluble in water; its colour was destroyed by chlorine: it presented characteristic appearances under the microscope, and consisted of *indigo*. The former was also insoluble in water, effervesced on the addition of an acid, as seen under a low object-glass, and answered to the tests for lime: it therefore consisted of *carbonate of lime*.

The chalk was evidently admixed with the indigo for the purpose of reducing its colour.

The *white powder* possessed a faint pink or rosy hue, and was *China clay* or *kaolin*, that is, decaying *granite*, the chemical composition of which has already been given; to the touch, the powder felt soft and slippy, and owing to the minuteness of the particles composing it, but very few fragments of mica could be detected in it, even when spread out on glass, and viewed through a lens. This substance was doubtless used to bloom or face the leaves after they had been coloured with the yellow and blue dyes.

On Spurious Green Tea of British Fabrication.

But the practice of converting black into spurious green tea by the addition of colouring matter, is not confined to the Chinese. In this country, for many years past, this practice has extensively prevailed, and persons have been detected from time to time who, in the perpetration of this fraud, have even outdone the Chinese themselves.

Thus, in some cases, parties have been discovered engaged in the manufacture of green tea out of used tea-leaves, both black and green, and in others they have been detected in making an imitation green tea of leaves other than those of the tea-plant.

Even so far back as the reign of George I., that is, shortly after the introduction of tea into this country, and while the quantity imported was still but small, it was found necessary to check, by legislative enactment, the adulteration to which tea at that early period was subject: thus, by 2nd Geo. I. cap. 30, sec. 4, it is declared,—"That the dealer in tea, or manufacturer or dyer thereof, who shall counterfeit or adulterate tea, or shall alter, fabricate, or manufacture it with *terra japonica*, or with any other drug or drugs whatsoever, or shall mix with tea any leaves other than leaves of tea, or other ingredients whatsoever, shall forfeit the sum of one hundred pounds."

"In 1778," writes Accum, "there was a printed circular signed by the headsman and secretary of a company of grocers in Norwich, stating that they had been shown a small quantity of green tea, *one fourth part of which was avowedly sloe-leaves*, yet so well manufactured as almost to prevent detection; and there is another counterfeit of Hyson tea, which is a strong deception: so much for the closeness of the imitation."*

In the year 1818, the *Times* and *Courier* report the prosecutions and convictions of numerous individuals detected in the manufacture of spurious tea, and which show the extent to which this fraud was at that time carried on in the metropolis and elsewhere.

One of these cases is thus reported in the *Times*, May 18th, 1818:—

"*The Attorney-General against Palmer.*—This was an action by the Attorney-General against the defendant Palmer, charging him with having in his possession a quantity of sloe-leaves, and white-thorn leaves, fabricated into an imitation of tea. Mr. Dauncey stated the case to the jury, and observed that the defendant, Mr. Palmer, was a grocer.

"It would appear that a regular manufactory was established in Goldstone-street. The parties by whom the manufactory was conducted, was a person of the name of Proctor, and another person named J. Malins. They engaged others to furnish them with leaves. The leaves, in order to be converted into an article resembling black tea, were first boiled, then baked upon an iron plate;

* A Treatise on the Adulterations of Food, 2nd edition, p. 216.

and when dry, rubbed with the hand to produce that curl which the genuine tea had: the colour, which was yet to be given to it, was produced by logwood. The green tea was manufactured in a manner more destructive to the constitution of those by whom it was drunk. The leaves being pressed and dried, were laid upon sheets of copper, where they received their colour from an article known by the name of Dutch pink. The article used in producing the appearance of the fine green bloom observable on the China tea, was, however, decidedly a deadly poison! He alluded to verdigris, which was added to complete the operation. This was the case he had to bring before the jury; and hence it would appear, that at the moment they were supposing they were drinking a pleasant and nutritious beverage, they were, in fact, in all probability, drinking the produce of the hedges round the metropolis, prepared for the purposes of deception in the most noxious manner.

"T. Jones deposed that he knew Proctor, and was employed by him at the latter end of April, 1817, to gather black and white thorn leaves. Sloe leaves were the black thorns. Witness also knew John Malins, the son of William Malins, a coffee-roaster; he did not at first know the purpose for which the leaves were gathered, but afterwards learnt they were to make imitation tea. Witness did not gather more than one hundred and a half weight of these leaves; but he employed another person of the name of Bagster to gather them. He had two-pence per pound for them. They were first boiled and the water squeezed from them in a press. They were afterwards placed on a slow fire upon sheets of copper to dry; while on the copper they were rubbed with the hand to curl them. At the time of boiling there was a little verdigris put into the water (this applied to green tea only). After the leaves were dried, they were sifted, to separate the thorns and stalks. More virdigris and some Dutch pink were then added. The verdigris gave the leaves that green bloom observable on genuine tea. The black tea went through a similar course as the green, except the application of Dutch pink: a little verdigris was put in the boiling, and to this was added a small quantity of logwood to dye it, and thus the manufacture was complete.

"John Bagster proved that he had been employed by Malins and Proctor to gather sloe and white thorn leaves; they were taken to Jones's house, and from thence to Malins's coffee-roasting premises. Witness received two-pence per pound for them; he saw the manufacturing going on, but did not know much about it. Witness saw the leaves on sheets of copper, in Goldstone-street.

"This was the case for the Crown. Verdict for the plaintiff 840*l*."

From the date of the above conviction up to the present year, discoveries of spurious tea manufactories have on many occasions been made, and seizures of the various articles used in the fabrication effected by the Excise authorities; to some of these we shall shortly refer.

Up to a certain point the process adopted in this country in the manufacture of artificial green tea is the same as that for black. If exhausted tea-leaves, either black or green, or a mixture of these, are used, they are made up with gum; if leaves other than those of tea are employed, they are broken up and prepared with catechu in the manner described under the head of black tea; it is in the colouring alone that the difference consists.

The colouring matter so disguises the character of the leaves—the tints of green tea, as imported, are so closely imitated—that the detection of this fraud is not easy. We have now in our possession samples of spurious green tea, which, by the eye alone, it would be impossible to discriminate with any certainty. One of these was kindly prepared for us by Mr. Phillips, in the following manner, in order to show how exact an imitation, with care and skill, might be made. "The tea itself," writes Mr. Phillips, "is black, and composed of exhausted leaves, similar to what you have a sample of; the colouring matter is indigo and Dutch pink; the bloom is French chalk. I steamed the exhausted leaves, and then added the colouring until a quantity sufficient to coat the surface of the leaves had been taken up, after which I added finely-powdered French chalk, and mixed the whole well together, and then sifted to get rid of the surplus powder."

Nevertheless, science is equal to the discovery of this as well as most of the other frauds practised on articles of food. It is not alone sufficient, however, to determine that the leaves are artificially coloured, for this colouring, as we have already seen, may have been the work of Chinese and not British fabricators. In the first place, the form of the dried leaves should be particularly noticed; if these want the characteristic twist — if they be broken and agglutinated into little masses of irregular shape — there will be reason to suspect that the tea is spurious. Having noticed these particulars, the leaves should then be washed for a minute or so in cold distilled water, and quickly re-dried, when, if they appear glossy, it is probable that they consist of exhausted tea-leaves made up with gum, a view which will be either dispelled or confirmed by chemical analysis, and by which the amount of gum and tannin must be determined. But the spurious green tea may consist of other leaves than those of tea, these being broken into pieces and made up with catechu. In this case the deception may be more readily detected; the fragments or particles of the tea will be still more irregular in size, and a close examination of them will show that they have not the character of leaves at all, but are heavy and solid, resembling some resinous substance broken up; moreover the catechu in them may be discovered, either by the taste or by soaking the fragments in cold water, when they will fall to pieces, disclosing minute pieces of the leaves used, and which may be identified with the microscope, the water at the same time acquiring a deep reddish-brown colour, and possessing the flavour of catechu.

The fabrication of spurious black and green tea is usually carried on in the same factory, at the same time; the latter, in consequence of the closeness of the imitation, being made in larger quantities than the former. For these worthless and in many cases pernicious, and even poisonous articles, we learn from Mr. Phillips that the prices given by the dealers is from 1*s.* 8*d.* to 2*s.* per lb. for the black, and from 1*s.* 10*d.* to 2*s.* 6*d.* for the green, the appearance of the article governing the price.

The following analyses of samples of spurious green tea seized by the Excise within the last few years, have been furnished us by Mr. Phillips: —

Seized in London, 24th August, 1843.

Green Tea.

Lignin	81·9
Gum	13·4
Colouring and Tannin	4·7
	100·0

Seized May 12th, 1843.

	A. Green Tea.	*B.* Green Tea.
Lignin	84·9	87·5
Gum	6·8	4·8
Tannin and colouring matter	1·1	0·6
Carbonate of lime	4·0	3·6
Carbonate of copper	3·2	3·5
	100·0	100·0

The leaves in these samples were black tea-leaves that had been exhausted, re-dried, and coloured to imitate green. The carbonate of lime was combined with a vegetable yellow dye, forming a substance analogous to Dutch pink. This was mixed with carbonate of copper, which produced a green colour, and with this poisonous matter the tea was coated.

Seized 15th May, 1843.

	A. Green Tea.	*B.* Green Tea.
Lignin	84·0	71·5
Gum	11·4	12·0
Tannin and colouring matter	0·8	14·6
Carbonate of lime, vegetable yellow dye, and Prussian blue	3·8	1·9
	100·0	100 0

A. was exhausted black and green tea-leaves, re-dried, and made up with gum, and coloured to represent green with Prussian blue and a yellow which was similar to Dutch pink. *B.* contained forty-four per cent. of *A.*, and fifty-six per cent. of an inferior genuine green tea.

Seized June 1st, 1843.

	A. Green Tea.	*B.* Green Tea.
Lignin	86·5	86 6
Gum	5·4	5·6
Tannin and colouring matter	0·9	0·8
Carbonate of lime, Prussian blue, and a vegetable yellow dye	7·2	7·0
	100·0	100·0

These samples were composed of exhaused black and green tea-leaves, made up with gum, Dutch pink, and Prussian blue, to represent green tea.

Seized June 20th, 1843.

	Green Tea.
Lignin	86·9
Gum	7·0
Tannin and colouring matter	0·6
Carbonate of lime, Prussian blue, and a vegetable yellow dye	5·5
	100·0

This sample consisted of exhausted black and green tea-leaves, re-dried, and adulterated with gum, Dutch pink, and Prussian blue, to represent green tea.

Seized in Manchester, June 19th, 1845.

This seizure comprised three samples of tea that were grossly adulterated with Prussian blue, bichromate of potash, carbonate of lime, carbonate of magnesia, and French chalk.

The adulteration was not less than fifteen per cent.

The following articles were also seized of the same party: —

Chromate of potash,
Bichromate of potash, } Mixed together.
Carbonate of lime,
French chalk.
Carbonate of magnesia.
Prussian blue.

Seized in Manchester, Feb. 16th, 1848.

No. 1.

CANTON IMPERIAL.

This tea is really a black tea that has been faced or glazed green, prior to the blooming process; it also contains sand as an adulteration. 100 grains gave—

Salts and earth	17·0
Sand	8·6
	26·6

No. 2.

SIFTINGS OF GREEN TEA.

This sample is chiefly black tea coloured to represent green; it is largely adulterated with sand and earth. 100 grains gave—

Salts and earth	14·8
Sand	19·2
	34·0

No. 3.

SCENTED CAPER.

This sample was seized as the tea had been faced and bloomed. 100 grains gave —

Salts and earth	10·0
Sand	1·2
	11·2

Compare the above with the following: —

No. 4.

GENUINE SCENTED CAPER.

100 grains gave —

Salts and earth	5·0
Sand	0·6
	5·6

There were also seized of this party the following articles: —

A. — A mixture of chromate of lead and carbonate of lime.

B. — Arsenite of copper.

C. — A mixture of indigo, chromate of lead, and carbonate of lime.

D. — A mixture of arsenite of copper, carbonate of magnesia, and Venetian red.

No. 5.

GENUINE BOHEA.

100 grains of the common kind of this description of tea yield from 5·5 to 5·8 per cent. of ash, consisting of salts, earth, and silica, sometimes to the extent of from two to four tenths per cent

No. 6.

GENUINE GREEN TEA.

The following analysis was made from a sample of green tea prepared and manufactured by Mr. Phillips himself: —

Lignin	55·3
Gum	5·4
Tannin and albumen	37·1
Colouring matter	2·2
	100·0

It may facilitate the researches of others, if, before giving the analyses, we point out briefly the more simple methods to be adopted for determining whether a sample of tea be artificially coloured or not.

For this purpose, if the leaves be coated to any considerable extent, it will be sufficient simply to view one or two of them as opaque objects, with a glass of one inch focus, when the colouring matters entering into the composition of the facing will be detected as minute specks or particles, each reflecting its appropriate tint.

Another method of determining the same point is to scrape gently the surface of two or three of the leaves with a penknife, when, if they be faced, the colouring matters may be detected in the powder thus separated, viewed as an opaque object.

A third method is to place five or six leaves on a slip of glass, moistening them with a few drops of water, and, after the leaves have become softened, firmly squeezing the water out between the finger and thumb; this will then be found to contain more or less of the ingredients forming the facing, should such have been employed.

Or, should it be desired to obtain the results on a large scale, half an ounce or so of the leaves may be agitated in a little water for a few minutes; this will detach much of the facing, without unfolding the leaves, and after a time the facing will collect as a sediment at the bottom of the vessel.

Lastly, the tea-dust, more or less of which is present in nearly every sample of tea, is usually found to contain the ingredients used in the facing in considerable quantity, and from its examination satisfactory results may in general be very readily obtained.

Having by one or other of the above processes determined whether the sample of tea be faced, the next step is to ascertain the nature of the substances used for this purpose.

The blue colouring matter has generally been found to be either Prussian blue or indigo, most frequently the former. Ferrocyanide of iron or Prussian blue is recognised under the microscope by the angular form of the fragments, and by their brilliant and transparent blue colour, but most decidedly by the action of liquor potassæ, which quickly destroys the blue, turning the fragments of a dull reddish-brown colour. This re-agent may be easily applied to the smallest particles of Prussian blue under the microscope. Indigo is distinguished under the same circumstances by the irregular form of the particles, their granular texture, and greenish-blue tint, but chiefly by the fact that the colour is not destroyed by liquor potassæ. These blue pigments may, however, readily be obtained in sufficient quantity to allow of complete chemical analysis.

The yellow dyes commonly used are turmeric powder and Dutch pink: the first of these is at once recognised by its microscopic characters, which have on previous occasions been fully described; and the latter, by the action of liquor potassæ and acetic acid: the one re-agent converts the bright-yellow into a dark-brown, and the other occasions effervescence,—results explained by the fact that Dutch pink consists of a vegetable yellow, in combination with chalk or carbonate of lime.

The white powders used are usually kaolin, soap-stone, or sulphate of lime; and although some clue may be obtained as to which of these is employed in any particular sample of tea, by the appearance of the leaves and the microscopic characters of the powder, yet, in order to obtain decided results, it is necessary to institute a chemical analysis.

The methods of detecting other substances occasionally used in the colouring of green tea, inasmuch as they are not commonly employed, it is unnecessary in this place to detail.

For many of the samples of which we now give the analyses, our acknowledgments are due to Mr. Bland, the writer of several interesting articles on "Tea," and "The Tea Trade," published in the *Merchant*.

Results of the Microscopical and Chemical Analyses of Thirty Samples of Green Tea, as imported into this Country from China.

No. 1.

Common Twankay.

Adulterated—Leaves of a dark-bluish, coppery-green colour, very highly faced with *Prussian blue* or *ferro-cyanide of iron*, and a small quantity of *a white powder*. The tea-dust contained an admixture of the same substances in larger quantity, and in a more obvious form.

No. 2.

Twankay.

Adulterated—Leaves of a dark-bluish, coppery-green colour, very highly dyed with *Prussian blue* and a small quantity of *the white* and *turmeric powders*. The tea-dust contained the same substances in particles large enough to be visible to the naked eye. Intermixed with the leaves were detected *fragments of seed-vessels*, *seeds*, *rice*, as well as *other substances* the nature of which did not admit of being determined, but all of which were artificially faced in the same manner as the tea-leaves themselves.

No. 3.

Twankay.

Adulterated—Leaves much broken, of a dull tawny-green colour, highly faced with *Prussian blue*, *turmeric*, and *a white powder*. Tea-dust contained the above ingredients in considerable quantity, and plainly visible to the naked eye.

No. 4.

GOOD COMMON HYSON.

Adulterated — Leaves bluish-green, highly dyed with *Prussian blue*, and a small quantity of a *white powder*, *China clay*, or *kaolin*. The dust contained a large quantity of Prussian blue, remarkable for its colour, which is so deep as to cause it to appear almost black under the microscope.

No. 5.

COMMON HYSON.

Adulterated — Leaves of a dull bluish coppery-green colour, highly faced with *Prussian blue* and a very small quantity of *kaolin*.

No. 6.

COMMON YOUNG HYSON.

Adulterated — Leaves much broken, and of a greyish-blue colour, being thickly coated with *Prussian blue* and *China clay*. The dust contained fragments of *mica*, probably derived from the kaolin in addition to the above ingredients, all visible to the naked eye.

No. 7.

FINE YOUNG HYSON.

Adulterated — Leaves of a greyish-black colour, tinged only with green, and slightly faced with *Prussian blue* and a very small quantity of *kaolin*.

No. 8.

FINE HYSON.

Adulterated — Leaves of a yellowish-green colour, slightly faced with *Prussian blue* and a very small quantity of *kaolin*.

No. 9.

HYSON.

Adulterated — Leaves of a dull yellowish-green colour, faced with *Prussian blue*, and a small quantity of *China clay*. The dust contained particles of *mica*, and much Prussian blue, both visible to the naked eye.

No. 10.

YOUNG HYSON.

Really Woping Tea prepared to imitate "Young Hyson."

Adulterated — Leaves of a dark and dull bluish-green colour, dyed with *Prussian blue* and a small quantity of *turmeric powder*.

No. 11.

YOUNG HYSON.

Ankoi Tea prepared for "Young Hyson."

Adulterated — Leaves twisted, wiry, glossy, and of a greyish-blue colour, faced with *Prussian blue*, *turmeric powder*, and *China clay*.

No. 12.

FINEST YOUNG HYSON.

Adulterated — Leaves of a greyish and obscure green colour, faced with a small quantity of *Prussian blue* and a very little *China clay*.

No. 13.

VERY FINE HYSON.

Adulterated — Leaves of an obscure yellowish-green colour, slightly faced with *Prussian blue* and a very small quantity of *turmeric powder* and *China clay*.

No. 14.

FINE COWSLIP HYSON.

Adulterated — Leaves of an obscure greyish-green colour, faced with *Prussian* *blue* and a small quantity of the *white powder*. The dust contained a considerable quantity of the former substance, and but little of the latter.

No. 15.

GUNPOWDER (?)

Adulterated—Leaves glossy, of a greyish-blue colour, highly faced with a white powder, containing much *mica*, and probably *kaolin*, *Prussian blue*, and a small quantity of *turmeric powder*. The dust largely admixed with the white powder, and exhibiting particles of mica.

No. 16.

GOOD CANTON GUNPOWDER.

Adulterated—Leaves glossy, of a greyish-blue colour, highly faced with *Prussian blue*, the *white powder*, and a small quantity of *turmeric powder*.

No. 17.

GUNPOWDER.

Ankoi Tea.

Adulterated—Leaves very glossy, of a greyish-blue colour, highly faced in the same manner as the previous sample—viz. with *Prussian blue*, the *white powder*, and *turmeric*.

No. 18.

COMMON OR CANTON GUNPOWDER.

Adulterated—Leaves of a greyish-blue colour, slighted coated with *Prussian blue*, the *white powder*, and a small quantity of *turmeric*; in addition to which, the sample was largely admixed with fragments of *paddy husk*, agglutinated and flattened masses of *tea-dust*, shaped so as to resemble the fragments of the tea-leaves themselves; these masses were also faced with the same substances, and occasionally presented on their surfaces particles of mica, visible to the naked eye. The tea-dust contained much Prussian blue, the white powder, and a little turmeric.

No. 19.

GUNPOWDER.

Woping Tea.

Adulterated—Leaves much broken, of a tawny-blue colour, and faced with *Prussian blue*, the *white powder*, and a small quantity of *turmeric*. The sample, in addition, was largely admixed with fragments of leaves, NOT THOSE OF TEA, as well as *masses* consisting of minute particles, of the *same leaves*, *tea-dust*, and *sand*, made up with *gum*, and faced with the same substances.

Having been informed that the dung of the silk-worm is sometimes prepared and faced, so as to resemble gunpowder, our first impression on the discovery of the masses in question was, that the particles of leaves contained in them were those of the mulberry tree, and that we had really lighted upon a sample of that inviting article; a further examination, however, showed that the fragments did not belong to the leaves of the tree referred to.

Figures 98. and 99. show the structure of the foreign leaves detected in this sample; it will be seen how very much they differ from those of tea.

No. 20.

GUNPOWDER.

Adulterated—Leaves of a greyish-green colour, faced with *Prussian blue*, *turmeric-powder*, and the *white powder*, the same substances being clearly visible in the tea-dust.

No. 21.

VERY FINE GUNPOWDER.

Adulterated—Leaves of a greyish and obscure green colour, faced with *Prussian blue* and a small quantity of the *white powder*.

No. 22.

GUNPOWDER.

Adulterated— This article consists entirely of little masses of a dull grey colour, formed of *tea-dust* and *sand*, made up with *gum*, and faced with *Prussian blue*, the *white powder*, and *turmeric-powder*, the masses exhibiting occasionally upon their surfaces particles of *mica;* these substances were more readily detected in large quantities in the fine dust found at the bottom of the sample. This spurious, or *Lie tea*, was sold in the market at 8*d.* per pound, and was purchased for exportation.

No. 23.

COMMON GUNPOWDER.

Adulterated— This sample resembles in every respect the preceding.

No. 24.

GUNPOWDER.

Adulterated— This article is of the same composition as the two previous ones, but differs in colour, it being of a greener tint, and in the small size of the masses, these not being larger than mustard-seeds; the dust contains a considerable quantity of each of the three substances used in the facing.

No. 25.

GUNPOWDER.

Overland Sample.

Adulterated— Of the same composition as numbers 22, 23, and 24, but the masses are several times larger than those of the previous sample, and are of a light greyish and agreeable blue colour. The quantity of China clay, Prussian blue, and turmeric which enters into the composition of the facing is considerable; and each of these substances was found in large quantity in the dust.

No. 26.

GUNPOWDER.

Adulterated— Composition the same as that of the four previous samples.

No. 27.

IMPERIAL.

Adulterated— Leaves of a deep bluish coppery-green colour, rather highly faced with *Prussian blue*, and a small quantity of *turmeric powder* and the *white powder*.

No. 28.

UNGLAZED YOUNG HYSON.

"*Shanghai.*"

Adulterated—Leaves of a dull, obscure, yellowish-green colour, faced with *indigo* and a small quantity of a white powder, probably *China clay*.

No. 29.

UNGLAZED HYSON.

Adulterated— Leaves of an obscure green colour, faced with *Prussian blue*, and a small quantity of the *white powder*. The dust contained particles of *mica* visible to the naked eye, and a large quantity of Prussian blue, with only a little China clay.

No. 30.

UNGLAZED GUNPOWDER.

"*Shanghai.*"

Adulterated— Leaves of a yellowish-green colour, rather highly faced with *indigo* and a small quantity of the *white powder*.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL EXAMINATION OF SAMPLES OF TEA, AS IMPORTED FROM ASSAM AND JAVA, AND OF BRITISH AND DUTCH GROWTH AND MANUFACTURE.

No. 31.

ASSAM TWANKAY.

Genuine — Leaves forming masses of very large size and irregular shape, of a yellowish-brown colour, and bearing no resemblance whatever to ordinary green tea; there were detected in the dust a small quantity of *sand*, a few particles of *Prussian* blue, with four or five *turmeric-cells*, the presence of all of which was, in all probability, accidental; this, therefore, is the first sample of so-called green tea which has been found to be free from adulteration.

No. 32.

YOUNG ASSAM HYSON.

Genuine — Leaves much broken, some black, but the greater part of a yellowish-brown colour, and all without facing of any description; this sample, like the preceding, is very dissimilar in appearance to green tea.

No. 33.

JAVA GUNPOWDER.

Adulterated — Leaves rolled and agglutinated into spherical masses of about the size and colour of whole black pepper, but in no respect resembling green tea, and slightly faced with a white powder, probably *kaolin;* there were detected in the dust a few particles of *mica* and a small quantity of the *white powder*, fragments of mica being occasionally visible on the surfaces of the masses themselves.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL ANALYSES OF SAMPLES OF SPURIOUS GREEN TEAS OF BRITISH FABRICATION.

Seized by the Excise, July, 1851.

No. 34.

Analysis. — Leaves misshapen, broken, of a bluish-black colour, and faced with *Prussian blue* and *French chalk.* Infusion very pale.

No. 35.

Analysis. — Leaves of a dull, greyish-green colour, some of them being entire, and presenting the twisted form of genuine tea; others broken and misshapen: the former, on analysis, are ascertained to be faced with *Prussian blue*, *turmeric*, and *kaolin;* and the latter with *Prussian blue, Chinese yellow*, and *soap-stone.*

From the form of the leaves, and the nature of the ingredients used in the facing, it is evident that this sample consists in part of *unused green tea*, prepared and faced in China, and in part of *exhausted tea-leaves*, coloured and made up in this country in imitation of green tea.

No. 36.

Analysis. — This article consists of little masses, irregular in size and form, of a greenish hue, and bearing a general resemblance to sample 22 and four following samples. The masses consist of broken fragments of leaves, made up with *catechu*, and faced with *indigo*, the leaves being those of the *sycamore* and *horse-chesnut.*

For the above specimen, we are indebted to Dr. Muspratt. It is one of the articles, of some of which we gave analyses in a former Report, manufactured by J. Stevens, of Liverpool, on whose premises a seizure of spurious tea was made by the Excise in December, 1850.

The following conclusions may be deduced from an examination of the analyses of GREEN TEA, as imported into this country from China:—

1st. That the *whole* of the *thirty samples* were adulterated.
2nd. That *five* of the samples called gunpowder, consisted of *Lie tea*—that is, of *tea-dust* and *sand*, made up with *rice-water*.
3rd. That *one* of the samples was composed in part of *paddy-husk* and *other substances*.
4th. That *another* sample was composed chiefly of *Lie tea* made up in part with *other leaves* than those of tea.
5th. That *another* sample consisted principally of *Lie tea*.
6th. That the *whole* of the samples were artificially *glazed* or *coloured*.
7th. That this *glazing* or *colouring* consisted of two, and in some cases three, substances—a *blue*, a *yellow*, and a *white*. The *blue* colouring matter was present in *all* the samples, and in *twenty-eight* it was ascertained to be *Prussian blue*, and in the other *two*, *indigo*; the *yellow* was detected in *seventeen* samples, and consisted in all instances of *turmeric powder*; the *white* was observed in *twenty-nine* samples, and in general consisted of *China clay* or *kaolin*.
8th. That in *no one* of the samples was a *single leaf possessed of a green colour not produced by artificial means* detected, from which strong fact, notwithstanding a certain amount of evidence to the contrary, we are almost led to conclude that there is really no such thing as a "*genuine green tea*" of the colour ordinarily supposed to be characteristic of that kind of tea. The leaves, when deprived of their artificial coating, have invariably presented different shades of yellow, olive, brown, and even black.

In the numerous examinations which we have made of samples of tea as imported into this country, the only evidence derived from personal observation which we have been able to obtain of the existence of tea-leaves of *a natural green colour*, is the occasional occurrence in several samples of *Oolong*, a black tea, of leaves, which, after infusion, presented a bright and coppery bluish-green colour.

From an examination of the three samples of *Assam* and *Java* tea submitted to analysis, it appears—

1s. That *two* of the samples—viz., those from *Assam*, were *genuine*, while the *Java* specimen was slightly faced with a *white powder*.
2nd. That the teas forming these samples were of a dull yellowish colour, *without the slightest tinge of green*, resembling, in fact, the leaves of the adulterated samples of green tea imported from China, when deprived of their facing.

Lastly, it is apparent from the Third Table of Analyses—

That British fabricators of spurious tea are *but little behind* the Chinese in the manufacture of imitation green tea, which, as we have seen, they can prepare either from exhausted tea-leaves or from any other leaves (the kind matters not) which may be picked up by the hedge-side, or in the wood.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL ANALYSES OF TWENTY SAMPLES OF GREEN TEA, PURCHASED OF GROCERS AND TEA-DEALERS RESIDENT IN THE METROPOLIS.

It will be remembered that we have already given numerous analyses of nearly every known kind of green tea, as imported into this country. We now propose to complete our investigations, and to make known the results of the analyses of samples as actually supplied to the consumer.

No. 1.

HYSON.

Purchased of J. Walton, 129. Bishopsgate-street Without.

Adulterated—Leaves of a dark-green colour, somewhat broken, faced with

Prussian blue, a little *turmeric-powder*, and the *white powder*. The dust contains much Prussian blue and China clay, with a little turmeric only.

No. 2.

YOUNG HYSON.

Purchased of G. E. Back, 123. Tottenham-court-road.

Adulterated— Leaves of a dark bluish-green colour, faced with *Prussian blue* and the *white powder*.

No. 3.

HYSON.

Purchased of A. Andrews and Co., 57. Tottenham-court-road.

Adulterated— Leaves of a greyish-green colour, much broken, with a considerable quantity of dust, all highly faced with much *Prussian blue* and a small quantity of *turmeric-powder* and the *white powder*.

No. 4.

HYSON.

Purchased of G. Clark, 135. Tottenham-court-road.

Adulterated— Leaves of a yellowish-green colour, a good deal broken, with a large quantity of dust, all highly glazed with *Prussian blue* and a small quantity of the *white powder*.

No. 5.

HYSON.

Purchased of Pembridge and Hunt, 107. Tottenham-court-road.

Adulterated— Leaves of a dull-green colour, not much broken, glazed with much *Prussian blue*, and only a very small quantity of the *white powder* and *turmeric-powder*.

No. 6.

DELICIOUS HYSON.

Purchased of M. Bousefield, 111. Tottenham-court-road.

Adulterated— Leaves of a greyish-green colour, rather glossy, glazed with *Prussian blue*, *turmeric-powder*, and the *white powder*.

No. 7.

HYSON.

Purchased of J. Rose, 233. High-street, Shoreditch.

Adulterated— Leaves of a dull greyish-green colour, highly coated with *Prussian blue*, the *white powder*, and a little *turmeric-powder*.

No. 8.

GUNPOWDER.

Purchased of J. Butterworth, 110. High-street, Shoreditch.

Adulterated— Composed in part of tea-leaves, and partly of LIE TEA, which, as already explained, consists, when not otherwise adulterated, of little masses (made up with *rice-water*) of *tea-dust* and *sand*, the leaves and masses all being highly glazed with *Prussian blue*, *turmeric-powder*, and *China clay*, and the dust containing these ingredients in quantity so large as sometimes to be visible to the naked eye.

No. 9.

GUNPOWDER.

Purchased of G. B. White, 147. Shoreditch.

Adulterated— This sample consists almost entirely of LIE TEA, highly glazed with *Prussian blue*, *turmeric-powder*, and the *white powder*, as well as particles of *mica*, all of which are visible to the naked eye in the dust.

This article, as tea, is all but worthless, and in consequence of the extent to which it is glazed with Prussian blue is calculated to prove, in some cases, injurious to health.

No. 10.

GUNPOWDER.

Purchased of J. Clark, 175. Shoreditch.

Adulterated — Leaves of a slaty-green colour, consisting in part of tea-leaves, and partly of LIE TEA, both being faced with *Prussian blue*, *turmeric-powder*, and the *white powder*, these ingredients being visible in the dust to the naked eye.

No. 11.

GUNPOWDER.

Purchased of J. Pringle, Shoreditch.

Adulterated — Leaves of a greyish-green colour, somewhat glossy, admixed with a small quantity of LIE TEA, both being highly coated with *Prussian blue*, *turmeric-powder*, and the *white powder*, all visible in the dust to the naked eye.

No. 12.

GUNPOWDER.

Purchased of G. W. Back, Mile-end-road.

Adulterated— Leaves of a slaty-green colour, somewhat glossy, and glazed with much *Prussian blue*, a little *turmeric-powder*, and the *white powder;* the sample was also adulterated with a small quantity of LIE TEA, coloured with the same substances.

No. 13.

PEARL LEAF GUNPOWDER.

Purchased of J. Clark, 8. Clare-street, Clare-market.

Adulterated — Leaves of a dark, coppery-green colour, and admixed with a small quantity of LIE TEA, both being thickly painted with *Prussian blue* and a small quantity of *turmeric-powder*, which, together with a considerable quantity of *starch-granules* of small size, were likewise present in the dust; the Prussian blue was remarkable for its deep colour.

No. 14.

GUNPOWDER.

Purchased of C. Belsham, 120. Drury-lane.

Adulterated — Leaves of a greyish, obscure green colour, and admixed with much LIE TEA, both being faced with *Prussian blue*, *turmeric-powder*, and the *white powder*.

No. 15.

GUNPOWDER.

Purchased of Hawthorn and Co., 38. Tottenham-court-road.

Adulterated — Leaves of a greyish, obscure green colour, somewhat glossy, containing a few pieces of *paddy-husk*, and admixed with a considerable quantity of LIE TEA, all being faced with *Prussian blue*, *turmeric*, and the *white powder;* these ingredients being also plainly visible in the dust to the naked eye.

No. 16.

GUNPOWDER.

Purchased of Salmon and Co., 69. Tottenham-court-road.

Adulterated — Leaves of a decided green colour, glossy, highly faced with *Prussian blue*, *turmeric-powder*, and a little of the *white powder*.

No. 17.

GUNPOWDER.

Purchased of J. Stanbury, 2. Portman-place, Edgware-road.

Adulterated — Leaves of a greyish-green colour, glossy, faced with *Prussian blue*, the *white powder*, and a little *turmeric*.

No. 18.

GUNPOWDER.

Purchased of Bodley and Co., 5. Portman-place, Edgware-road.

Adulterated — Leaves of a green colour, largely admixed with LIE TEA, both being faced with *turmeric-powder*, the *white powder*, and *Prussian blue*, the first two being visible in the dust to the naked eye.

No. 19.

CHOICE GUNPOWDER.

Purchased of Martin and Co., 147. Edgware-road.

Adulterated — Leaves of a grey-green colour, but more than half of the article consists of LIE TEA, both being faced with *Prussian blue*, *turmeric-powder*, and the *white powder*.

No. 20.

GUNPOWDER.

Purchased of J. M. Stubbs, 140. Edgware-road.

Adulterated — Nearly the whole of this article consists of LIE TEA, the masses of which are thickly coated with *Prussian blue*, *turmeric-powder*, and the white powder, most probably *China clay*, much of each of which is visible in the dust to the naked eye.

ON THE ADULTERATION OF TEA BY THE CHINESE WITH LEAVES OTHER THAN THOSE OF THE TEA-PLANT.

It will be recollected that in a previous portion of this former Report we quoted a statement by Dr. Dickson, that the Chinese annually gathered and dried millions of pounds of leaves not those of tea, to be used in the adulteration of that article.

It will also be remembered, that in the analysis, already given, of a sample of gunpowder (*Woping tea*), we stated that we had discovered portions of leaves presenting a very different structure from those of tea; the statement made by Dr. Dickson, as well as the discovery referred to, have induced us to institute further investigations on a subject of so much importance.

We have therefore submitted the leaves of four different samples of tea, of low quality, as imported into this country from China, to careful microscopic examination, and with the following results: —

The first was the "*Gunpowder*" already referred to; in this we detected fragments, not only of the leaf first noticed, but also those of a second leaf, not tea, and likewise possessing a very distinct organisation. The tea in question consisted in part of leaves, and partly of Lie tea. Now these foreign leaves formed not only the greater portion of the loose leaves, but also entered largely into the composition of the little masses of which Lie tea is constituted, scarcely a particle of the tea-leaf itself having been observed in the sample.

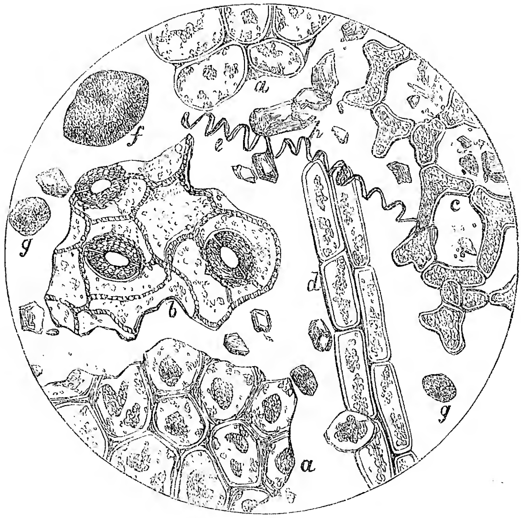
The structure of these leaves is shown in the two following figures. (*Figs.* 98. and 99.)

A sample of "*Lie tea*," admixed with a few small fragments of leaves, we found to consist principally of portions of the same leaf, much broken up, as is represented in *fig.* 99. We may remark that it is customary, in order the more effectually to aid deception, to mix with Lie tea a certain quantity of broken tea or other leaves.

In a sample of *Twankay* we detected, in addition to tea, the leaves of three other species of plants, two of which we identified, the one as *Camellia Sasanqua*, the other as a kind of *plum*; these are represented in *figs.* 100. and 101.

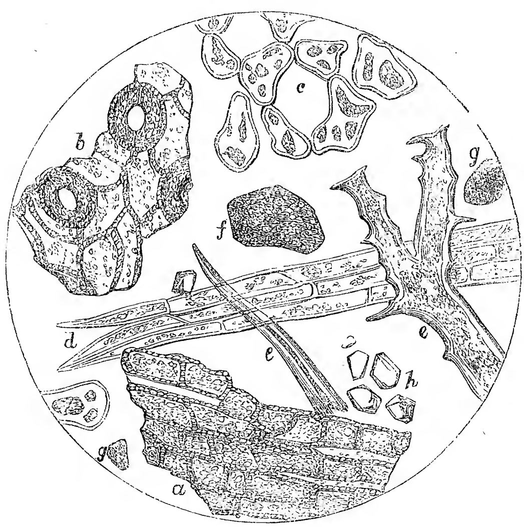
Foreign Leaves in Tea.

Fig. 98.



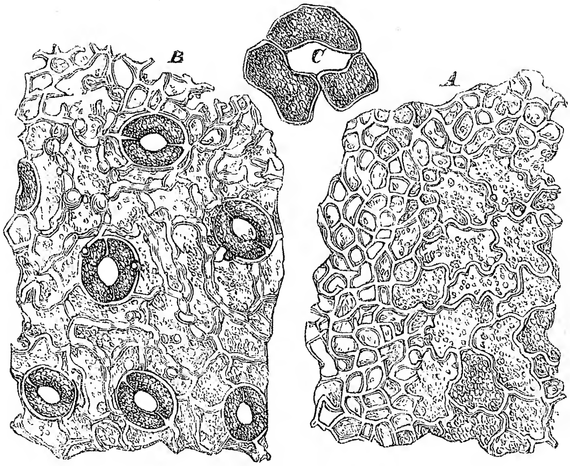
a, Upper surface of leaf; *b*, lower-surface, showing the cells with their slightly-beaded margins, of which it is composed; *c*, chlorophylle cells, so disposed as to form very large areolæ; *d*, elongated cells found on upper surface of the leaf in the course of the veins; *e*, spiral vessel; *f*, cell of turmeric; *g*, fragment of Prussian blue; *h*, particles of the white powder, probably *China Clay*.

Fig. 99.



a, Upper surface of leaf; *b*, lower surface; *c*, chlorophylle cells; *d*, elongated cells; *e*, portion of one of the branched and spinous hairs situated on the under surface of the leaf; *f*, cell of turmeric; *g*, fragment of Prussian blue; *h*, particles of the *white powder*.

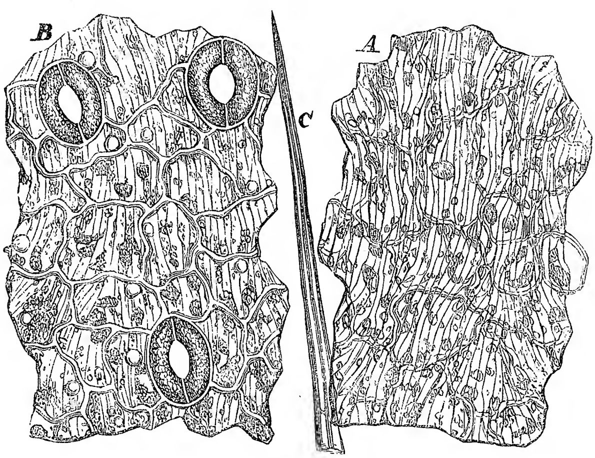
Fig. 100.



LEAF OF CAMELLIA SASANQUA.

A, upper surface of leaf, showing the cells of which it is composed; *B*, under surface, exhibiting its cells and stomata; *C*, chlorophylle cells.

Fig. 101.



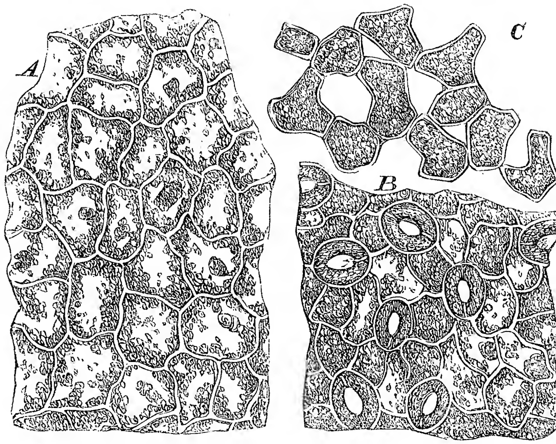
LEAF OF PLUM.

A, upper surface of leaf; *B*, under surface; *C*, chlorophylle cells.

A second sample of "*Twankay*" was ascertained to consist of tea mixed with paddy-husk, portions of seed-vessels, and other substances, the leaves being of a coarse description, and wanting the peculiar twist characteristic of the more carefully prepared kinds of tea.

Between the *old* and *young* tea-leaf there exists a considerable difference of structure: we have already given figures showing the organisation of the leaf as met with in most black teas, and we now add to those another figure, exhibiting the characters of the leaf in a more advanced stage of its growth. On comparing this figure with the former, it will be observed that the differences are very great, and such as might be referred by an inexperienced observer to even distinct leaves, and on this account we have deemed it desirable to give an additional drawing.

Fig. 102



TEA-LEAF.

A, upper surface of fully-developed leaf, representing the cells of which it is constituted; *B*, under surface, showing its cells and stomata; *C*, chlorophylle cells.

The above four analyses alone clearly prove that the Chinese do adulterate some of their teas, more particularly certain green teas, and especially the spurious article denominated LIE TEA, with leaves other than those of tea.

On a future occasion we propose to make an extended examination of numerous samples of tea, as imported into this country, in order that we may be the better able to judge of the extent to which this scandalous fraud is carried.

In examining different kinds of leaves with the microscope, one cannot fail to be struck with the very great resemblance which these organs bear in organisation, as well as in function, to the lungs of animals. The mesophylle consists of cells, denominated chlorophylle cells, which contain the colouring matter of the leaf, chlorophylle; these cells are united together at certain points only, so as to leave a number of areolar spaces, analogous to the air-cells of the lung, and which communicate with each other, one of these spaces of large size being always situated opposite each of the stomata; by this arrangement a free circulation of air throughout the whole tissue of the leaf is effectually ensured.

BRITISH TEA.

Some years since an article was prepared bearing the above name, under the sanction and protection of a *patent*; it was composed chiefly of *sloe leaves*, as well as those of the *elm*, *apple*, *rose*, *poplar*, *willow*, &c. This so-called tea, when manufactured, was sold clandestinely to tea-dealers, and mixed with genuine tea. This having come to the knowledge of the excise authorities, several seizures of the worthless stuff were made at various tea-dealers, and ample proof having been obtained that the article was employed solely for the purpose of adulteration, the stock in the possession of the manufacturer was seized and publicly destroyed in the yard of the Excise office.

This seizure, we believe, was effected on the 11th of October, 1833, and an account of it is to be found in the *Times* of October 12, 1833.

That the government of the day laying claim to integrity, or even common sense, should legalise the adulteration of coffee by permitting it to be admixed with that worthless root, chicory, is truly surprising, but the case of public authorities granting a patent for the manufacture of an article, such as British tea, utterly valueless in itself, and which could only be employed to adulterate genuine tea, the public and the revenue being defrauded thereby, is indeed an act of still greater folly and culpability.

Returning now to the Table of Analyses of the samples purchased of dealers, and reviewing the results therein contained, we arrive at the following conclusions: —

1st. That the whole of the *twenty* samples of green tea were artificially coloured, glazed, or painted, with a mixture of *Prussian blue*, *turmeric*, and a *white powder*, probably *China clay*.

2nd. That *eleven* out of the *thirteen* gunpowder teas, in addition to being artificially coloured, were adulterated with different proportions of *Lie tea*; this article in some cases forming the chief part, and in other instances nearly the whole of the samples.

3rd. That out of the *twenty* samples, *not one* was found which possessed the *natural* green colour.

We have already repeatedly given the composition of Lie tea, from which it appears that it is not only worthless, but, in consequence of the extent to which it is glazed, calculated to prove injurious to health. The price of this article, exclusive of duty, is from sixpence to eightpence per pound; and in the country from which it is exported, it probably would not fetch one penny per pound. That persons should be made to pay for a pound of such deleterious rubbish, four shillings of hard-earned money, is indeed disgraceful.

We will now, on bringing our Report on tea, for the present, to a conclusion, recapitulate the more important results arrived at in the course of our investigations.

The chief points ascertained with regard to *Black tea* are —

1st. That the principal black teas—namely, the Congous and Souchongs, arrive in this country, for the most part, in a genuine state.

2nd. That certain descriptions of black tea, as Scented Orange Pekoe and Caper, are invariably adulterated, the adulteration in general consisting in the glazing of the leaves with plumbago or black lead; the Caper likewise being subject to admixture with other substances, as paddy-husk, Lie tea, and leaves other than those of tea.

3rd. That several varieties of a spurious Caper, or black Gunpowder, are prepared, which consist of tea-dust, and sometimes the dust of other leaves, and sand, made up into little masses with gum, and faced or glazed with plumbago, Prussian blue, and turmeric-powder: in some cases these imitations are sold separately, but most frequently they are used to mix with and adulterate the better qualities of Caper — viz. those which are made of tea faced with plumbago only.

With respect to *Green tea* the principal conclusions are —

1st. That these teas, with the exception of a few of British growth and manufacture, from Assam, are invariably adulterated — that is to say, are glazed with colouring matters of different kinds.

2nd. That the colouring matters used are in general Prussian blue, turmeric-powder, and China clay, other ingredients being sometimes but not frequently employed.

3rd. That of these colouring matters, Prussian blue, or ferro-cyanide of iron, possesses properties calculated to affect health injuriously.

4th. That in this country there is really no such thing as a green tea—that is, a tea which possesses a natural green hue.

5th. That green teas, and more especially the Gunpowders, in addition to being faced and glazed, are more subject to adulteration in other ways than black teas, as by admixture with leaves not those of tea, with paddy-husk, and particularly with Lie tea.

6th. That Lie tea is prepared so as to resemble green tea and is extensively used by the Chinese themselves to adulterate gunpowder tea; it is also sent over to this country in vast quantities, and is employed for the same purpose by our own tea-dealers and grocers.

The above are the more important conclusions as to the condition of black and green teas as imported, but these articles undergo further deterioration in our own country. Thus we have adduced evidence to show —

1st. That exhausted tea-leaves are frequently made up with gum, &c., and resold to the public as genuine black tea, and, when artificially coloured and glazed, even as green tea.

2nd. That the substances employed in the colouring are in many cases very much more objectionable and injurious than those used by the Chinese, being often highly poisonous.

3rd. That it is no uncommon thing for tea, both black and green, to be fabricated from leaves not those of tea, and possessing no properties in common with the leaves of that plant.

4th. That black Lie tea is often coloured and extensively employed by our own dealers and grocers for the adulteration of green tea.

Of the adulterations noticed, those practised by the Chinese are of course by far the most important, because they extend to a very considerable portion of the tea consumed in this country; at the same time the frauds resorted to by our own dealers must not be lost sight of.

It having been shown, then, that there exists much that is wrong in connexion with tea, especially green tea, as imported into this country, it now remains for us to consider whether means cannot be devised by which these evils may to a great extent be remedied.

We propose, then, by way of remedy,—

1st. A reduction of duty on all descriptions of *black tea*, to the extent of at least one-third, allowing it to remain the same as at present on every kind of green tea.

2nd. That all Lie tea, (notwithstanding that it sometimes contains a small quantity of tea-dust, and pays the same duty as tea,) since it is invariably made up largely with sand, as well as frequently leaves not those of tea, and as it is used chiefly for the purpose of adulteration, should, as soon as it falls under the notice of the excise authorities, be confiscated and destroyed; similar steps should also be adopted with those kinds of tea, whether black or green, which are found to be admixed with Lie tea.

We are fully persuaded that the before-mentioned reduction of duty on black tea would extend the consumption of that useful and for the most part unadulterated kind of tea so largely, that in place of there being any *diminution* in the revenue, there would positively be an *increase* of income from this source, provided the dealers were not allowed, as is too frequently the case, to appropriate the difference.

Tea, although not an absolute necessary of life, is an article of daily consumption amongst a very large portion of the community; a still larger portion, however, from the high price at which it is sold, are unable to procure one-sixth part as much as they would gladly consume, were it but placed within their reach; and we firmly believe, that were any considerable reduction of duty on tea to be made, the consumption would very soon be doubled. This reduction, we are persuaded, would not only increase the consumption without injury to the revenue, but would effectually put a stop to much of the adulteration now so prevalent, frequently to the detriment of health. The duty on green teas remaining the same as at present, would do much to lessen their consumption.

The recommendation made in the above Report has since been acted upon, and the duty is now reduced.

In 1852, at the old duty of 2*s*. 1*d*. per lb. and 5 per cent., the quantity entered for home consumption was 54,724,612 lbs.; in 1853, the duty being reduced to 1*s*. 10*d*. on the 5th of April, it was 58,860,127 lbs.; in the *first six* months of 1854, the duty being reduced on the 5th April to 1*s*. 6*d*., the quantity entered for home consumption was 30,926,294 lbs.; on the 5th April, 1855, the duty will be further reduced to 1*s*. 3*d*. per lb.; and on 5th April, 1856, to 1*s*. per lb., and so to remain.

Another good effect of the publication of these Reports, and one which could scarcely have been looked for, is, that the Chinese themselves have begun to give up, to some extent, the practice of colouring or glazing their green teas, and now not unfrequently send to this country chests of uncoloured green tea, even branded on the outside with the words "Uncoloured Tea." For a knowledge of this fact we are indebted to Mr. Bland, whose letter we publish below.

To the Editor of THE LANCET.

SIR, — In the course of my duty, inspecting arrivals, I have been pleased to notice many indications of the effects of your critical remarks on coloured and dyed teas, now that New Crop Greens are in course of arrival, many pale, natural kinds being observable. Four or five classes have particularly arrested my attention, being purely unsophisticated both in manipulation and colour, the latter the hue of an ordinary green-glass bottle when broken thin. On further examination, I find that the inscription on the mat covering the chests is "Uncoloured Tea;" descriptive enough, perhaps, seeing that we have no better English word to designate the desideratum. Should you wish it, I would get samples of these from the bonded warehouses, or accompany any agent of yours to see them there.

I am your obedient servant,
W. J. BLAND.

Mark-lane, March, 1854.

We are also indebted to Mr. Bland for numerous samples of the "Uncoloured Tea" referred to, of different kinds; these we have examined, and find to be entirely free from colouring matter. The appearance of the samples is, however, very different from that of ordinary and artificially coloured green tea; the leaves are of a yellowish or olive-brown colour, rather than of a green hue.

To the number of uncoloured green teas may be added the East Indian tea, known as Kumaon, in reference to which the following notice, in reply to a correspondent, appeared in the LANCET some time back: —

"The samples of black and green Kumaon tea are both of excellent flavour and quality; and we are happy to inform our correspondent that, unlike all the green teas which we have ever met with imported from China, the Kumaon green tea is not in any way artificially coloured. This tea, although it possesses the flavour of ordinary green tea, differs very considerably from it in appearance, the leaves being of so dull and yellowish a tint, that in day-light the article would scarcely be recognised as green tea at all. The teas of Assam are now rising considerably in value."

Subsequent to the publication of the above Report we received from the author a paper, entitled "Observations on the Teas of Commerce," by R. Warington, F.C.S. This communication was read before the Chemical Society May 19th, 1851, and published in their Quarterly Journal for July, 1851. Under the head Adulteration and Sophistication of Teas we meet with the following observations: —

"ADULTERATION AND SOPHISTICATION OF TEAS.

"Since writing my former paper, several teas have come under my notice, which must be classed under this head. The first I shall mention is a sophistication which has been carried on in this country to some extent, and consists in giving the appearance of green tea to an imported black tea. The material used as the basis for this process of manufacture is a tea called scented caper; it is a small, closely-rolled black tea, about the size of small *gunpowder*, and when coloured, is vended under this latter denomination, the difference in price between the scented caper and this fictitious gunpowder being about 1*s*. per lb., a margin sufficient to induce the fraud. This manufacture has been carried on, I understand, at Manchester, and was kept as secret as possible; and it was only after considerable trouble that some of my friends succeeded in obtaining two different specimens for me, that could be fully depended on, as originating in this manufactory. It appears that it is generally mixed with other tea, so as to deceive the parties testing it. How this manufacture was conducted, I am not prepared to say; but some preparation of *copper* must have been employed, as the presence of that metal is readily detected in the specimens I received. I believe, however, that this sophistication has ceased.

"I have now to call your attention to another adulteration of the most flagrant kind. Two samples of tea, a black and a green, were lately put into my hands by a merchant for examination, the results of which he has allowed me to make public. The black tea was styled *scented caper;* the green, *gunpowder;* and I understand they are usually imported into this country in small chests called catty packages. The appearance of these teas is remarkable; they are *apparently* exceedingly closely rolled, and very heavy; the reasons for which will be clearly demonstrated. They possess a very fragrant odour. The black tea is in compact granules, like shot of varying size, and presenting a fine glossy lustre of a *very black* hue. The green is also granular and compact, and presents a bright pale-bluish aspect, with a shade of green, and so highly glazed and faced, that the facing rises in clouds of dust when it is agitated or poured from one vessel to another; it even coats the vessels or paper on which it may be poured. On examining these samples, in the manner described in my former paper, to remove this facing, I was struck by the tenacity with which it adhered to the surface, and which I had never remarked in any previous sample, requiring to be soaked for some time in the water before it could be detached; with this precaution, however, the greater part of the facing material was removed. It proved, in the case of the sample of green tea, to be a pale Prussian blue, a yellow vegetable colour, which we now know to be turmeric, and a very large proportion of sulphate of lime. The facing from the sample of black tea was *perfectly black* in colour, and on examination was found to consist of earthy graphite or black lead. It was observed, that during the prolonged soaking operation, to which these teas had been submitted, there was no tendency exhibited in either case to unroll or expand, for a reason which will be presently obvious. One of the samples was therefore treated with hot water, without however any portion of a leaf being rendered apparent. It increased in size slightly, was disintegrated, and then it was found that a large quantity of sand and dirt had subsided; this was separated by decantation, and collected; it was found to amount to 1·5 grains from 10 grains of the sample, or 15 in the 100 parts. It was evident, however, that much of the lighter particles must necessarily have been lost in the process of decantation; a weighed quantity of the sample was therefore carefully calcined, until the ash was quite white, and the whole of the carbonaceous matter burnt off; it yielded a result equivalent to 37·5 on the 100 parts. During this operation also, no expansion or uncurling of the leaf, as is generally to be observed when heat is applied to a genuine tea, was seen; in fact, it was quite evident that there was *no leaf to uncurl*, the whole of the *tea* being in the form of dust. The question next presented itself as to how these materials had been held together, and this was readily solved; for, on examining the infusion resulting from the original soaking of the sample, abundant evidence of gum was exhibited.

"The sample of green tea was of a precisely similar kind to the black; it yielded 4·55 grains of ash, &c. from 10 grains of the specimen, or 45·5 per cent. A specimen of Java gunpowder yielded 5 per cent. of ash; so that we have in this sample 40·5 per cent. of dirt and sand over and above the weight of ash yielded by the incineration of a genuine tea.

"Thus we have then in these samples a mixture of tea-dust with dirt and sand, agglutinated into a mass with a gummy matter, most probably manufactured from rice flour, then formed into granules of the desired size, and lastly dried and coloured, according to the kind required by the manufacturer, either with black lead, if for black tea; or with Prussian blue, gypsum, or turmeric, if intended for green.

"Since examining these two samples, I have obtained through a friend another specimen of green tea, having a very different appearance; that is, better manufactured, or rather, I should say, more likely to deceive the consumer, from its being made to imitate an *unglazed tea.* It is of a yellowish-green colour, scented and granulated as the former samples, and not much dusted; it yielded 34 per cent. of ash, sand, and dirt.

"On inquiry, I have learnt that about 750,000 lbs. weight of these teas have been imported into this country within the last eighteen months, their introduction being quite of modern origin; and I understand that attempts have been made to get them passed through the Customs as *manufactured goods*, and not as teas; a title which they certainly richly merit, although it must be evident, from a moment's consideration, that the revenue would doubtless be defrauded, inasmuch as the consumer would have to buy them as teas from the dealer. It is to be feared, however, that a market for them is found elsewhere. The Chinese, it appears, will not sell them except as teas, and have the candour to specify them as *lie* teas; and if they are mixed with other teas of low quality, the Chinese merchant gives a certificate, stating the proportion of the *lie tea* present with the genuine leaf. This manufacture and mixing is evidently practised to meet the price of the English merchant. In the case of the above samples, the black is called by the Chinese, *lie flower caper;* the green, *lie gunpowder;* the average value is from 8*d.* to 1*s.* per lb. The brokers have adopted the curious term *gum and dust*, as applied to these lie teas or their mixtures, a cognomen which at first I had some difficulty in understanding, from the rapid manner in which the two first words were run together.

"I may subjoin the results obtained from the careful incineration of a variety of teas, as they may be interesting, for the purpose of comparison, and illustrate the point I have mentioned as to these spurious teas being mixed with genuine ones.

"Gunpowder tea, made in Java, gave 5·0 grains of ash in the 100 parts;

Gunpowder, during the East India Company's Charter	5·0
Kemaon hyson - - - -	6·5
Assam hyson - - - - -	6·0
Lie gunpowder, No. 1. - - - -	45·5
,, No. 2. - - - -	34·0
Scented caper - - - - -	5·5
Lie flower caper - - - -	37·5
Mixtures containing these lie teas, No. 1. - -	22·5
,, ,, No. 2. - -	11·0"

The investigations contained in the Report on Tea and its Adulterations were made early in the spring of 1851, and the first part of the Report was published in the LANCET of July, 1851.

MILK, AND ITS ADULTERATIONS.

MANY infants subsist entirely upon the milk of the cow; that nutritious fluid also usually forms a large portion of the diet of most young children, and, in some shape or other, enters into the daily food of almost every adult; it therefore becomes a matter of primary importance to determine whether milk as supplied for the consumption of the public, especially the inhabitants of this great city, is in a genuine state or not; and to this task we now propose to devote ourselves.

If the testimony of ordinary observers, and even of many scientific witnesses, is to be credited, there are but few articles of food more liable to adulteration, and this of the grossest description, than milk.

The great value of these Reports on Food and its Adulterations consists in the fact, that all the conclusions are based upon actual observation, the statements made by other observers and writers seldom being accepted as correct without previous experiment; the result is, that, while we frequently ascertain prevailing notions to be erroneous, we discover many new and unexpected facts. The correction of an error is of no less importance than the discovery of a fact. We have reason to believe that the truth of the preceding remarks will become remarkably evident in the course of the inquiries the particulars of which we are now about to make known.

Composition and Analysis of Milk.

Before proceeding to refer to the adulterations of milk, it will be proper to treat of its composition.

From the fact that persons may be entirely sustained upon a diet of milk for an indefinite period, it may be concluded that that fluid must contain all the elements necessary for the growth and sustenance of the human body, a view the correctness of which is fully established by chemical research.

Milk consists of water holding in solution casein, or cheese, sugar of milk, various salts, and in suspension, fatty matter, in the form of myriads of semi-opaque globules, to which the colour and opacity of milk is due.

Skim-milk, butter-milk, cream, butter, curds-and-whey, cream-cheese, and ordinary cheese, are mere modifications of milk, differing only from each other either in the abstraction of one or more of its constituents, or else in the variation of their proportions.

Skim-milk.—The first of these (skim-milk) differs from ordinary milk in containing a less quantity of fatty matter, a portion of this having been removed with the cream; it still, however, contains nearly all the cheese, the sugar of milk, some butter, and the salts of milk: it is therefore scarcely less nutritious than new milk, but, in consequence of the diminished amount of fatty matter, is less adapted to the development of fat, and to the maintenance of respiration and the temperature of the body. In some cases where fatty matter is found to disagree, and where, in consequence, milk in its usual state cannot be taken without inconvenience, skim-milk may be substituted with advantage.

Butter-milk.—Butter-milk approaches skim-milk in its composition, but contains a still smaller quantity of fat; as an article of diet for poor persons, it has the recommendation of cheapness.

Potatoes and butter-milk, as is well known, taken together, form a very considerable portion of the diet of the peasantry of Ireland: the butter-milk constitutes an essential part of such a diet, it supplying the nitrogenized matter necessary for the growth of the body, and of which the potatoes themselves are comparatively deficient.

Cream.—In contradistinction to these, cream consists almost entirely of the fat, with a very small quantity of casein and the other constituents of milk.

Butter.—Butter differs little from cream, but is more completely separated from the cheese, sugar, and salts; and the fat globules, in place of being free and distinct, have all run together, so as to form a semi-solid substance.

Curds-and-Whey.—Curds-and-whey are made up of all the elements of milk, but the form in which they exist is altered; the cheese is thrown down by rennet, or by the addition of an acid, as acetic acid, and in its descent, carries with it the greater part of the butter, the two together forming the curd; while the whey, or serum, consists entirely of water, the sugar, and the salts.

Cream-Cheese.—Cream-cheese consists of the curd (that is, of the cheese and butter), the greater part of the serum or whey being removed by slight pressure.

Ordinary Cheese.—Ordinary cheese contains little or no butter, and is made either from pure or skim-milk, according to the quality: the casein is precipitated by rennet in the usual manner, and subjected to great pressure in moulds, *annato* being frequently added, to heighten its colour.

The relative proportions of the different constituents of cow's milk, especially the fatty matter, are subject to very great variation: the age of the cow, the time after calving, food, temperature, weather, and the time and frequency of milking, all occasion considerable differences.

Influence of Age on Milk.—With respect to age, a young cow with her first calf gives less milk than with her second, third, or fourth calf, she being considered to be in her best condition, in most cases, when from four to seven years old.

The period during which cows give milk after calving is usually five or six months, but very frequently the time is much prolonged beyond this; we have been informed of an instance of a cow continuing to give milk for three years and a half after calving.

The first milk yielded by the cow after calving is yellow, thick and stringy: it is called colostrum, and by milkmen and others, "beastings." This state of the milk lasts from about three weeks to a month, but is very bad for the first ten days, during which time the milk is not fit for use. From the end of the first to the termination of the third or fourth month, the milk is in its best condition.

The cow carries her calf for forty weeks, or ten lunar months: it is the common practice to milk the cow regularly for the first seven, eight, or nine months of this period, a practice which, at first sight, appears to be highly objectionable, but which is really not so much so as might be supposed; and it is rendered absolutely necessary by the fact, that cows could not otherwise be profitably kept; nevertheless, it is very important that the milking should not be continued too long, for the sake of the cow, the calf, and the milk itself: in general it should cease at the end of the seventh month; many cowkeepers, however, continue to milk up to a very short period of calving.

Another very objectionable practice is to permit the cow again to become in calf within two or three months after having calved; the object of doing so is to derive as much profit as practicable from the animal, without regard to the effect on its constitution, the quality of the milk, or the growth of the calf. It is impossible to conceive that a cow can continue to yield large quantities of good milk daily, and afford, at the same time, sufficient nourishment for carrying on effectively the process of gestation.

Influence of Food on Milk.—The natural food of the cow is evidently that derived from pastures, viz. grass, the milk obtained from cows fed upon this being of excellent quality and sufficiently rich for all purposes.

The next most natural food is dried grass or hay, which is given largely to cows in winter, the milk being nearly the same in quality as from grass.

Beet-root and carrots, being very nutritious, are also usually given to cows in the winter time with advantage. With regard to the effect of beet-root and carrots on milk, we obtain the following information by MM. O. Henrie and Chevalier, as reported in Mr. Mitchell's treatise on the "Falsification of Food,"—p. 74.

The constituents of cow's milk in the normal state, according to MM. O. Henrie and Chevalier, are as follows:—

Casein (cheesy matter) - - -	4·48
Butter - - - - -	3·13
Sugar of Milk - - - -	4·77
Salts, various - - - -	0·60
Water - - - - -	87·02
	100·00

When the cows are fed on beet:—

Casein - - - - -	3·75
Butter - - - - -	2·75
Sugar of Milk - - - -	5·95
Salts - - - - -	0·68
Water - - - - -	86·87
	100·00

When on carrots:—

Casein - - - - -	4·20
Butter - - - - -	3·08
Sugar of Milk - - - -	5 30
Salts - - - -	0·75
Water - - - - -	86·67
	100·00

It will be observed that, according to the above tables, the effect of feeding cows on carrots is to occasion a slight diminution in the amount of casein and butter, but an increase in the quantity of sugar, while feeding them on beet-root reduces still more the quantity of casein and butter, but very largely increases the sugar, effects which, from the richness of carrot and beet in sugar, might have been anticipated.

As is well known, a very considerable number of the cows which supply London with milk, are kept in various confined and unhealthy places in the metropolis; such cows are seldom turned out to grass; the system of feeding adopted being altogether artificial and unnatural—grains and distillers' wash form the chief part of their food; these stimulate the animals unnaturally, and under the stimulus large quantities of milk of inferior quality are secreted, the cow quickly becoming worn out and diseased in consequence.

In reference to the effects of grains on cows, Mr. Harley makes the following remarks:

"Brewers' and distillers' grains, and distillers' wash, make the cattle grain-sick, as it is termed, and prove injurious to the stomach of the animal. It has been ascertained that if cows are fed upon these grains, &c., their constitutions become quickly destroyed." *

The *Veterinary Record* for April, 1850, publishes the annexed extract from a New York paper, which shows the effect of distillers' wash on cows:—

"There exists on Long Island, near Brooklyn, several manufactories of milk, the process of conducting which should be known; one of these dairies covers a space of 600 feet front, by 300 feet deep, carefully fenced in so as to be as private as possible, the business of the people being to drink the milk, not to know how it is made, in which enclosure 400 cows are kept the whole year round. These cows are fed on the refuse slop of whisky-distillers, and it is given to them warm. Such is the fondness of cows for this vile compound, that after having fed upon it for a week or more, their appetites become so depraved that they will take no other food. The result is, their milk-producing organs are stimulated to a wonderful degree; they yield enormously, but soon become diseased; their gums ulcerate; their teeth drop out, and their breath becomes fœtid. Though thus diseased, they do not fall away in flesh; but on the contrary, puff up and bloat to an appearance of great fatness; their joints become stiff, so that they cannot with ease lie down, and rarely, or never, come out alive. Bad as this is, their milk is afterwards mixed with molasses, water, and whiting, and these sold to the public of New York for pure milk! It is of course very injurious to children, who use it in much greater quantities than adults."

MM. Boussingault and Lebel, from experiments made, have arrived at the conclusion that the kind of food has not a great influence either upon the amount or composition of milk, provided quantities containing equal proportions of nutritious matter be given.

Influence of Temperature on Milk.—In hot countries and dry seasons the quantity of milk yielded is said to be less, but the quality is richer; it is also stated that cold favours the production of sugar and cheese, whilst hot weather augments the amount of butter.

It would be extremely desirable to ascertain precisely the extent to which the quality of milk is influenced by weather.

Influence of the Time and Frequency of Milking.—With regard to the quality of milk as affected by the time and frequency of milking, morning milk is said to be better than that obtained in the afternoon; and the milk of cows when milked but once a day only, is richer than either. It is the common belief that the last portion of the milk obtained at any milking is richer than the first; we have taken pains to ascertain whether there is any foundation for such an opinion, and find it to be really the case to a remarkable extent, as will appear from the following table:—

TABLE SHOWING THE DIFFERENCE IN THE QUALITY OF THE FIRST AND LAST MILK OBTAINED AT EACH MILKING.

1st Milk.

Afternoon.

Cows.	Milk. Spec. Grav.	Cream.
1	1027	9°
2	1026	13

* Harleian Dairy System, pp. 73. and 74.

Cows.	Milk. Spec. Grav.	Cream.
3	1027	8
4	1029	7
5	1030	11
6	1030	8
7	1029	$3\frac{1}{2}$
8	1031	2
		$61\frac{1}{2}$
	2nd Milk.	
1	1023	25
2	1023	22
3	1025	10
4	1024	15
5	1024	32
6	1022	25
7	1026	$7\frac{1}{2}$
8	1030	5
		$141\frac{1}{2}$

From an examination of these tables it appears that the second milks are of much lower specific gravity than the first; and hence, had the specific-gravity test alone been relied on, they would have been pronounced to be inferior in richness to the first; a conclusion the reverse of that which is correct. Thus, while the cream of the whole eight samples of the first milks amounted to $61\frac{1}{2}$ percentages, that of the last amounted to $141\frac{1}{2}$; that is, they contained more than double the quantity of cream. This fact is not without practical importance.

It is a common practice for invalids and others to procure their glass of milk direct from the cow; we thus perceive that in this way they seldom obtain the proper proportion of butter, a circumstance which may be of advantage in some cases, and of disadvantage in others. In London it is now common for cows to be driven through the streets, and to be milked in the presence of the purchaser; although in this way the buyer succeeds in procuring it genuine, he does not always obtain the best milk.

The great difference in the amount of cream contained in the first and last milk taken from the cow at one milking, appears to be satisfactorily explained on the supposition, that the fatty matter of the milk obeys the same law in the udder of the cow that it does when set aside in a vessel.

It is thus evident that even genuine milk varies exceedingly under different circumstances in the proportion of its several constituents.

On the Housing of Cows. — In a very useful little pamphlet, published some time since by Mr. H. Rugg, surgeon, on London Milk*, we meet with many particulars relating to the improper mode pursued in feeding and housing cows kept in various parts of the metropolis.

" Any place, any hovel," writes Mr. Rugg, "cow-keepers seem to consider, will do for a cow, — narrow lanes, confined corners, &c., — and yet they wonder how it is that they lose so many from disease. Can any one with a grain of common sense at all wonder that cows should be afflicted with disease when they are huddled together in a space that does not allow them sufficient breathing-room, with their heads placed close up to the wall, and without a sufficient current of air or ventilation? The carbonic acid expired from their lungs is, before it can rise, the greater part inhaled again, unmixed with a sufficiency of pure air, so necessary for the oxidation of the blood, and consequent vitality of the body.

" The air of the cow-houses is not alone vitiated by the exhalations of the lungs of the cows, but from the improper drainage of their sheds, and from the collections of all kinds of offal and filth and vegetable substances in a state of decomposition, together with pigs running about the place, or enclosed in one corner of the shed.

* Observations on London Milk, second edition. 1s. Bailey and Moon, Regent Street.

"It is really astonishing that cow-keepers do not see that the cause of their losing so many cows by disease is from those close, filthy, unventilated, damp, badly-drained, and ill-constructed sheds. They have it, in some measure, in their power, one would imagine, to remedy this deadly evil; but it appears they have very little regard either for the cleanliness of those sheds or their cows, though cleanliness should be the life and soul of a dairy in all its departments."

The late Mr. Harley, of Glasgow, who kept 300 cows, states that "in close, ill-ventilated cow-houses, the cattle will often be found in a profuse perspiration, which is brought on solely by their inhaling a vitiated atmosphere, deficient in vital air (oxygen gas). This necessarily exhausts their vigour, and makes them liable to be injured by cold; and when they are milked in these dirty hovels, the milk is always impregnated with foul air; thus the necessity of proper ventilation, and no stagnant water should be allowed to remain on the premises."*

"Milk," says Mr. Aiton, "which is one of our most nutritive species of food, is too apt to become neglected, and many have rejected it from a belief that it was seldom obtained free from impurities. The atmosphere of a cow-house not duly ventilated, and especially in the stenching lanes of a large town, the nastiness of the cows, want of cleanliness in those who feed and milk them, and the nature of the milk itself, so apt to become impregnated with foul air and every impurity, have often driven people who have a due sense of cleanliness, as well as those of delicate constitutions, who most needed that excellent restorative, from the use of it with disgust." †

Dr. Thompson, in his calculations on the amount of carbon consumed by a cow in her food, states, that if his views be correct, upwards of 6 lbs. of carbon are expended by a cow, daily, in the production of animal heat; and as one pound of carbon, when combined with the necessary amount of oxygen to form carbonic acid, gives out as much heat as would melt 104·2 lbs. of ice, it is evident that the quantity of ice capable of being melted by the heat generated by one cow in a day, would amount to upwards of 625 lbs., or it would heat one of water 87,528°. It would consume, at the same time, the enormous quantity of 330,429 cubic inches of oxygen gas, or 191¼ cubic feet; and as this amounts to one-fifth of the atmospheric air, we find that one cow, consuming 6 lbs. of carbon for respiratory purposes, would require 956¼ cubic feet of atmospheric air." ‡

We will conclude our remarks on the housing of cows by the following description of the actual condition of cow-sheds, taken from a pamphlet by the Hon. F. Byng, on the Sanitary Condition of the Parish of St. James's, Westminster:—

"Two of these sheds (of which there are fourteen in the parish) are situated at the angle of Hopkins and New Streets, Golden Square, and range one above the other, within a yard of the back of the houses in New Street. Forty cows are kept in them, two in each seven feet of space. There is no ventilation, save by the unceiled tile roof, through which the ammoniacal vapours escape into the houses, to the destruction of the health of the inmates. Besides the animals, there is at one end a large tank for grains, a store-place for turnips and hay, and between them a receptacle into which the liquid manure drains and the solid is heaped. At the other end is a capacious vault, with a brick partition, one division of which contains mangel-wurzel, turnips, and potatoes, and the other a dirty, yellow, sour-smelling liquid, called brewers'-wash, a portion of which is pumped up, and mixed with the food of the cows. The neighbours are subject also to the annoyance of manure-carts, which frequently stand some time in front of their houses; and when the mouth of the vault is opened, to admit the ingress of the brewers' wash, a 'burning sour smell' is described by them as pervading their dwellings. After the buildings have remained closed for the night, the atmosphere within becomes heated, foul, and unwholesome. In summer time the smell is most offensive. Decomposition of the vegetable matters in the vault is also stated to be frequent, and the stench thence arising insufferable.

"At the opposite side of the houses in the same street is another shed, with even less possibility of ventilation than in those just described. Thirty-two

* Harleian Dairy System, p. 14. † Aiton's Dairy Husbandry, p. 70.
‡ Thompson's Experimental Researches on the Food of Animals, p. 114.

cows stand side by side, two in each space of seven feet, as above. In Marshall Street there is a third establishment, containing twenty-eight cows. In a wall on one side, overlooking a yard in which is a slaughter-house, are several grated openings, but they are carefully covered with pieces of sacking, as if to prevent all possible admission of air. In this shed are receptacles for vegetables and grains as before: the manure-tank holds twelve tons, and that for brewers'-wash, 600 gallons.

"It is to be remarked that even the manure, from the nature of the food supplied to the cows, acquires a peculiarly unhealthy and offensive odour, altogether dissimilar to that from farm-fed animals. In this atmosphere, reeking with all these pestiferous effluvia, the poor creatures are kept close shut up, night and day, till their milk failing, they are consigned to the butcher.

"The effects of this system of feeding, impure air, and deprivation of all exercise, are thus described from actual inspection of four cows, which the keeper said were suffering from the old disease:—There was inflammation of the mucous membrane of the mouth, fauces, and gullet, a catarrhal discharge from the nostrils, and such prostration of the muscular system, as to render the animals unable to remain in a standing position for any length of time. The mucous membrane of the mouth is sometimes so blistered as to prevent the animals from taking food.

"Swellings of the udder appeared, attended by a change in the quality, and deficiency in the secretion of the milk. The feet also became much diseased and swollen; general emaciation followed, in which the animals continued for an indefinite period, or till death. Four months prior to this visit, the owner of one of the sheds lost thirteen cows by disease.

"A Dutch cow was pointed out to me, which was evidently in a state of marasmus, her head hanging nearly to the ground, the horns cold, the ribs staring through the hide on each side of her emaciated body, on which the hair bristled and stood erect. Notwithstanding this prostration of the vital powers, this cow was regularly milked with the others, furnishing a daily supply of two quarts.

"On inquiry, it did not appear that veterinary aid was ever sought; the only means used was to keep the poor animals as warm as possible."

Another matter for consideration is the neglected condition of the skin of cows.

"Cowkeepers," remarks Mr. Rugg, "never have the skins of their beasts regularly and properly groomed, which is equally necessary with respect to their health, and consequent good quality of their milk, as being well housed in properly constructed sheds. The cows would be more healthy, would yield more milk, and that of a very much better quality.

"It is impossible for cows to be healthy unless the insensible perspiration, as given off through the pores of the skin, goes on regularly and uninterruptedly, and this cannot be the case when they are kept in dirty cow-houses, and no care taken to remove the dirt by which these pores are obstructed. Cows, from not having that attention paid to the health of their skins, are frequently subject to diseases thereof, such as the mange, itch, &c. There is scarcely a cow-shed that one enters but some of the beasts will be found afflicted with the mange. I entered one shed under the Adelphi Arches, where forty cows were kept, and every one of them had that disease; also another shed in the same locality where the poor beasts never saw the light of heaven from year's end to year's end, the place being entirely lighted by gas, and the only ventilation that existed was by means of a small hole, not half a foot square, knocked out of the wall that forms part of the lane leading to the halfpenny steamboats."

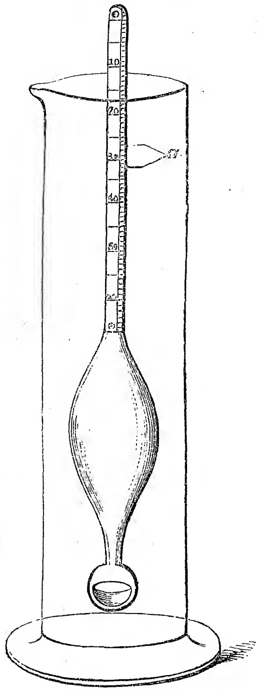
Analysis of Milk.

With the view of determining approximately the quality of milk, the following proceedings may be adopted:—

Method of determining the Specific Gravity of Milk.—First. The specific gravity should be ascertained.

The specific gravity or density of milk is usually determined by means of a common hydrometer, in using which the precaution should be taken to shake the milk up well, as, should the cream have collected on the surface, the specific gravity would be greatly affected thereby.

Fig. 103.
COMMON HYDROMETER,
(*Reduced one-half.*)



a, Range of pure milk.

As this report will probably fall into the hands of many persons unacquainted with the nature of the hydrometer, and as it is desirable to simplify as much as possible the means to be pursued in determining the quality of milk, we append a drawing, showing the construction of the ordinary hydrometer.

According to M. Lassaigne and other observers, the ordinary specific gravity of cow's milk at 50° Fahr. is 1031; as will presently appear by our own observations, the specific gravity is liable to the greatest variation, and but seldom reaches the density given by M. Lassaigne. It must be borne in mind, however, that temperature affects somewhat the specific gravity of milk, but unless the extremes be very great this circumstance will scarcely make any material difference in ordinary observation, and it will hardly be necessary to employ a thermometer, and to make corrections for ordinary variations of temperature.

Fat being lighter than water, according as the amount of this varies in any sample of milk, so will that milk vary in specific gravity; if the quantity be very considerable, *cæteris paribus*, the milk will be so much lighter; but if very little, the density will be so much the greater. This is readily shown by taking the specific gravity of milk after the removal of the fat, as of skim milk or serum; if the quantity of fat be very considerable, the difference of specific gravity will amount to several degrees: thus a milk may be of a low density from excess of fat, or it may be of high specific gravity arising *partly* from the deficiency of it. In most cases, however, a high specific gravity obtains in milk possessing the ordinary per-centages of cream. In some samples we have observed both a high specific gravity and excess of cream; this must have arisen from the presence of a large quantity of cheese or sugar.

The effect of the fat of milk in decreasing its specific gravity is strikingly shown in the following table, from which it appears that the specific gravity test is highly fallacious, and that very frequently the richness of milk is in an inverse ratio to that of its density; a conclusion which is just the very opposite to that commonly taught and believed.

TABLE SHOWING THE VARIATION IN THE SPECIFIC GRAVITY OF GENUINE MILK, AND THE RELATION OF THIS TO THE PER-CENTAGES OF CREAM.

Cows.	Milk. Spec. Grav.	Skim. Spec. Grav.	Cream.
1	1031	—	2°
2	1029	—	2½
3	1019	1027	26
4	1008	1026	80
5	1030	—	2½
6	1027	1030	9
7	1026	1028	13
8	1029	1030	8
9	1030	1031	7
10	1024	1028	10
11	1027	1031	10
12	1023	1030	25
13	1024	1031	32
14	1025	1029	10

The above tables include samples of both morning and afternoon milks, as well as some of the first and last milk obtained at the same milking; they are not, therefore, to be taken as average samples of milk.

From an examination of the table, it appears that a milk may be of high specific gravity, and yet yield but little cream (see 1); or it may be of low specific gravity, and yet afford a very large quantity of cream (see 4); also, that the removal of the cream increases the density of the milk (skim milk) several degrees. It will be observed that not one of the samples in the table shows a low specific gravity with deficiency of cream. We have never met with a natural milk of this kind, and believe it to be of very rare occurrence.

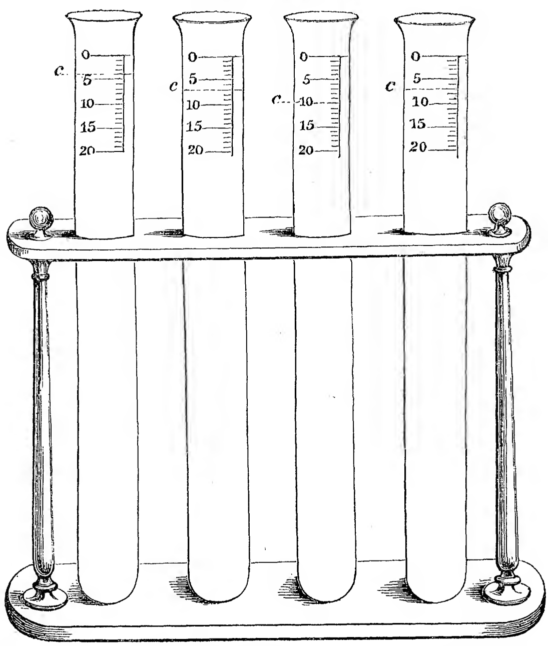
Method of determining the Cream.—Second. The amount of cream should be ascertained.

The amount of cream is determined by means of an instrument invented by the late Sir Joseph Banks, termed a *lactometer*. This consists of a tube, usually eleven inches long and half an inch in diameter; ten inches of this are graduated in tenths of an inch—that is, in hundredths of the whole. The tube is filled with milk, and set aside for twelve hours; the cream ascends to the surface, and its amount is determined by the thickness of the stratum formed, and which is ascertained by noting the number of degrees or tenths through which it extends.

Some lactometers resemble test-tubes in shape, and, like them, are supported in racks; they are usually graduated only in the upper two inches; others are provided with feet, and are graduated throughout their whole length. As the quantity of cream not unfrequently exceeds twenty per cent., the tubes should in all cases be graduated for nearly their whole length. As already referred to, we obtained one sample of milk from the cow, which contained eighty per cent. of cream.

The construction of the lactometer is shown in the accompanying woodcut, representing a rack, holding four of these instruments.

Fig. 104.
LACTOMETER AND STAND.
(*On a reduced scale.*)



The dotted lines indicate the per-centages of cream on four samples of milk from different cows after standing twelve hours.

Cream forms more quickly in warm than cold weather, and in making comparative observations on a number of samples, it is proper that each should be set aside in lactometers, at the same time and for the same period.

The thickness of the stratum of cream formed on genuine milk is, like the specific gravity, subject to considerable variation: in two extreme cases we have met with, one of the samples showed but *two* degrees of cream, and the other *eighty*. According to Dr. Normandy, the thickness of the stratum of cream on pure milk is generally from eight to eight and a half per-centages. M. Dinocourt finds the per-centages to range between 9 and 14, while, according to our observations, the average does not exceed $9\frac{1}{2}$.

It must be remembered that London milk, as delivered to the houses, consists in general of the milk of different cows mixed together; and therefore, in order to determine what ought to be the depth of cream formed on good milk, we should take the average amount obtained from such mixed milks.

We have said that the quantity of cream varies much in different samples of genuine milk; and not only is this the case, but it should also be known that the amount of cream yielded by any sample of milk is no certain criterion by which to judge of its quality, as some milks are rich in cream and deficient in casein and sugar, and *vice versâ*.

It is stated that the addition of a small quantity of warm water to milk increases the amount of cream: the belief in the accuracy of this statement is general, and it is commonly acted upon by milkmen; nevertheless, the assertion is entirely erroneous — the addition of water to milk does not increase the quantity of cream; it merely facilitates and hastens, in a most remarkable manner, its formation and separation, as is shown by what follows: —

Six lactometers were filled, one with pure milk, the remainder with the same milk diluted respectively with ten, twenty, thirty, forty, and fifty per-centages of water.

Twenty minutes after the addition of the water, the lactometer showed in the milk containing fifty per cent. of water, six degrees of cream; in that with forty per cent., five degrees; with thirty per cent., four degrees; with twenty per cent., three degrees; with ten per cent., one degree; and in the pure milk, half a degree only.

At the end of forty minutes, the cream stood thus: six and a half degrees on the milk containing fifty per cent. of water; six on that with forty per cent.; five and a half on that with thirty per cent.; five on that with twenty per cent.; four and a half on that with ten per cent.; and four on the pure milk.

At the end of twelve hours, the milk with fifty per cent. of water showed five degrees of cream; that with forty per cent., five degrees and three-quarters; that with thirty per cent., six and a half degrees; that with twenty per cent., seven degrees and a quarter; that with ten per cent., eight degrees; and the pure milk, nine degrees of cream.

It thus appears, that the addition of a large quantity of water to milk occasions an almost immediate formation of cream, but does not augment the amount; of this fact, in some cases, it would be an advantage to dairymen to avail themselves. The addition of water to milk of course lessens its specific gravity, and so facilitates the ascension of the cream.

Method of determining the Fatty Matter. — Cream is nearly identical with the fatty matter of milk; but as only part of this rises to the surface, part remaining diffused throughout the liquid, in determining the amount of cream, we do not succeed in ascertaining the entire quantity of fatty matter present, and which it is often necessary to do.

For this purpose acetic acid is to be added to a measured or weighed quantity of milk: the acid precipitates the casein, and this, in separating, becomes incorporated with nearly all the butter, the two together forming the curd; this is to be collected on a weighed filter, dried by means of blotting-paper, and the fat dissolved out with ether; the etherial solution is next to be evaporated in a weighed capsule, with a gentle heat, the weight of the residual fat being ascertained by the increased weight of the capsule. This method for determining the richness of milk in butter is of course much more accurate than that by the lactometer.

Another means of ascertaining the amount of butter in milk is by the Lactoscope.

The Lactoscope. — Some years since, an instrument termed a lactoscope was invented by M. Donné, of Paris, for determining the richness of milk, by estimating the quantity of butter contained in it.

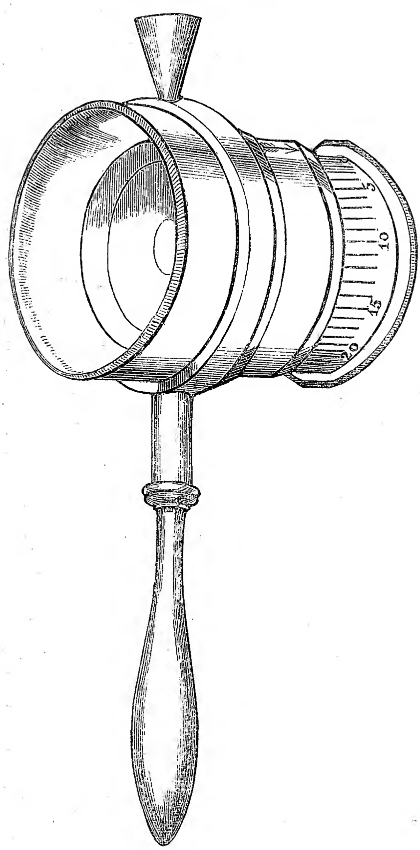
We have procured one of these instruments, accompanied with a description, and directions for its application; from these we extract the following observations: —

" Milk owes its white dense colour to the globules of fatty matter or butter which it contains; the more numerous these globules the more opaque is the milk, and the more, at the same time, is it rich in the fatty part or in cream, the more or less opacity being in relation with its principal quality — its richness in cream; the measure of this opacity is capable of giving then, indirectly, the measure of the richness of the fluid, and of indicating its value.

" But the degree of opacity of milk cannot be appreciated upon a mass of the fluid; it is not possible to measure it but in very thin layers, and it is this which is done with our lactoscope. This instrument is constructed in such a way that the milk may be examined in it in layers of every thickness, from the thinnest, through which all objects may be distinguished, up to that which allows of nothing to be perceived; it gives at once the richness of milk in indicating the degree of opacity to which the proportion of cream stands in relation.

" The instrument consists of a kind of eye-glass, composed of two tubes sliding one within the other, furnished with two parallel glasses, which approach each other up to contact, and separate more or less the one from the other at will by means of a very fine screw; a little funnel destined to receive the milk is placed at the upper part; on the opposite side is fixed a handle, which serves to hold the instrument. The tube which screws within the other forms the anterior or ocular part, that to which the eye is applied; it is marked with divisions to the number of 50, and figures which indicate the richness of the milk.

Fig. 105.
THE LACTOSCOPE.



" A few drops of the milk to be examined are poured into the funnel. It is necessary to take the sample of milk from the mass of the milk, and not the surface of the liquid only, where the layer of cream collects; if then the milk has been at rest for some time, it must be agitated a little in order to mix all the parts.

" The funnel being full, the ocular tube is turned from right to left, until the liquid has penetrated between the plates of glass, and collected at the bottom; the ocular tube is then turned in the contrary direction, from left to right, and one looks through it until the flame of a taper or candle can be distinguished. At this point stop and impress a slight rotatory movement, until, by a little manipulation, the light is lost to view, without going beyond the moment when it is extinguished, so to speak, and ceases to be perceived; that is the point, definitely, where it is necessary to stop; it is only then required to read the figure of the division to which the arrow corresponds; that we suppose will be 25. The annexed table shows to what degree of richness, or to what proportion of cream the figure corresponds.

"The light ought to be placed at about a metre (at least three feet) from the observer; a greater distance will not impair the accuracy of the operation, but it is not the same if one looks from too near.

"One may assure himself of the accuracy of the instrument by adding a very small quantity of water, or even gruel, to the milk. Twenty degrees of water are sufficient to change the transparency of the liquid; thus milk marking 25, will mark 28 or 30 on mixing with it a little water.

"At the moment when the milk is introduced between the two plates of glass, it commonly happens that bubbles of air are enclosed in the layer of liquid; it is necessary to drive them out, and this is easily done by impressing certain movements on the milk, by separating more or less the eye-piece so as to cause the two plates of glass to withdraw and approach each other alternately. When the trial is terminated, the eye-piece is to be removed so as to clean the instrument perfectly, and to wipe the glasses; the glasses ought always to be very bright, and one ought to avoid, during the observation, to tarnish with the breath the glass of the eye-piece."

Table indicating the Richness of different kinds of Milk, after the Degree which they show on the Lactoscope.

Milk of cow, giving about 5 per cent. of cream, shows 40 to 35 on the lactoscope.
Ditto ditto, ordinary, giving from 5 to 10 per cent. ditto, shows 35 to 30 on the lactoscope.
Ditto ditto, sufficiently rich, giving from 10 to 15 per cent. ditto, shows 30 to 25 on the lactoscope.
Ditto ditto, very rich, giving from 15 to 20 per cent. ditto, shows 25 to 20 on the lactoscope.
Ditto ditto, excessively rich (last extraction), shows 20 to 15 on the lactoscope.
Ditto ditto, very weak (first extraction), shows 150 to 3 on the lactoscope.
Milk of the common ass, of good quality, shows from 50 to 80 on the lactoscope.
Ditto, very weak, shows from 150 to 20 or 4 on the lactoscope.
Milk of goat, rich, shows 10 to 15 on the lactoscope.
Milk of woman, rich and substantial, shows 20 to 25 on the lactoscope.
Ditto, medium, shows 30 to 35 on the lactoscope.
Ditto, weak, shows 40 to 45 on the lactoscope.

It must be remembered that the lactoscope has regard only to one element of milk, and does not estimate the amount of sugar or cheese. M. Donné entertains the greatest confidence in the indications which it affords.

The construction of the instrument, and mode of employment, will be more clearly understood from an examination of the woodcut on the preceding page.

Method of determining the Cheese.—The curd which is formed in milk on the addition of rennet or acetic acid consists, as we have more than once explained, of both the butter and cheese: the former being dissolved out by means of ether, the residue, which is not acted upon by that menstrum, consists of cheese; this is to be dried in a water-bath, and its amount determined by weighing. Thus, the process employed for ascertaining the quantity of butter, up to a certain point serves also for determining the quantity of cheese. A tolerably accurate knowledge of the quality of milk may be obtained by simply ascertaining the relative weights of the curd yielded by different milks when carefully dried.

Some persons form their judgment of the quality of milk simply by its density, regarding all samples which do not indicate a certain specific gravity of inferior quality. We have already seen that this method is very fallacious, and that by it some milks, rich in cream, would be pronounced of inferior quality, in consequence of their low density; while others deficient in that constituent, would be declared of superior quality, on account of their high density.

Others rely upon the indications afforded by the lactometer, which also has its fallacies, but which are not so great when the instrument is used with the necessary precautions, as those relating to the specific gravity of milk. Like the lactoscope of M. Donné, the lactometer has regard to only one component of milk—namely, the fatty matter.

The following facts will show how fallacious is the lactometer in some cases. We have met with several samples of genuine milk, which gave only three or four per-centages of cream, but which yet possessed a specific gravity of 1830: judged by the lactometer-test alone, such milks would be pronounced by all as very poor, and by others even as adulterated. Now the conclusions would be to a very great extent erroneous; for such milks, although certainly deficient in butter, have the full proportion of the remaining constituents—namely, the cheese and the sugar. Again, we constantly meet with samples of milk giving six, eight, or more per-centages of cream, and which nevertheless, as shown by the specific gravity of the serum, were unquestionably adulterated with large quantities of water.

The observer who relied upon the indications of the lactometer would have regarded such samples as of average quality. The inquirer, therefore, should not rely solely upon the specific gravity or lactometer-tests, but in all cases employ both, the one acting as a corrective of the fallacies of the other.

For all practical purposes, the above methods of examination are sufficient. Should it be desired to institute a very careful analysis, we may then adopt the process described by Haidlen.*

The Butter.—The weighed quantity of milk is mixed with one-sixth of its weight of common unburnt gypsum, previously reduced to a very fine powder. The whole is then evaporated to dryness, with frequent stirring, at the heat of boiling water; a brittle mass is obtained, which is reduced to a fine powder. By digesting this powder in ether, the whole of the butter is dissolved out, and by evaporating off the ether, may be obtained in a pure state, and weighed; or the powder itself, after being treated with ether, may be dried and weighed; the butter is then estimated by the loss.

The Sugar.—After the removal of the butter, alcohol is poured upon the powder, and digested with it. This takes up the sugar with a little saline matter, soluble in alcohol. By evaporating this solution, and weighing the dry residue, the quantity of sugar is determined; or, as before, the powder itself may be dried and weighed, and the sugar estimated by the loss. If we wish to estimate the small quantity of inorganic saline matter which has been taken up along with the sugar, it may be done by burning the latter in the air, and weighing the residue.

Saline Matter.—A second weighed portion of milk is now carefully evaporated to dryness, and again weighed. The loss shows the quantity of the water. The dried milk is then burned in the air. The weight of the incombustible ash indicates the proportion of inorganic saline matter contained in the milk.

The Casein.—The weight of the butter, sugar, saline matter, and the water, being thus known, and added together, the deficiency shows the weight of the casein.

If preferred, the following process, by Professor Poggiale †, may be adopted:—

"As none of the processes hitherto known furnish a quick and accurate indication of the richness of milk, I imagined, that if we could determine, without the balance, by the method of volumes, one of its constituent elements, the problem would be solved. I believe I have succeeded in attaining the result by ascertaining the proportion of the sugar of milk. Several samples of pure milk have been submitted to chemical analysis.

"The following is the mean of ten analyses:—

Water - - - - -	862·8
Butter - - - - -	43·8
Sugar of milk - - - -	52·7
Casein - - - - -	38·0
Salts - - - - - -	2·7
	1000·0

"Thus, according to my experiment, 1000 grammes of milk contain 52·7 grammes‡ of sugar. M. Boussingault found, in a series of observations, a mean

* Annalen der Chemie und Pharmacie, xiv. p. 263; copied in "Mitchel's Treatise," p. 78.
† "On the Estimation of the Sugar of Milk and Determination of the Richness of Milk," Prof. Poggiale. *Chemical Gazette*.
‡ The gramme weighs 15·4330 grains.

of fifty grammes, a difference which is undoubtedly owing to the process followed for its determination. The quantity of sugar contained in milk is considerable, and moreover, presents but slight variations. The process which I propose is the application of that of M. Barreswil to the estimation of the sugar of milk, which, like glucose, reduces the salts of copper, and the proportion of salt of copper decomposed will afford the amount of sugar of milk.

"*Preparation of the Test-liquor.* — This is prepared by adding to a solution of sulphate of copper, bitartrate of potash, and dissolving the precipitate which is formed in caustic potash. The strength of the alkaline solution is then determined with great care, from the quantity of sugar employed to decolorize a known volume of the liquid. It is important to observe that milk-sugar, and not cane-sugar, must be employed in this operation. I made several experiments, in order to avoid the determination of the strength of the solution of binoxide of copper, which is decidedly the longest and most delicate experiment. The following proportions constantly furnished a liquid, twenty cubic centimètres of which correspond to 0·200, or two decigrammes, of whey: —

	Grammes.
Crystallized sulphate of copper	10
Crystallized bitartrate of potash	10
Caustic potash	30
Distilled water	200

"The filtered liquid is perfectly clear, and of an intense blue colour.

"*Preparation of the Whey.* — To determine the amount of sugar-of-milk, it is indispensable to separate the fatty matter and the casein by coagulation. This is easily effected by placing fifty or sixty grammes of the milk in a small flask, adding to it a few drops of acetic acid, and then raising the temperature to between 104° and 122°. A transparent liquid is obtained on filtration. According to my experiments, 1000 grammes of milk yield 923 grammes of whey, which gives for 1000 grammes of whey about fifty-seven grammes of sugar.

"*Examination of the Whey.*—Twenty cubic centimètres of the test-liquor are introduced by means of a pipette into a small flask, which should be preferred to a porcelain capsule, as it allows of the liquid being seen from top to bottom, and of observing with the greatest ease the moment the decolorization is complete. The liquid is then boiled. On the other hand a burette, each division of which is equal to a fifth of a cubic centimètre, is filled with the whey and poured drop by drop into the liquid, agitating the latter continually, and heating it after each addition of whey. This is continued until the blue tint has entirely disappeared. At first, a yellow precipitate of hydrated protoxide of copper is formed, which, however, soon turns red, and sinks to the bottom of the flask. When the operation is terminated, the quantity of whey employed is read off the burette, and the weight of sugar contained in 1000 grammes of whey determined by the rule of three.

"I admitted above that 1000 grammes of whey contain fifty-seven grammes of sugar; we must, however, not be particular about a few grammes, more or less. The most usual adulteration, the addition of water, is easily detected by estimating the sugar. It is, however, possible that the cream might be removed without any addition of water, or with the addition of cane-sugar, or sugar of milk. In this case, I determined by a simple and quick process the quantity of fatty matter, by adding acetic acid to the milk, boiling and agitating it after cooling with ether, which removes the butter. The ethereal solution is decanted and evaporated. It is frequently advisable to repeat the examination of the whey, which, as all the arrangements are made, and the strength is nearly known, does not occupy more than one or two minutes."

The Centesimal Galactometer.

Some years since an instrument was invented by M. Dinocourt *, under the above name, for determining the goodness and purity of milk. In a pamphlet explanatory of the use of the galactometer, we meet with the following description of the instrument: —

"The centesimal galactometer is an aerometer of the ordinary form. It differs from it only by its special graduation. Its name, drawn from two Greek

* Constructeur d'instruments de physique, et de chemie en verre, 9, Quai St. Michel à Paris.

words, signifies *measure of milk.* This instrument is used to comparé the different kinds of the milk of cows, in relation to their density, and consequetly not make known their degree of purity.

"The centesimal galactometer is represented in the accompanying figure; it is composed—

1st. Of a stem *A a*, enclosing scales.

2nd. Of a cylinder *B*, serving to float it.

3rd. And of a bulb *C*, charged with shot, serving as a ballast, so that the instrument floats upright in the milk. Of these three parts, it is only necessary to well understand one, that which encloses the scales *A a*; the scale *A*, *in part coloured yellow*, serves to weigh the milk with its cream; the first degree on the top of the scale is marked 50. The following extend from 50 to 100 and over.* Each degree starting from 100 in mounting up to 50 represents a hundredth of pure milk; the degrees formed by a line are equal, as 50, 52, 54, &c.; the degrees formed by a dot are unequal degrees, as 81, 83, 85, &c. To comprehend well the value of the degrees of this scale, it is sufficient to give an example:—Supposing then that the galactometer is sunk to the 85th degree, that will indicate 85-hundredths of pure milk, and consequently that 15-hundredths of water had been added to this milk; the galactometer is stopped at 60 degrees, there will be 40-hundredths of water, or four-tenths of water added. We see from this that in adding to the number of hundredths indicated by the instrument a complementary number to form one hundred, this complementary number will give in hundredths the quantity of water added to the milk under trial. If we wish to avoid reckoning by hundredths, one may count only by tenths; we have only to notice that the first tenth is white, that the second is coloured yellow, the third is white, the fourth yellow, and that the fifth is also white. This alternation of white and yellow gives a very evident demarcation between each tenth; towards the middle of each tenth we have placed the figures 1, 2, 3, 4, 5, to indicate their order.

"The space comprised between 100 to 120 is also coloured yellow; this comprehends the different densities of pure milk—that is to say, without the extraction of cream, as well as without the addition of water; we have prolonged the scale from 120 to 136, so that it may serve in all cases.

"The scale *a*, in part coloured blue, is destined to weigh skim-milk; it is, like the first, divided into 100 degrees or hundredths, of which the first 50 have been cut off as useless; each degree commencing from 100 to 50, and amounting upwards represents a hundredth of pure skimmed milk; consequently, the manner of estimating the quantity of water added to skim-milk is absolutely the same as for pure milk with its cream; the examples given for estimating the value of pure milk are applicable to skim-milk. We may equally confine ourselves to estimating the value by tenths; these tenths, alternately coloured blue and white, are sufficiently distinct not to be confounded.

"These two scales give the value of milk only in hundredths; nevertheless, it will always be easy to compare these degrees with the density *or specific gravity of milk;* we understand by the word *density* the specific weight of any liquid, water being taken as a thousand, a litre of distilled water weighing 1000 grammes or one kilogramme, at the temperature of 4° of the centigrade thermometer.

"If now we wish to know the density of the milk under trial, we call to mind that 50 degrees of the scale *A* of the galactometer corresponds exactly with 1014 degrees of the densimeter of M. Collardeau†, and that each tenth of the scale of the galactometer is equal to three degrees of the densimeter; consequently, three-tenths and a third are equal to a degree of this densimeter; thus, 1014 correspond to 50, 1017 correspond to 60, 1020 correspond to 70, &c."

It will be perceived that this instrument is essentially a densimeter or measurer of specific gravity, and since the specific gravity of milk is subject to great variation from natural and other causes, the galactometer is of course, to a great extent, liable to the same fallacies as the densimeter or hydrometer, although both are capable of affording useful indications.

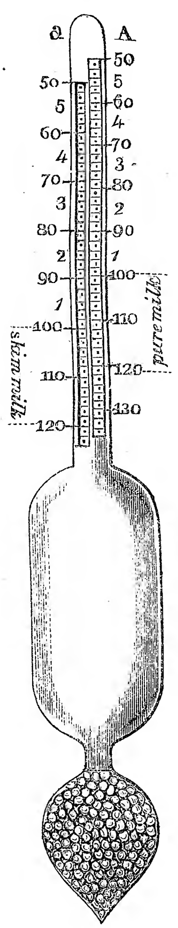
* It will be seen that this scale has been cut down to half its graduation, and that its 0 corresponds to distilled water; we have suppressed the first 50 degrees, which would have lengthened the stem of the instrument, and have rendered it more fragile without any utility.

† *a* 15° centigrade.

Pure milk not deprived of its cream has a less specific density than skim-milk caused by the lightness of the cream. If the cream be either in part or wholly removed from milk, the residual milk will weigh heavier than that which contains its normal proportion of cream. Skim-milk, therefore, tried by the galactometer scale, for pure milk only, would give a higher specific gravity than ordinarily belongs to pure milk, and hence the error might be committed of supposing it to be pure, an error which can only be corrected by means of the lactometer, by estimating with it the per-centage of cream; should this per-centage fall short of that which is proper to pure milk, the sample of milk is one the value of which should be determined by the scale for pure skim-milk.

Again, if to such skim-milk we add a certain per-centage of water, we restore to it its proper specific gravity, and therefore this milk would show, with the centesimal galactometer, the density proper to pure milk, and hence this fraud would escape detection. In order to meet cases of this kind, which are of frequent occurrence — namely, the complete or partial removal of the cream, it is recommended, and indeed necessary, to employ the lactometer, and ascertain by it whether the sample under examination contains the proper proportion of cream or not; indeed, it is scarcely possible in any case to come to certain or safe conclusions without employing the lactometer.

Fig. 106.
THE CENTESIMAL GALACTOMETER.
(*On a reduced scale.*)



Where the specific gravity of a milk is very light, and this not produced by a large excess of cream, it is due to the admixture of water, the quantity of which may be determined with considerable accuracy by the common hydrometer, but still more accurately by the centesimal galactometer.

The reason for having two scales, one for pure and the other for skim-milk, it will be perceived, is on account of the very different densities possessed by each.

The great advantage of the centesimal galactometer consists in its centesimal graduation, whereby calculation is so much facilitated, and in the wide range of degrees which it affords; thus, while in the hydrometer the range of degrees from pure milk to milk adulterated with fifty per cent. of water is only from 16° to 1031°, that in the centesimal galactometer is from 50° to 130°; by which arrangement far greater accuracy in estimating the density of milk is obtained; thus, three degrees and one-third of the galactometer, as we have seen, correspond with one degree of the densimeter of M. Collardeau.

It is proper, in using the ordinary hydrometer, where the extremes of temperature are great, as in winter and summer, to take the specific gravity of milk, and to make allowance for the difference which temperature occasions; this precaution being necessary with the hydrometer, it is very much more so with the centesimal galactometer, in which, from the delicacy of the graduation, a comparatively slight alteration of temperature occasions a difference of several degrees.

When it is desired to make use of the scale for skim-milk, the temperature and specific gravity should be determined precisely as in the case of pure milk. One portion of the skim-milk is to be set aside for from twelve to twenty-four hours in a lactometer; another in a pan for the same length of time: the per-centage of cream to be noted in the lactometer, and the density of the milk in the pan, after being skimmed, taken in the ordinary manner with the centesimal galactometer, corrections being made for the temperature.

The pamphlet of M. Dinocourt is accompanied with coloured tables of corrections, in which allowance is made for temperature,—that is, the apparent degrees are reduced to real,—the degrees of the hydrometer or densimeter corresponding with those of the centesimal galactometer are shown side by side.

Considered altogether, the centesimal galactometer of M. Dinocourt is capable of affording, especially when used in connection with the lactometer, very useful and accurate indications; much more so than the ordinary hydrometer, the use of which, in taking the specific gravity of milk, ought entirely to supersede it.

We are glad to hear that Mr. Griffin, Manufacturer of Chemical Apparatus, proposes to introduce this instrument into this country, and is about to make it at a cost which will render it accessible to all.

Its construction will be comprehended from the figure appended.

Of all the constituents of milk the sugar is the least subject to variation, and as the density of the serum of milk is principally due to the sugar, its specific gravity of course is also but little liable to alteration. This statement is founded upon the results of numerous observations. It therefore long since occurred to us, that the utility of the galactometer might be greatly enhanced by the addition of a centesimal scale for the serum of milk. The advantage of this scale would be that, starting from a fixed point, the normal specific gravity of the serum, it would show, with very great nicety, the extent of the more usual adulteration of milk, being that with water; for in proportion as water is added, so does the weight of the serum diminish, and this in such a marked manner that the quantity of water added may readily be determined in per-centage. We had intended either to have had an instrument specially constructed to show the varying specific gravity of the serum under different additions of water, or to have modified for this purpose the centesimal galactometer. Pressing engagements have, however, up to this time prevented our giving the necessary attention to the subject. Numerous observations are first required, in order to fix accurately the normal specific gravity of the serum of the milk of the cow.

Adulteration of Milk.

Before proceeding to make known the results of our own observations bearing on the adulteration of milk, in accordance with our usual practice, we now give the investigations and remarks of other writers on this subject.

Adulteration with Water.—In reference to this adulteration, Mr. Mitchell makes the following observations:—

"This is the substance that is employed most generally in the adulteration of milk. This fraud is difficult of detection, more especially when the quantity employed is very small.

"The following comparative experiments have been made*:—

The general density of pure milk is about - -	1·038
A mixture of 75 parts milk and 25 of water has a density -	1·021
A mixture of 66 parts milk and 33 of water has a density -	1·020

"The density of pure milk being variable, it may be readily seen that it is impossible to arrive exactly at the truth, by the density of milk examined, as to the quantity of extra-contained water.

"The truth can only be comparatively arrived at, by ascertaining the *minimum* density of pure milk, and seeing whether the density of the examined sample be above or below that.

"Not only is water added to the milk, but cream, at the same time, abstracted. These two operations cause in the appearance of the milk a very considerable difference, for merely by the abstraction of the cream the residual milk takes a flimsy look, so to speak, together with a bluish tinge. These appearances increase when water has been added, and, in order to mask the two previous impositions, a third, fourth, or even fifth must be practised.

"In order to ascertain whether a partially skimmed milk has been supplied, we must either ascertain the amount of butter, by one of the processes already pointed out, or have recourse to an instrument termed a *lactometer*."

In reference to the same adulteration, Dr. Normandy's work contains the subjoined remarks:—

* "Dictionaire des Réactifs Chemiques." Par M. J. S. Lassaigne. Article Milk.

"The most frequent, and, one might say, the unexceptionable adulteration of the milk sold in towns, consists in an addition of water. Pure milk having a mean density of about 1·031, or 1·030, the addition of water may, to a certain extent, be detected by means of the specific gravity bottle, or hydrometer. According to M. Lassaigne, the specific gravity of cows' milk, at 50° Fahr., is 1·031; and it would appear that an addition of one-quarter or one-third of the volume of such milk is necessary to lower its gravity to the extent of 0·017 or 0·018. The results of M. Lassaigne's experiments are as follows: —

Pure milk at 50° Fahr.	1·031
73 parts of milk with 25 parts of water	1·021
66 ,, 33 ,,	1·020

"The specific gravity, therefore, proves only that the density of milk should never be below 1·031 or 1·030; but can give no indication respecting the quantity added up to one quarter.

Adulteration with Flour or Starch. — "The simplest indication of the existence of flour or starch in milk is that of small diaphanous clots, which may be seen on the sides of the vessel containing it, if it be transparent. Milk containing starch burns more readily on the bottom of the vessel in which it is boiled than pure milk. This, however, is an equivocal test.

"The best test is to add to a portion of the whey of the suspected milk a small quantity of tincture of iodine; if starch be present, a blue colour will become apparent." * — *Mitchell.*

"The milk should first be coagulated, by boiling with it a little acetic acid, and it is then filtered. The filtered serum is allowed to cool, and when quite cold, it is tested with a few drops of a solution of iodine. If this produces a blue colour, it is a sign that *starch*, *flour*, or a *decoction of bran*, of *barley*, or *rice*, or some other *amylaceous* substance, has been added." — *Normandy.*

Adulteration with Milk of Almonds. — "This is very little used, on account of its expense; but when it is employed, it may be thus detected. To about a quarter of an ounce of the milk, add a few grains of amygdaline, and stir well. If it contains milk of almonds, the odour of *bitter* almonds will be developed in a few minutes; if the milk be pure, no peculiar smell will be produced." — *Mitchell.*

Adulteration with Gum. — "This is seldom employed, like the last-named substance, on account of its expense. The following is the method of discovering it: — Coagulate the milk by ebullition with a little acetic acid; filter off the whey, and pour into it a small quantity of alcohol; a dull, opaque, and abundant white precipitate will fall, which, if collected, may be proved to be gum by its properties.

"If the same course of treatment be pursued with pure milk, a very light, bluish-white precipitate falls, somewhat diaphanous, and in a very small quantity." — *Mitchell.*

"When *gum-arabic* or *dextrine* has been mixed with milk, its presence may be detected by pouring alcohol in the serum or liquor filtered from the coagulum produced by acetic acid, because a white, opaque precipitate is then formed, very different from the light, bluish, and diaphanous flakes which alcohol produces in pure milk, which are besides much less abundant. The precipitate produce may be separated by filtering, and identified as gum or dextrine by drying.

"The addition of gum-arabic to milk seems hardly probable, at least practically, since it scarcely affects the density of the milk. According to M. Quevenue, an addition of not less than 1582 grains per quart of water is required to bring it to a density of 1·030, which is about the density of milk. The fraud would therefore be unprofitable, and consequently is not very likely to take place." — *Normandy.*

Adulteration with Gum Tragacanth "is sometimes employed in the state of mucilage to augment the volume of the cream in ordinary milk, or to stimulate its presence on skim-milk. Gum tragacanth may be detected by boiling the milk, and leaving it at rest for some hours; a gelatinous, translucid deposit is then formed, which being washed with a small quantity of water, and tested by

* Des Falsifications des Substances Alimentaires, par Garnier et Harell, p. 278.

a few drops of solution of iodine, produces a blue colour, because gum tragacanth contains starch.

Adulteration with Chalk. — "The common notion of milk being adulterated with chalk, or *whiting*, is unfounded. Such an adulteration is not practicable without being immediately detected; because the smallest quantity of *whiting*, or chalk, speedily separates, and falls to the bottom. I have been frequently called upon to examine samples of milk supposed to be sophisticated with whiting, but a chemical examination of the milk always proved the contrary. That a liberal quantity of water is often added to the London milk admits of no doubt." — *Accum.*

The presence of this body may be determined by evaporating and igniting a portion of the milk, treating the residue with a small quantity of hydrochloric acid, and filtering. If, on the addition of a few drops of a solution of oxalate-of-ammonia, a tolerably abundant precipitate is formed, chalk is present in the milk. A very slight precipitate always takes place under these circumstances with milk.

Adulteration with Turmeric. — "*Turmeric* may be detected by evaporating a portion of the milk to about one-eighth its bulk, and then adding caustic potash in small quantity. If the yellow colour of the milk be rendered brownish, turmeric has been added. A solution of this substance is added for the purpose of producing in milk a richness of colour, serving to prevent dilution with water and abstraction of cream being apparent." — *Mitchell.*

On the addition of Carbonate of Soda to Milk. — "In order to prevent milk from turning sour, or from coagulating, a little carbonate of soda may be, and is sometimes, added; milk may thus be kept for eight or ten days. This addition is harmless, provided the quantity added be not too great. According to D'Areet, $\frac{1}{2000}$ part of bicarbonate of soda is sufficient for the purpose. The carbonate of soda in milk may always be detected by adding to the milk its own weight of strong alcohol, by which the caseum is separated; both the caseum in the filter, and the liquor filtered therefrom, being tested with red litmus paper or turmeric paper, an alkaline reaction will be observed, if carbonate of soda is present, that is to say, the reddened litmus paper will be rendered blue, and the turmeric paper brown. Moreover, if the filtrate be evaporated to dryness, and an acid poured on the residuum, a perceptible effervescence will be observed, which is due to a disengagement of carbonic acid gas, from the decomposition of the carbonate of soda by the acid employed. Pure milk treated in the same manner yields a caseum and serum, which is neutral to test-papers, or which has a slightly acid reaction, and the dry residue of the evaporated serum never effervesces when treated by an acid." — *Normandy.*

Adulteration with Sugar. — "According to MM. Raspail and Baruel, two per cent. of sugar added to milk are sufficient to impart a decided sugary flavour to it, and even one per cent. is sufficient to impart an unusual degree of sweetness. Sugar, therefore, can hardly be employed to augment the density of milk. However this may be, its presence is easily detected by coagulating the milk, filtering, and mixing a little yeast with the filtrate. If the whole be then exposed to a temperature of between 70° and 80° Fahr., an abundant and rapid disengagement of gas will take place in the course of two or three hours. Fermentation in that case is a sure sign of the presence of sugar, for pure milk cannot ferment, at least in so short a time, and the fermentation is never brisk. But the smallest proportion of sugar (either grape or cane-sugar) very speedily gives rise to a tumultuous fermentation." — *Normandy.*

Adulteration with Emulsion of Hemp-seed. — "The experiments of M. Quevenue seem to prove that the emulsion of hemp-seed, and of almonds, cannot be employed for adulterating milk, as is generally supposed, for hemp-seed communicates to the milk a very unpleasant flavour, and almonds very speedily coagulate it." — *Normandy.*

Adulteration with Cerebral Matter. — "As to the adulteration of milk by the addition of the cerebral matter of various animals, accounts of which were published by newspapers some time ago, it would appear from the experiments which were performed at that time by the 'Conseil de Salubrité,' that no such admixture could be detected in any of the considerable number of samples of milk which were then submitted to examination; the results of the investigations made by the eminent chemists of the Conseil have proved that were this disgustingly horrible fraud ever practised, it would be immediately detected by the microscope." — *Normandy.*

On the Effect of storing Milk in Zinc Pans. — " Milk is sometimes kept in zinc pans for the purpose of augmenting the yield of cream. It should be known that lactic acid, which is formed in that case, and which exists in the free state even in new milk, might decompose a little of the carbonate, or saturate a little of the oxide of that metal, and render the milk unwholesome and possibly poisonous. The presence of zinc is detected by coagulating the milk with nitric acid, filtering, super-saturating with ammonia, and filtering again if necessary; if, on pouring hydro-sulphuret of ammonia in the clear filtrate, a white precipitate is formed, it is sulphuret of zinc." — *Normandy.*

Before giving the results of the examination of milk purchased in the metropolis, it is desirable to determine certain particulars in reference to the specific gravity of samples of milk as obtained from different cows, and the per-centage of cream, to serve as standards of comparison.

TABLE SHOWING THE SPECIFIC GRAVITY OF PURE MILK, AND THE PER-CENTAGES OF CREAM.

Morning Milk.

Cows. Richmond.	Milk. Spec. Gravity.	Cream.	Curd.
1	1030	6½	63 grs.
2	1031	7	69 ,,
3	1028	4½	66 ,,
4	1030	9	80 ,,
5	1031	10	78 ,,
6	1028	7½	75 ,,
London.			
7	1030	12	55 ,,
8	1023	5	81 ,,
9	1029	7	61 ,,
10	1028	9	65 ,,
Average nearly	1029	Total - 77½	Total - 693 ,,

Average about 7½.

Afternoon Milk.

Cows. Richmond.	Milk. Spec. Gravity.	Cream.	Curd.
1	1028	7½	69 grs.
2	1027	10	91 ,,
3	1027	6	75 ,,
4	1028	9	78 ,,
5	1028	11½	87 ,,
6	1027	7½	83 ,,
London.			
*7	1028	22	98 ,,
*8	1026	6	74 ,,
*9	1026	6	69 ,,
*10	1026	11	86 ,,
Average about	1027	Total - 96½	Total - 810 ,,

Average more than 9½.

The Richmond cows from which the first six morning and afternoon milks were obtained, were fed partly on grass and partly on grains. It is desirable that the following particulars relating to each cow should be made known : —

Cows.	Age.	Number of Calves.	Date of last Calf.	Yield per Diem.
1	5½ years	3	5 weeks	14 quarts
2	7 ,,	4	7 months	7 ,,
3	7 ,,	4	5 ,,	10 ,,
4	8 ,,	5	6 ,,	16 ,,
5	5 ,,	3	7 ,,	8 ,,
6	10 ,,	7	5 ,,	12 ,,
*7	6 ,,	2	10 weeks	10 ,,
*8	6 ,,	3	3 ,,	10 ,,
*9	5 ,,	2	3 months	10 ,,
*10	7 ,,	3	9 weeks	9 ,,

The samples were taken from the milk-pail containing the whole of the milk obtained from each cow, and whilst still warm.

From the preceding tables, it appears—

1st. That the specific gravity of genuine milk, in its ordinary condition, varies between 1031 and 1026; and that the average specific gravity of the morning milk is about 1029, and the afternoon 1027.

2nd. That the amount of cream ranges from 4½° to 22°, the average being 9½°.

3rd. That the quantity of curd varies from 55 to 98, the average being 75.

The above are the results in the case of samples of milk of ordinary quality; but exceptional cases sometimes occur, in which the specific gravity is less, as also the quantity of cream, curd, butter, and cheese.

TABLE SHOWING THE DENSITY OF SERUM, AND ITS RELATION TO THE SPECIFIC GRAVITY OF MILK.

Cows.	Milk. Specific Gravity.	Serum. Specific Gravity.	Cows.	Milk. Specific Gravity.	Serum. Specific Gravity.
1	1029	1028	22	1022	1027
2	1026	1028	23	1030	1027
3	1029	1025	24	1031	1028
4	1031	1027	25	1028	1028
5	1030	1027	26	1030	1028
6	1008	1025	27	1031	1028
7	1019	1027	28	1028	1027
8	1026	1026	29	1028	1027
9	1030	1027	30	1027	1028
10	1028	1028	31	1028	1027
11	1027	1027	32	1030	1028
12	1026	1027	33	1029	1028
13	1027	1025	34	1026	1027
14	1029	1027	35	1024	1026
15	1030	1027	36	1027	1026
16	1030	1027	37	1026	1028
17	1023	1028	38	1028	1028
18	1023	1028	39	1026	1027
19	1025	1027	40	1026	1026
20	1024	1027	41	1030	1026
21	1024	1028	42	1023	1028

The above table includes many samples of milk of an exceptional character.

It will be observed, that while the specific gravity of the milk extends over a wide range, varying from 1008 to 1031, that of the serum, on the contrary, is subject only to a slight variation, the limits being from 1028 to 1025.

We have here, then, a fixed datum, from which to determine, with precision, the adulteration of milk with water, a point of the greatest importance.

TABLE SHOWING THE EFFECT OF THE ADDITION OF DIFFERENT PER-CENTAGES OF WATER ON THE SERUM OF MILK.

Milk containing Per-centages of Water.	Specific Gravity.	Skim-milk. Specific Gravity.	Serum. Specific Gravity.	Curd Grains.
50	1014	15	16	29
40	1017	18	17	35
30	1020	21	21	42
20	1023	25	22	50
10	1026	27	25	54
Pure	1029	30	29	61

From the above table it appears that the serum of milk, the density of which is itself subject to slight variation only, experiences a marked and uniform alteration of specific gravity, on the addition of different per-centages of water. Starting, therefore, from these points, we have the means of ascertaining, not only the adulteration of milk with water, but even of calculating, with very considerable accuracy, the proportion of water that has been added to any sample of milk. Although this calculation may be effected with the common hydrometer, more accurate results are to be obtained by means of an instrument constructed on the centesimal principle; such we intend to have made for this purpose. The objections to the ordinary hydrometer are, that it is not easy to take with it specific gravities within a degree or so, and that it is rare to meet with two instruments of this kind that correspond exactly with each other, there being a difference sometimes of as much as two degrees.

The specific gravity of skim-milk, although less uniform than that of the serum, is yet much more so than pure milk; on this account, the next most accurate method of determining the admixture of water with milk is, to take the density of skim-milk, the per-centage of cream being previously ascertained by the lactometer.

Results of the Microscopical and Chemical Examination of Twenty-six Samples of Milk purchased at the Establishments of different Cowkeepers and Dairymen resident in the Metropolis.

1st Sample.—Purchased of J. Hendron, 80. Earl-street, Paddington.

Analysis.—Specific gravity of *milk*, 1028; of *serum*, 1025; per-centage of *cream*, 5°; weight of dried *curd*, 50 grains.

It will be observed that the specific gravity of the serum is just upon the lowest limit of the density of pure serum, while the quantity of cream and of curd is much below that which is proper to good milk; this milk, therefore, is either one of inferior quality, or it has had a small per-centage of water added to it, and a portion of cream subtracted.

2nd Sample.—Purchased of T. Mansell, 10. New Church-street, Edgware-road.

Adulterated—specific gravity of *milk*, 1023; of *serum*, 1020; per-centage of *cream*, 2°; weight of dried *curd*, 42 grains.

This milk has been adulterated with from 25 to 30 per cent. of water, and has also been deprived of the greater part of its cream.

3rd Sample.—Purchased of H. Leach, 34. Lisson-grove.

Adulterated—specific gravity of *milk*, 1022; of *serum*, 1022; per-centage of *cream*, 8°; weight of dried *curd*, 45 grains.

This milk has had added to it about 20 per cent., or one-fifth, of water.

4th Sample.—Purchased of Mr. Sales, 13. Upper Lisson-street, Paddington.

Adulterated—specific gravity of *milk*, 1020; of *serum*, 1018; per-centage of *cream*, 6°; weight of *curd*, 43 grains.

This milk has been adulterated with about 25 per cent. of water.

5th Sample.—Purchased of F. Holder, 31. Homer-street, New-road.

Genuine—specific gravity of *milk*, 1030; of *serum*, 1027; per-centage of *cream*, 29°; weight of dried *curd*, 64 grains.

While set aside in the lactometer, this milk became slightly acid and curdled; a portion of the curd rising with the cream increased its apparent amount, which, had it not been for this circumstance would not have shown so high a per-centage as 29. This is an instructive fact, as it shows that the milk to be tested by the lactometer ought to be perfectly fresh, and ought not to be permitted to remain in that instrument (in warm weather) more than twelve hours. We have met with several samples in which the amount of cream has been apparently increased from this cause, and others in which it would not rise to the surface at all.

6th Sample.—Purchased of C. Cutts, 28. Praed-street, Paddington.

Analysis.—Specific gravity of *milk*, 1021; of *serum*, 1024; per-centage of *cream*, 22°; weight of dried *curd*, chiefly *butter*, 72 grains.

It will be noticed that this milk yields a very large per-centage of cream, and that the serum is under the usual standard. On an examination of the cream with the microscope, numerous corpuscles, peculiar to and characteristic of colostrum—that is, of the milk of the cow of the first month after calving, were discovered; it is perhaps more safe to regard this milk as exceptional, and not to pronounce upon its admixture with water from the specific gravity of the serum.

7*th Sample.*—Purchased of J. Harris, 17. Harrow-road.

Analysis.—Specific gravity of *milk*, 1023; of *serum*, 1023½; per-centage of *cream*, 12°; weight of dried *curd*, 72 grains.

There were noticed in this case a few colostrum corpuscles; this milk appears to resemble somewhat the previous sample (No. 6.).

8*th Sample.*—Purchased of P. Mullins, 30. Bryanston-street.

Genuine.—Specific gravity of *milk*, 1027; of *serum*, 1025; per-centage of *cream*, 12°; weight of dried *curd*, 66 grains.

9*th Sample.*—Purchased of J. Ennever, 31. Upper York-street, Bryanstone-square.

Genuine—Specific gravity of *milk*, 1028; of *serum*, 1027; per-centage of *cream*, 13°; weight of dried *curd*, 64 grains.

10*th Sample.*—Purchased of B. Mills, 33. Adam-street, Portman-square.

Adulterated—Specific gravity of *milk*, 1024; of *serum*, 1022; per-centage of *cream*, 6°; weight of dried *curd*, 45 grains.

This milk is admixed with about 20 per cent. of water.

11*th Sample.*—Purchased of T. Turner, 41. Adam-street West, Portman-square.

Adulterated—Specific gravity of *milk*, 1026; of *serum*, 1023; per-centage of *cream*, 8°; weight of dried *curd*, 53 grains.

This sample contains about 15 per cent. of water.

12*th Sample.*—Purchased of R. Robbins, 79. Adam-street West, Portman-square.

Genuine—Specific gravity of *milk*, 1030; of *serum*, 1027; per-centage of *cream*, 15°; weight of dried *curd*, 73 grains.

13*th Sample.*—Purchased of E. Edmonds, 23. Edgware-road.

Adulterated—Specific gravity of *milk*, 1023; of *serum*, 1022; per-centage of *cream*, 12°; weight of dried *curd*, 56 grains.

This milk contains about 20 per cent. of water.

14*th Sample.*—Purchased of C. Crew, 60. Bell-street, Paddington.

Adulterated—Specific gravity of *milk*, 1018; of *serum*, 1017; per-centage of *cream*, 8°; weight of dried *curd*, 48 grains.

This sample of milk is adulterated with 35 per cent., or upwards of one-third of water.

15*th Sample.*—Purchased of H. Edwards, 39. Exeter-street, Paddington.

Adulterated—Specific gravity of *milk*, 1016; of *serum*, 1016; per-centage of *cream*, 4°; weight of dried *curd*, 42 grains.

This milk is adulterated with about 45 per cent. of water.

16*th Sample.*—Purchased of Mr. Rowley, 78. Salisbury-street, Paddington.

Adulterated—Specific gravity of *milk*, 1015; of *serum*, 1016; per-centage of *cream*, 5°; weight of dried *curd*, 42 grains.

This milk is adulterated with about 44 per cent., that is, it consists of nearly one-half water; the centesimal galactometer stood in it at 56°, which gives the same per-centage of water; thus, by observations made with two different kinds of instruments results nearly similar were obtained.

17*th Sample.*—Purchased of J. Cheney, Dorset House, 93. Mount-street, Grosvenor-square.

Genuine—Specific gravity of *milk*, 1029; of *serum*, 1028; per-centage of *cream*, 10½°; weight of dried *curd*, 68 grains.

The centesimal galactometer stood at 109°; that is, nearly in the middle of the scale for pure milk.

18*th Sample.*—Purchased of W. Ball, 23. Davies'-street, Berkeley-square.

Genuine.—Specific gravity of *milk*, 1028; of *serum*, 1027; per-centage of *cream*, 8½°; weight of dried *curd*, 63 grains.

The galactometer stood in the milk at 104°.

19*th Sample.*—Purchased at the Friern Manor Farm Dairy, 8. Charles-street, Berkeley-square.

Genuine—Specific gravity of *milk*, 1029; of *serum*, 1028; per-centage of *cream*, 9½°; weight of dried *curd*, 66 grains.

20*th Sample.*—Purchased of T. Tubb, Original Alderney Dairy, 59. Brooke-street, Hanover-square.

Genuine—Specific gravity of *milk*, 1028; of *serum*, 1027; per-centage of *cream*, 8°; weight of dried *curd*, 71 grains.

21*st Sample.*—Purchased of W. Eaton, 17. Paradise-street, Marylebone.

Adulterated—Specific gravity of *milk*, 1022; of *serum*, 1022; per-centage of *cream*, 10°; weight of dried *curd*, 69 grains.

This milk contains about 20 per cent. of water.

22*nd Sample.*—Purchased of W. Wrench, 7. William-street, Marylebone.

Genuine—Specific gravity of *milk*, 1027; of *serum*, 1027; per-centage of *cream*, 15°; weight of dried *curd*, 79 grains.

23*rd Sample.*—Purchased of R. Ragg, 9. William-street, Marylebone.

Adulterated—Specific gravity of *milk*, 1023; of *serum*, 1022; per-centage of *cream* 7°; weight of dried *curd*, 60 grains.

This milk is adulterated with about 20 per cent. of water.

24*th Sample.*—Purchased of E. Reynolds, Farnborough Farm Dairy, 44. Paddington-street.

Genuine—Specific gravity of *milk*, 1027; of *serum*, 1027; per-centage of *cream*, $5\frac{1}{2}$°; weight of dried *curd*, 56 grains.

The quantity of cream on this milk is below the usual average.

25*th Sample.*—Purchased of Mr. Ranson, 44. North-street, Manchester-square.

Genuine—Specific gravity of *milk*, 1027; of *serum*, 1026; per-centage of *cream*, 7°; weight of dried *curd*, 67 grains.

26*th Sample.*—Purchased of Mr. Harris, 9. James-place, Charles-street West, Paddington.

Genuine—Specific gravity of *milk*, 1026; of *serum*, 1026; per-centage of *cream*, $8\frac{1}{2}$°; weight of dried *curd*, 69 grains.

From an examination of the above Table it appears that out of twenty-six samples of milk submitted to analysis—

1st. That *twelve* were genuine.

2nd. That of these, *two* showed a deficiency of cream.

3rd. That *eleven* were adulterated.

4th. That this adulteration consisted, in all cases, of *water*, the per-centages of which varied from ten to fifty per cent., or one half of the article.

5th. That in no case was chalk, size, gum, sheep's brains, or any of the other substances said to be occasionally used for the adulteration of milk, detected.

These results are more favourable than might have been anticipated from the statements made by writers, and the belief generally entertained respecting the adulteration of milk.

The addition of water to milk is, however, a fraud of the gravest description, and the parties practising it, are morally as guilty as though they had employed, for the purpose of adulteration, the brains of sheep, or any other equally disgusting substance.

Although in the examinations we have made of milk, we have not met with any other adulteration than that with water, we are yet not warranted in concluding that no other adulterations are practised; the revelations that have come to light from time to time have shown that other frauds in milk are sometimes perpetrated. It is extremely satisfactory, however, to be able to inform the public that the milk, as supplied to them, although bad enough, is not in so bad a condition as generally reported and believed.

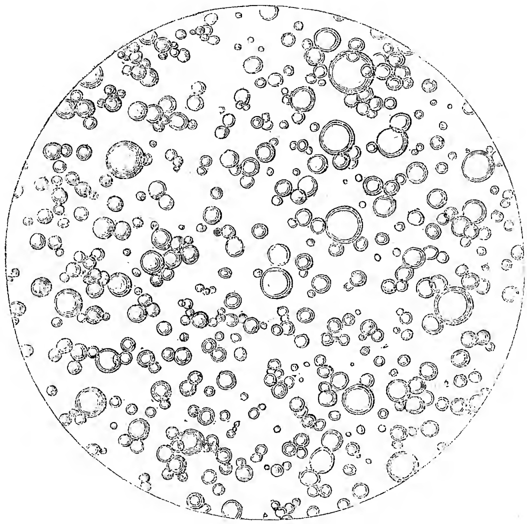
In some countries and cities the necessity of securing a supply of genuine milk is deemed of such importance that enactments imposing fines and penalties for adulterating it have been enforced. Although, from the *laissez-aller* principle so long manifested, in relation to the important subject of the adulteration of food, we have no reason to expect that any public regulation will be put in force to check the adulteration of this prime article of consumption, we yet conceive that we have rendered the public a good service, in not only making known the names of parties guilty of scandalously adulterating milk with water, but especially in pointing out simple means by which, with a little trouble, each person may ascertain for himself whether the milk supplied to him be genuine or not. These means are—

1st. To ascertain, through the instrumentality of a graduated glass tube, termed a lactometer, the amount of cream, which ought not to be less than eight per-centages. This instrument can be purchased of almost any glass manufacturer or philosophical instrument maker; it may be procured of Mr. Griffin, Finsbury-square, or at the Whitefriars Glasshouse, Bouverie-street, Fleet street.

2nd. To take the specific gravity of the milk with the common hydrometer, or, better still, by the centesimal galactometer, or the instrument for taking the density of the serum of milk, referred to in a previous part of this report.

In this investigation, as in all others relating to the adulteration of food, the microscope is capable of affording invaluable assistance. The fatty matter of milk, as already described, and upon which its value mainly depends, exists in the form of innumerable semi-opaque white globules of various size. In good milk these globules are seen by the microscope to be very abundant, and some of them are of considerable size.

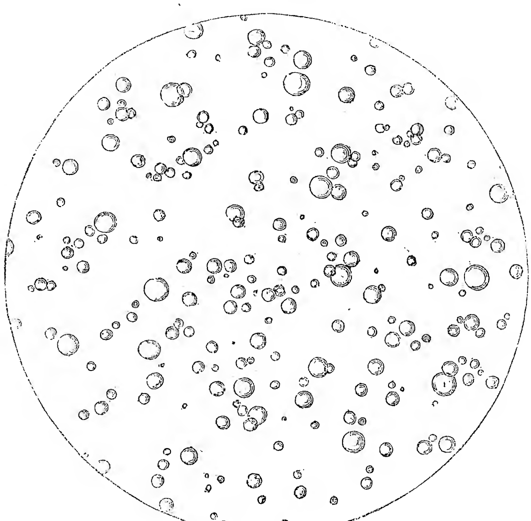
Fig. 107.
GOOD MILK.



This and the five following figures are all drawn to a scale of about 630 diameters.

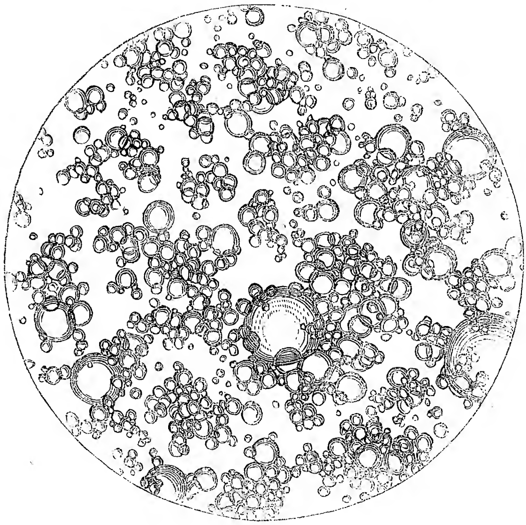
In poor milk the globules are much less numerous, and of smaller size.

Fig. 108.
POOR MILK.



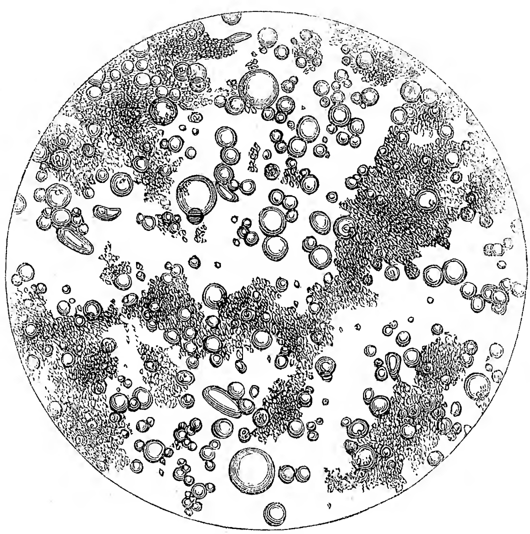
Cream consists almost entirely of these fat globules, some of which are often met with of very considerable size.

Fig. 109.
CREAM.



The curd of milk, as already explained, is composed of both the cheese and the fat globules. Its appearance under the microscope is represented in fig. 110.; the casein or cheese is distinguished by its granular texture.

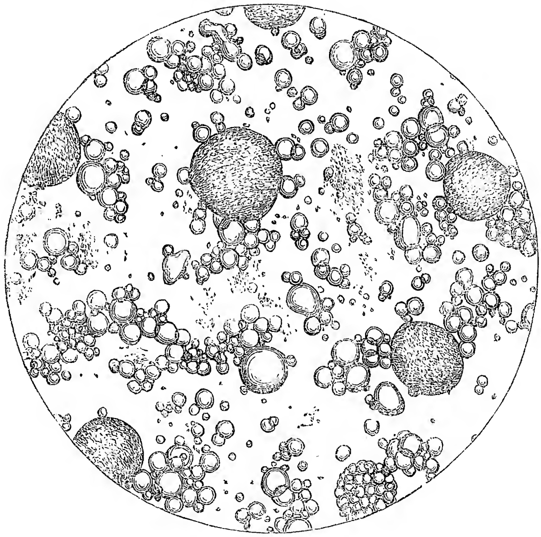
Fig. 110.
CURD OF MILK.



The first milk yielded by the cow after calving, called colostrum, is characterised, as before noticed, by the presence of numerous corpuscles of large size and granular appearance. Cow's milk in the state of colostrum is represented in fig. 111.

Fig. 111.

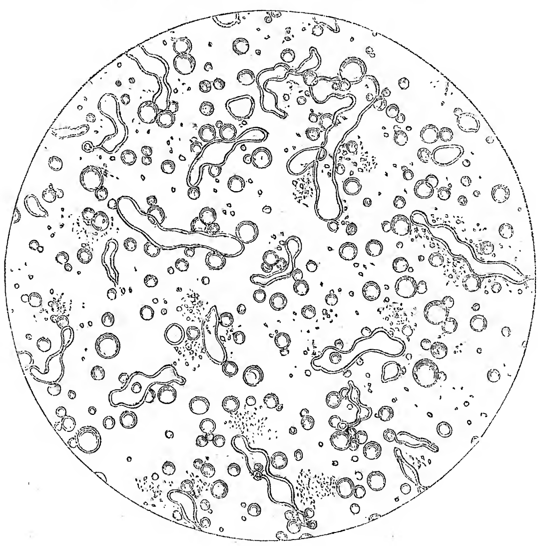
COLOSTRUM.



The disgusting adulteration of milk with cerebral matter, known to be occasionally, although it is to be hoped very rarely practised, is readily detected in recent milk by the aid of the microscope, portions of the nerve-tubules being discovered in such milk.

Fig. 112.

MILK ADULTERATED WITH SHEEP'S BRAINS.



ARROW-ROOT, AND ITS ADULTERATIONS.

In our first Report* on Arrow-root we minutely described the different kinds of arrow-root met with in commerce, gave engravings showing the structural peculiarities of the starch-granules, stated the relative values of each kind, and published the results of the microscopic examination of fifty different samples.

In that Report, however, there was one thing which we did not do. We then refrained, except in the case of proprietary arrow-roots, from making known the names of those persons from whom adulterated arrow-roots had been procured. As, however, many months have elapsed since we first commenced our investigations, and as all parties have now had ample notice and warning, we must on the present occasion discharge our duty to the public, by giving to the world the name of each individual from whom arrow-root was purchased, and this whether the article, on examination, was ascertained to be genuine or adulterated.

Results of the Microscopical Examination of Thirty-Six Samples of Arrow-root of Different Qualities and Prices, Purchased at different Shops in the Metropolis.

1*st Sample.* — Purchased of C. Carter, 292. Oxford-street. Price 2*s.* per lb.
Adulterated — admixed to a large extent with *sago-powder.*

2*nd Sample.*— Purchased of Westbrook and Company, 21. Oxford-street. Price 1*s.* 4*d.* per lb.
Adulterated — containing *very much sago powder.*

In our first Report on Arrow-root, we stated that we had detected sago-powder in a canister of arrow-root purchased of Westbrook and Company; we discovered the same article in two other samples of loose arrow-root purchased at the same establishment on the same occasion.

3*rd Sample.* — Purchased of J. Lawrence, 51. Broad-street, Bloomsbury. Price 1*s.* 4*d.* per lb.
Genuine Maranta or West India arrow-root.

4*th Sample.*— Purchased of E. Folkard and Company, Drury-lane. Price 1*s.* 4*d.* per lb.
Adulterated — consisting chiefly of *sago-powder.*

5*th Sample.* — Purchased of E. Folkard and Company, Drury-lane. Price 2*s.* per lb.
Genuine Maranta arrow-root.

6*th Sample.*— Purchased of Belchem, 120. Drury-lane. Price 1*s.* 4*d.* per lb.
Adulterated — *the greater portion consisting of potato-flour*, with very little Maranta arrow-root.

7*th Sample.* — Purchased of Hale and Co., 100. Drury-lane. Price 1*s.* 4*d.* per pound.
Genuine Maranta arrow-root.

8*th Sample.*— Purchased of W. E. Rogers and Company, Clare-street, Clare-market. Price 1*s.* 4*d.* per lb.
Genuine Maranta arrow-root.

9*th Sample.*— Purchased of G. Clarkson, corner of Marshall-street, Golden-square. Price 1*s.* 4*d.* per lb.
Consisting almost entirely of potato-flour.

10*th Sample.* — Purchased of J. Hale, 53. Brewer-street, Golden-square. Price 2*s.* per lb.
Genuine Maranta arrow-root.

11*th Sample.* — Purchased of H. J. Knevett, 7. Windmill-street, Haymarket. Price 1*s.* 4*d.* per lb.
Adulterated — containing *very much sago-powder*, and *a little tapioca-starch.*

12*th Sample.* — Purchased of S. Saward, 21. Little Windmill-street, Golden-square. Price 1*s.* 4*d.* per lb.

* The Lancet of February 1. 1851, p. 139., and p. 31. of the present work.

Adulterated—consisting of a mixture of *sago-powder*, *Maranta arrow-root*, and *tapioca-starch.*

13*th Sample.*—Purchased of Russell and Company, 21. King-street, Covent-garden. Price 1*s.* per lb.

Adulterated—consisting of a mixture of *sago-powder*, *Canna arrow-root*, or *Tous les Mois*, *Maranta arrow-root*, and *a little potato-flour.*

14*th Sample.*—Purchased of Underwood Brothers, 8. King-street, Covent-garden. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

15*th Sample.*—Purchased of N. Yarrow, 42. King-street, Snow-hill. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

16*th Sample.*—Purchased of J. Roberts and Company, Barbican. Price 1*s.* 4*d.* per lb.

Consisting almost entirely of potato flour.

17*th Sample.*—Purchased of Liquorish and Company, 50. Beech-street, Barbican. Price 2*s.* per lb.

Adulterated—containing *much potato flour*, a *little Curcuma or East India arrow-root*, with a small proportion of Maranta arrow-root.

18*th Sample.*—Purchased of J. Thomas, 107. Upper Whitecross-street. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

19*th Sample.*—Purchased of A. Dutton, 84. Whitecross-street. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

20*th Sample.*—Purchased of E. Taylor, 89. Whitecross-street. Price 1*s.* 4*d.* per lb.

Adulterated—consisting *principally of potato-starch.*

21*st Sample.*—Purchased of W. Earl, 128. Whitecross-steeet. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

22*nd Sample.*—Purchased of Betherege and Company, 152. Upper Whitecross-street. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

23*rd Sample.*—Purchased of Stevenson and Company, 159. Whitecross-street. Price 1*s.* 4*d.* per lb.

Genuine Maranta arrow-root.

24*th Sample.*—Purchased of G. W. Turner, 215. Whitecross-street. Price 1*s.* 4*d.* per lb.

Adulterated—consisting *principally of sago-meal.*

25*th Sample.*—Purchased of Robert Jackson, 21. Goswell-street. Price 1*s.* 8*d.* per lb.

Genuine Maranta arrow-root.

26*th Sample.*—Purchased of T. Barber, 104. Goswell-street. Price 1*s.* 8*d.* per lb.

Genuine Maranta arrow-root.

27*th Sample.*—Purchased of Anderson and Company, 26. Old-street-road. Price 1*s.* 6*d.* per lb.

Genuine Maranta arrow-root.

28*th Sample.*—Purchased of S. Rains, 115. Old-street-road.

Consisting almost entirely of potato-starch.

29*th Sample.*—Purchased of Phillips & Co., 37 & 38. Aldersgate-street. Price 1*s.* 4*d.*

Genuine Maranta arrow-root.

30*th Sample.*—Purchased of T. Smith, 53. Aldersgate-street. Price 1*s.* 4*d.* per lb.

Adulterated—consisting of *a mixture of Tous les Mois, and Maranta arrow-root*, with *a little potato starch.*

31*st Sample.*—Purchased of W. Rhodes, 77. Aldersgate-street. Price 2*s.* 6*d.* per lb.

Adulterated—*with sago-powder.*

32*nd Sample.*—Purchased of Lloyd, Hare & Co, 141. Aldersgate-street. Price 1*s.* 4*d.* per lb.
Genuine Maranta arrow-root.

ARROW-ROOT SENT TO WORKHOUSES.

33*rd Sample.*—Sample of arrow-root supplied to the St. Marylebone Workhouse.
Adulterated—Consisting chiefly of *tapioca-starch*, with *some sago-powder, and a little Maranta arrow-root.*

34*th Sample.*—Sample of arrow-root supplied to the in-door poor of the Kensington Workhouse.
Genuine Maranta arrow-root.

35*th Sample.*—Sample of arrow-root, given to *out-door poor* of the Kensington Union, supplied by contract.
Adulterated—consisting almost entirely of potato-flour.

We may state that we have found the oatmeal furnished to this Union by contract, to be adulterated with *barley-flour.*

36*th Sample.*—Sample of arrow-root supplied to the Holborn Union.
Adulterated—consisting almost entirely of potato-starch.

From an examination of the above Table, it appears—

That no *less than Eighteen, or one half the samples, were either adulterated, or else some inferior starch, as potato-flour, was substituted for the genuine arrow-root.*

That *Five of the samples consisted almost entirely of potato-starch.*

That *the remaining Thirteen samples consisted of mixtures in various proportions of potato-starch and sago-powder (these in some cases forming the chief part of the article), with occasionally other starches, as those of tapioca, canna, and curcuma.*

In a previous Report, we showed that the oatmeal supplied to our unions and charitable institutions is extensively and systematically adulterated; it now appears that the arrow-root is not less extensively and generally deteriorated.

From inquiries we have made, we do not believe that the slightest blame is in general attached to the workhouse authorities in this matter, because we have ascertained that in the majority of cases such a price is paid for the arrow-root as should ensure their obtaining a genuine article.

The guardians and governors of unions and public institutions will, we are assured, have much reason to thank us for putting them on their guard, and calling their attention to so important a subject.

We believe that the majority of the other articles of food supplied to our workhouses, &c., as coffee, tea, cocoa, mustard, pepper, are also often adulterated to a fearful extent.

The evil which we have now pointed out is one of immense extent and importance, and the several boards of guardians and others should lose no time in taking steps to remove it. Fortunately the remedy is simple and efficient. Let the various articles of food supplied on contract be regularly submitted to microscopical examination; this done, we will answer for it, there will soon be an end put to the adulteration of the food supplied to our unions, workhouses, hospitals, charitable, and other public institutions.

We have, in conclusion, to render our thanks to the boards of guardians of the Marylebone and St. Andrew Holborn Unions for the ready manner in which they acceded to our request, and forwarded samples of the various articles supplied to the unions under their charge, the first-named board expressing, at the same time, the opinion that the proposal made by us of submitting to microscopic examination all the articles of food furnished to workhouses, &c., "was calculated to prove of great public utility."

BREAD, AND ITS ADULTERATIONS.

Although in the Reports which we published some months since, on Bread and its Adulterations, we gave a list of analyses, and even indicated the streets in which the samples were purchased, we at that time refrained from making known the names of the bakers from whom they were procured. As all parties have had ample notice and warning, we now give the results of additional analyses, and publish in connexion with them the names and addresses of twenty-five bakers, from all of whom purchases of bread have been made within the last few days.

Results of the Chemical and Microscopical Examinations of Twenty-five Samples of Bread Purchased at the Establishments of Different Bakers in the Metropolis.

1*st Sample.* — Purchased of William Grineau, 33. Paddington-street.
Adulterated — containing *alum.*
2*nd Sample.* — Purchased of J. T. Dennis and Co., 87. High-street, Marylebone.
Adulterated — containing a considerable quantity of *alum.*
3*rd Sample.* — Purchased of W. Fuelling, High-street, Marylebone.
Adulterated — containing a considerable quantity of *alum.*
4*th Sample.* — Purchased of H. Miller, 2. High-street, Marylebone.
Adulterated — containing much *alum.*
5*th Sample.* — Purchased of M. Schlarb, 64. Marylebone-lane.
Adulterated — containing much *alum.*
6*th Sample.* — Purchased of M. Staner, 16. Hinde-street, Manchester-square.
Adulterated — containing much *alum.*
7*th Sample.* — Purchased of W. Jobbins, 3. Thayer-street, Manchester-square.
Adulterated — containing *alum.*
8*th Sample.* — Purchased of Davies and Son, 19. George-street, Portman-square.
Adulterated — containing much *alum.*
9*th Sample.* — Purchased of A. Michie, 33. Edwards-street, Portman-square.
Adulterated — containing a considerable quantity of *alum.*
10*th Sample.* — Purchased of T. Cooper, 173. Tottenham-court-road.
Adulterated — containing a considerable quantity of *alum.*
11*th Sample.* — Purchased of B. Stephens, 75. Tottenham-court-road.
Adulterated — containing much *alum.*
12*th Sample.* — Purchased of F. Pearse, 32. Goodge-street, Tottenham-court-road.
Adulterated — containing a very considerable quantity of *alum.*
13*th Sample.* — Purchased of C. T. Wade, 8. Goodge-street, Tottenham-court-road.
Adulterated — containing a considerable quantity of *alum.*
14*th Sample.* — Purchased of C. Butler, 2. Goodge-street, Tottenham-court-road.
Adulterated — containing a considerable quantity of *alum.*
15*th Sample.* — Purchased of G. Whalley, 27. Cumberland-street, Goodge-street.
Adulterated — containing *alum.*
16*th Sample.* — Purchased of J. Fortescue, 3. Charles-street, Middlesex Hospital.
Adulterated — containing much *alum.*
17*th Sample.* — Purchased of J. Thurgood, 92. Great Tichfield-street.
Adulterated — containing much *alum.*
18*th Sample.* — Purchased of W. Jones, 18. Great Tichfield-street.
Adulterated — containing *alum.*
19*th Sample.* — Purchased of W. Clapperton, 11. Mortimer-street, Cavendish-square.
Adulterated — containing *alum.*
20*th Sample.* — Purchased of J. L. Bragg, 2. Wigmore-street.
Adulterated — containing a considerable quantity of *alum.*
21*st Sample.* — Purchased of R. P. Cook, 286. Oxford-street.
Adulterated — containing much *alum.*
22*nd Sample.* — Purchased of G. Wordley, 274. Oxford-street.
Adulterated — containing much *alum.*

THE LEAGUE BREAD COMPANY.

This company, from time to time, has put forward advertisements in which it is declared that alum is not employed in the manufacture of the bread sold by it. From one of these the following is copied:—

"The object for which the above Company was established, and is now in operation, is to insure to the public bread of a pure, wholesome, and nutritious character.

"Experience daily proves how much our health is dependent on the quality and purity of our food; consequently, how highly important it is that an article of such universal consumption as bread should be free from adulteration.

"That various diseases are caused by the use of alum, and other deleterious ingredients, in the manufacture of bread, the testimony of many eminent medical men will fully corroborate.

"Pure unadulterated bread, full weight, best quality, and the lowest possible price."

As the use of alum by bakers is almost constant, and as this substance undoubtedly exercises a prejudicial influence upon the digestive system, and consequently upon health, it became a matter of much importance to ascertain whether the statements made by the Company can be relied on; we therefore have submitted samples of bread, bought at *three* different establishments of the Company, to analysis, with the results given below.

23*rd Sample.*—Purchased at the Depôt of the League Bread Company, University-street, Tottenham-court-road.

Adulterated—containing *alum.*

24*th Sample.*—Purchased at the Depôt of the League Bread Company, Charles-street, Middlesex Hospital.

Adulterated—containing *alum.*

25*th Sample.*—Purchased at the Depôt of the League Bread Company, James-street, Oxford-street.

Adulterated—containing *alum.*

It thus appears that the declaration of the Company, "that the bread sold by it is pure and unadulterated," is incorrect.

At this result of our inquiries we are much surprised, and we regret the circumstance the more, because we had hoped to have had it in our power to inform the public where it might procure that great desideratum, strictly wholesome and unadulterated bread.

It is true that many of the samples examined contained a larger proportion of alum than was discovered in the samples of "League Bread;" but still the amount detected was by no means insignificant or unimportant.

From the above analyses it therefore appears,—

1st. That the whole of the *twenty-five* samples examined, including three sold by the *League Bread Company*, contained *alum.*

2nd. That in none of the samples was *potato* detected.

It will be observed that these results approximate very closely to those of our former analyses, which were,—

1st. That the whole of the *twenty-four samples of bread examined were adulterated with alum.*

2nd. That in *no one of the samples was potato or any other farinaceous matter, other than wheat-flour, detected; nor did any of the breads contain either carbonate or sulphate of lime.*

A point, second only in importance to the purity of bread, is the question of weight. From a number of trials which we have made, we are enabled to state that bread as delivered to houses is almost constantly deficient in weight, and this in many cases, on half and quartern loaves, to the extent of several ounces. See Table, p. 166.

We now make known our intention to publish, in a future article on bread, the names and addresses of bakers who are detected in supplying the public with bread deficient in weight.

We have now shown that many of the bakers of London daily commit at least a double violation of the law, whereby they expose themselves to heavy penalties —first, in selling bread deficient of its proper weight; and secondly, in making use of the forbidden ingredient, *alum*.

The state of the law in reference to these two points is clearly set forth in the following quotation from M'Culloch's "Dictionary of Commerce:"—

"Bakers and others sending out bread in carts, are to supply them with beams, scales, &c., and to weigh the bread, if required, under a penalty of not more than 5*l.* (3 Geo. 4. c. 106. § 8.)

"Bakers, either journeymen or masters, using alum or any other unwholesome ingredients, and convicted on their own confession, or on the oath of one or more witnesses, to forfeit not exceeding 20*l.*, and not less than 5*l.*, if beyond the environs of London, and not exceeding 10*l.*, nor less than 5*l.*, if within London or its environs. Justices are allowed to publish the names of offenders. The adulteration of meal or flour is punishable by a like penalty."

CHICORY AND COFFEE, WITH THEIR ADULTERATIONS.

In previous Reports we quoted the observations made by Dr. Pereira in reference to the employment of mineral ingredients, as Venetian-red and reddle, for the purpose of heightening the colour of the roasted and ground chicory-root.

In corroboration of these remarks, we stated that we had detected a red earthy substance in two samples, the results of the examination of which have already been made known.

As, however, it is of great importance, in a sanitary point of view, to determine the extent to which this kind of adulteration is carried, we have instituted some further special analyses.

The evidence of the use of these substances is principally derived from the incineration of a certain quantity of the suspected chicory-powder. All vegetable substances, whether coloured or not, yield, on incineration, a greyish-white ash. The ash of coloured earthy substances, on the contrary, after being burned in a crucible, remains more or less coloured.

As, however, chicory is the root of a plant, and as the earthy matter is but seldom entirely removed from it by washing, the ash of even genuine chicory not unfrequently exhibits, on this account, a slight degree of coloration, being occasionally brownish, or of light-fawn colour. It is only, therefore, when the ash is decidedly coloured, and especially when of a red or rusty-red colour, that the presence of Venetian-red, reddle, or some other analogous substance, is rendered certain.

In these facts, therefore, we have a ready means of determining whether a sample of chicory, or any other vegetable powder, contains an admixture of any mineral colouring matter containing iron, a conclusion which may be further confirmed by chemical analysis.

In the following analyses we have not confined our attention to this one particular, but have made complete analyses of the whole of the samples under examination.

Results of the Microscopical and Chemical Examination of Samples of Chicory obtained of different Manufacturers.

We refrain from publishing the names (except in the instance of proprietary articles) of the manufacturers of the samples of chicory given below, as they were not procured by ourselves direct from the manufacturers, but through other parties.

In Powder.

1*st Sample.*—*Adulterated*—containing much roasted *wheat-flour;* ash, of a *fawn* colour.

2*nd Sample.* — Ash, of a *light-fawn* colour.
3*rd Sample.* — Ash, of a *fawn* colour.
4*th Sample.* — *Adulterated* — containing roasted *wheat-flour;* ash, of a *dark-brown* colour, indicating the presence of a large quantity of *oxide of iron.*
5*th Sample.* — Ash, of a *fawn* colour.
6*th Sample.* — Ash, of a *light-brown* colour.
7*th Sample.* — *Adulterated* — containing much *wheat-flour;* ash, of a *fawn* colour.
8*th Sample.* — Ash, of a *rusty-red* colour, from the presence of a considerable quantity of *iron.*
9*th Sample.* — Ash, of a *rusty-red* colour.
10*th Sample.* — *Adulterated* — with much *wheat-flour;* ash, of a *rusty-red* colour.
11*th Sample.* — Ash, of a *light-fawn* colour.
12*th Sample.* — Ash, of a *deep rusty-red* colour.
13*th Sample.* — Purchased of W. R. Turner, 267. Oxford-street, in packages, price 2*d.*

"GENUINE
CHICORY POWDER,
A great improvement to Coffee, manufactured from the finest
Hambro-root,
by
TAYLOR BROTHERS."
Ash, of a *rusty-red* colour.

14*th Sample.* — Purchased of J. Gates, 76. Lisson-grove North, in packages, price 2*d.*

"BARRY AND COMPANY'S
GENUINE
HAMBRO CHICOREE,
A great improvement to Coffee.
GENUINE AS IMPORTED."
Ash, of a *fawn* colour.

15*th Sample.* — Purchased at the Barbican Steam Mills, 49. Barbican, in packages, price 1½*d.*

"GENUINE CHICORY."

Adulterated — containing roasted *wheat-flour;* ash, of a *rusty-red* colour.

IN NIBS.

16*th Sample.* — Ash of incinerated nibs, of a *rusty-red* colour on the surface.
17*th Sample.* — Ash of incinerated nibs, of a *rusty-red* colour on the surface.
18*th Sample.* — Ash of incinerated nibs, *white* on the surface.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL EXAMINATION OF SAMPLES OF CHICORY PURCHASED AT THE ESTABLISHMENTS OF DIFFERENT GROCERS IN THE METROPOLIS.

19*th Sample.* — Purchased of R. Jones, 16. High-street, Borough.
Ash, of a *deep rusty-red* colour.
20*th Sample.* — Purchased of Newson and Williams, 5. High-street, Borough.
Ash, of a *fawn* colour.
21*st Sample.* — Purchased of White and Fairchild, 63. High-street, Borough.
Ash, of a *fawn* colour.
22*nd Sample.* — Purchased of D. Plant, 76. High-street, Borough.
Adulterated — containing roasted *farina;* ash, of a *fawn* colour.
23*rd Sample.* — Purchased of White & Company, 107. High-street, Borough.
Ash, of a *fawn* colour.
24*th Sample.* — Purchased of Harrington & Lucas, 113. High-street, Borough.
Ash, of a *rusty-brown* colour.
25*th Sample.* — Purchased of Rose & Co., 213. High-street, Borough.
Ash, of a *light-fawn* colour.
26*th Sample.* — Purchased of Brocksopp, Sons, & Co., 234. High-street, Borough.
Ash, of a *light-brown colour.*

27*th Sample.* — Purchased of J. Pringle, 35. Blackman-street, Borough.
Ash, of a *fawn* colour.
28*th Sample.* — Purchased of C. Hart & Co., 4. Newington-causeway.
Ash, of a *yellowish-brown* colour.
29*th Sample.* — Purchased of Horwood & Co., 69. Newington-causeway.
Ash, of a *light-brown* colour.
30*th Sample.* — Purchased of Dannan & Co., 2. Walworth-road.
Ash, of a *dirty-brown* colour.
31*st Sample.* — Purchased of Field & Co., 9. Walworth-road.
Ash, of a *light-brown* colour.
32*nd Sample.* — Purchased of Weller & Co., 14. Crown-row, Walworth-road.
Ash, of a *fawn* colour.
33*rd Sample.* — Purchased of J. Clarke, 8. Crown-row, Walworth-road.
Ash, of a *light-fawn* colour.
34*th Sample.* — Purchased of Fisher & Co., 24. Crown-row, Walworth-road.
Ash, of a *yellowish-brown* colour.

Results of the Microscopical and Chemical Examination of Samples of Coffee purchased at the Establishments of Different Grocers in the Metropolis.

35*th Sample.* — Purchased of Anderton & Co., 26. Old-street, St. Luke's.
Adulterated — consisting principally of *chicory;* ash, of a *greyish-white* colour.
36th *Sample.* — Purchased of S. Rains, 175. Old-street, St. Luke's.
Adulterated — containing a considerable quantity of *chicory;* ash, of a *greyish-white* colour.
37*th Sample.* — Purchased of Mr. Jackson, 21. Goswell-street.
Adulterated — nearly one-half of the sample consisting of *chicory;* ash, of a *greyish-white* colour.
38*th Sample.* — Purchased of T. Barber, 104. Goswell-street.
Adulterated — admixed with a considerable quantity of *chicory;* ash, of a *greyish-white* colour.
39*th Sample.* — Purchased of Phillips & Co., 37. and 38. Aldersgate-street.
Adulterated — with a considerable quantity of *chicory;* ash, of a *greyish-white* colour.
40*th Sample.* — Purchased of V. Smith, 53. Aldersgate-street.
Genuine — ash, of a *greyish-white* colour.
41*st Sample.* — Purchased of W. Rhodes, 77. Aldersgate-street.
Adulterated — containing *chicory;* ash, of a *greyish-white* colour.
42*nd Sample.* — Purchased of Lloyd, Hare, & Co., 141. Aldersgate-street.
Adulterated — containing a considerable quantity of *chicory;* ash, of a *reddish-yellow* colour.
43*rd Sample.* — Purchased of Betteridge & Co., 152. Upper Whitecross-street.
Adulterated — containing much *chicory;* ash, of a *salmon* colour.
44*th Sample.* — Purchased of A. Dutton, 84. Whitecross-street.
Adulterated — this article consists almost entirely of *chicory;* ash, of a *reddish* colour.
45*th Sample.* — Purchased of J. Peppercorn, 89. Whitecross-street.
Adulterated — consisting almost entirely of *chicory;* ash, of a *greyish-white* colour.
46*th Sample.* — Purchased of J. Thomas, 107. Whitecross-street.
Adulterated — nearly one-half *chicory;* ash, of a *greyish-white* colour.
47*th Sample.* — Purchased of Weldon & Co., 111. Whitecross-street.
Adulterated — with *chicory;* ash, of a *reddish* colour.
48*th Sample.* — Purchased of W. Earl, 128. Whitecross-street.
Adulterated — containing *chicory;* ash, of a *dirty-brown* colour.
49*th Sample.* — Purchased of Stevenson & Co., 159. Whitecross-street.
Adulterated — with a considerable quantity of *chicory;* ash, of a *pale-fawn* colour.

50th Sample. — Purchased of W. Turner, 215. Whitecross-street.
Adulterated — containing a considerable quantity of *chicory;* ash, of a *greyish-white* colour.
51st Sample. — Purchased of N. Yarrow, 42. King-street, Snow-hill.
Adulterated — nearly one-half the article consists of *chicory;* ash, of a *fawn* colour.
52nd Sample. — Purchased of Russell & Co., 72. High-street, Borough.
Adulterated — containing much *chicory;* ash, of a *light-brown* colour.
53rd Sample. — Purchased of Liquorish & Co., 50. Beech-street, Barbican.
Adulterated — nearly one-half *chicory;* ash, of a *reddish-brown* colour.
54th Sample. — Purchased of Roberts & Co., 31. Barbican.
Adulterated — the greater portion of the article consisting of *chicory;* ash, of a *light-brown* colour.

The conclusions to be deduced from the above analyses are as follow: —

1st. That out of the *eighteen* samples of Chicory procured from manufactories, *five* were adulterated with *roasted wheat-flour.*

2nd. That several of the samples yielded a coloured ash, indicating the presence of *Venetian Red* or some other analogous ferruginous earth.

3rd. That out of the *sixteen* samples of Chicory purchased at the establishments of different grocers in the metropolis, *one* only was adulterated with roasted *farina.*

4th. That the ashes of several of the samples were coloured.

5th. That out of the *twenty samples* of Coffee submitted to examination, *nineteen* were adulterated with *chicory.* The genuine coffee was purchased of Mr. Valentine Smith, of 53. Aldersgate-street.

6th. That several of the samples, on incineration, left a coloured residue.

From The Lancet.

"With reference to a portion of the Sanitary Report on Bread and its Adulterations that appeared in The Lancet of last week, the following advertisement was published by the League Company in the *Times* of Thursday. We do not hesitate to give it a place in our columns. On another and very early occasion we shall return to the subject."

"League Bread Company. — The Directors of the Company, having seen in The Lancet journal of the 25th of Oct. inst. a statement to the effect that alum was contained in three samples of their bread, think it due to themselves, their shareholders, and to the public, unequivocally to declare that it is entirely untrue. Ever since the commencement of their undertaking, the Directors have faithfully carried out the principles on which it was founded — viz., the manufacture and sale of 'Pure Unadulterated Bread.' As the only means immediately within their power of refuting the calumny thus cast upon the Company, they subjoin a copy of a declaration signed by the whole of the men employed in the manufacture of the Company's bread, which is as follows: —

"'League Bread Company. — We, the several persons whose names are hereunto subscribed, being the whole of the workmen now and for the last twelve-months at least employed by the League Bread Company in the manufacture of their bread, do severally, solemnly, and sincerely declare, that having read a statement in The Lancet journal, published on the 25th October, 1851, to the effect that alum was contained in three samples of the Company's bread, we know such statement to be utterly false and unfounded, and we further severally declare, that during the time we have been in the Company's service no alum or other deleterious ingredient whatever has ever been used or employed in the manufacture of the Company's bread, and that it is impossible that the same could be so used or employed without the fact being known to us.'

"The three agents of whom the bread is stated to have been purchased have also signed a declaration that they have never sold any bread but what has been delivered to them by the Company, and expressing their belief that the statement in question is untrue.

"Applications have been personally addressed to three several police magistrates to allow the above declarations to be judicially made by the parties who attended for the purpose, but the magistrates, and afterwards a judge at chambers, decided that they had no power to permit them to be made.

"Head Offices, 7. John-street, Clerkenwell, Oct. 29. 1851."

BREAD, AND ITS ADULTERATIONS.

[SUPPLEMENTAL REPORT.]

Since the publication of our last Report on "Bread, and its Adulterations," we have carefully repeated the analyses of the samples of bread purchased of the League Bread Company, of Mr. Clapperton, and of Messrs. Davies and Son,—in the last two instances, at the request of the parties themselves,—and we have now to repeat that those analyses were correct, and that the bread in each case did really contain alum, and furnished conclusive evidence of the presence of that salt.

Believing, nevertheless, that the published declaration and the statements of the above parties, that they do not knowingly use alum in the manufacture of their bread, have been made in good faith, we have thought it right to institute further investigations, in order to ascertain whether the presence of alum could not be accounted for without supposing that it had been wilfully introduced into the bread by the bakers.

With this view, we procured several samples of *flour*, and submitted them to analysis, with the following results:—

1*st Sample.*—Procured at the depôt of the League Bread Company, James-street, Oxford-street.

Analysis.—Contains *alum* in small quantity.

Received from Mr. Clapperton, baker, Mortimer-street, Cavendish-square.

2*nd Sample.*—Stated by Mr. Clapperton to have been purchased of Mr. Powers, miller, of Stamford Mills, Bedfordshire.

Analysis.—Contains *alum.*

3*rd Sample.*—Stated by Mr. Clapperton to have been purchased of Mr. Fountain, miller, Yewsley Mill, Buckinghamshire.

Analysis.—Does not contain *alum.*

4*th Sample.*—Stated by Mr. Clapperton to have been purchased of Messrs. Lury Brothers, millers, of Southampton.

Analysis.—Does not contain *alum.*

5*th Sample.*—Stated by Mr. Capperton to have been purchased of Messrs. Watney & Wells, millers, Wandsworth, Surrey.

Analysis.— Contains *alum* in small quantity.

Received from Messrs. Davies & Son, baker, George-street, Portman-square.

6*th Sample.*—Stated by Messrs. Davies & Son to have been purchased of Messrs. Stevens & Mercer, millers, Denham, Buckinghamshire.

Analysis.—Contains much *alum.*

7*th Sample.*—Stated by Messrs. Davies & Son to have been purchased of Mr. Hutton, miller, Nine Elms.

Analysis.—Does not contain *alum.*

8*th Sample.*—Stated by Messrs. Davies & Son to have been purchased of Mr. Dives, miller, Mill Wharf, Battersea.

Analysis.—Does not contain *alum.*

We have thus ascertained, from these analyses, the important fact that four of the flours used by the bakers who have questioned the accuracy of the analyses which we published contained alum.

We were led to the examination of the flour, first, in consequence of knowing that *alumina*, the base of alum, has been occasionally, though very rarely, discovered, in very minute quantity, in *particular descriptions* of wheat; and, second, because we were fully persuaded that in some cases, the millers, and not the bakers, introduce alum into the flour, and thus the flour is prepared ready for the baker's hands, and his conscience is thereby saved.

We next submitted to examination samples of the salt used by Mr. Clapperton and Messrs. Davies & Son in the manufacture of their bread; in both of these we detected a very small quantity of alumina, with a considerable amount of combined sulphuric acid. The quantity in Mr. Clapperton's salt were 1·1 per cent. of sulphuric acid and about 0·06 per cent. of alumina; and in Messrs. Davies & Son's salt, 1·5 per cent. of sulphuric acid and 0·05 of alumina.

Now, as bakers invariably employ salt in the manufacture of their bread, we have here in many cases an explanation of the *source* of the presence of a very small quantity of alum in bread.

Finding, then, alum in the flour and salt used by Mr. Clapperton, and the same in large quantity in one of the flours received from Messrs. Davies & Son, as well as distinct traces in their salt; and lastly, detecting it in small amount in the flour purchased of the League Bread Company, we believe these circumstances account satisfactorily for the presence of the alum detected in the samples of bread purchased of these parties, without supposing that they themselves were aware of its introduction.

It will be remembered that we drew a distinction between the quantities of alum present in the samples of bread purchased of the League Bread Company and Mr. Clapperton, and those contained in the other breads subjected to analysis, simply remarking that they did contain alum, without making any statements as to quantity.

In regard to the League Bread Company, we append the report of a chemist of high authority, detailing the results of a second examination of two samples of bread purchased of that Company:—

REPORT.

"I have again made a careful analysis of the bread marked No. 1. and No. 2., which you last forwarded to me, and I have to repeat, as before, that they both contain alumina. No. 1. contains it in larger proportion than No. 2. Sulphuric acid is also detectable, in a very distinct manner, in the solution of the bread.

HENRY LETHEBY, M.B.
Lecturer on Chemistry, London Hospital."

We thus find the accuracy of our original analyses confirmed in every particular.

It is due to Mr. Clapperton and Messrs. Davis & Son, to notice the fair and straightforward spirit in which they have acted in the matter: they waited upon us, placed in our hands samples of the flour and salt used by them in the manufacture of their bread, and left the investigation entirely to ourselves, stating they felt assured that we should do them full justice. On the publication of the first analyses of bread purchased of the League Bread Company the following letter and declaration was addressed to the editor of THE LANCET:—

THE ANALYTICAL SANITARY COMMISSION AND THE LEAGUE BREAD COMPANY.

To the Editor of THE LANCET.

"SIR,—The Directors of the League Bread Company have consulted us on the subject of a statement which appeared in your journal on Saturday last, imputing to them the intermixture of alum in their bread. Having from the outset of their undertaking carefully excluded from their bread the use of alum or other deleterious ingredient, they feel greatly surprised and proportionally aggrieved at an imputation coming from so influential a journal as THE LANCET, which attributes to them the very act against which they have so sedulously endeavoured to guard. The very basis on which their company was established is thus impugned, the ground on which it has claimed the public support is attacked, and if truly attacked, destroyed; and either the directors in their published appeals to the public have asserted a deliberate falsehood, or the statement in question is untrue. Unless they have been grossly deceived by their servants or agents, for which no imaginable motive exists, they know it to be untrue, for as far as they are individually concerned, they know they have never directly or indirectly authorised, or connived at, the use of a particle of alum, or other deleterious ingredient, in a single loaf of bread; and as far as their servants are concerned they have unanimously signed a declaration negativing the imputation in terms of which we forward you a copy. The agents have also signed a declaration, of which we likewise send you a copy, and we ought to add, that the declaration would have been made under the Act of Parliament, which constitutes the making of a false declaration a misdemeanour, but for the objection of the magistrates and a judge, to whom applications were addressed to allow them to be made.

"We trust, therefore, that, under the circumstances, you will see fit to disavow or retract the statement made in your paper, and of which our clients complain, and which, if not withdrawn, is calculated to inflict very great injury upon the company.

We are, Sir, your most obedient servants,
HODGSON & BURTON."

10. Salisbury-street, Strand. Oct. 31. 1851.

LEAGUE BREAD COMPANY.—"We, the several persons whose names are hereunto subscribed, being the whole of the workmen now and for the last twelve months at least employed by the League Bread Company in the manufacture of their bread, do severally, solemnly, and sincerely declare, that having read a statement in THE LANCET journal, published on the twenty-fifth day of October, one thousand eight hundred and fifty-one, to the effect that alum was contained in three samples of the Company's bread, we know such statement to be utterly false and unfounded. And we further severally declare, that during the time we have been in the Company's service, no alum or other deleterious ingredient whatever has ever been used or employed in the manufacture of the Company's bread; and that it is impossible that the same could be so used or employed without the fact being known to us. And we severally make this solemn declaration, conscientiously believing the same to be true, and by virtue of the provisions of an Act made and passed in the sixth year of the reign of his late Majesty, King William the Fourth, entitled, an Act to repeal an Act in the present Session of Parliament, entitled, an Act for the more effectual abolition of Oaths and Affirmations taken and made in various departments of the State, and to substitute Declarations in lieu thereof, and for the more entire suppression of voluntary and extrajudicial Oaths and Affidavits, and to make other Provisions for the Abolition of unnecessary Oaths.

	Quality of each Declarent.
James Stiff William Watts	Master Bakers.
James Stiff, Jun.	Yeast Brewer.
Henry Leach John Arkell Thomas Roddis John Stiff George White John Bagley	Foremen.
Charles Feedon James Martin Edward Fitzroy Holmes John Moll Edward Harding Robert Giles John Nye Arthur Lyon William Charles	Second Hands.

Witness, T. S. BURTON, *Solicitor*,
10. Salisbury-street, Strand."

League Bread Company.—"We, Eleanor Myers, of 1. University-street, Tottenham-court-road, Jane Hyde Burfield, of 10. Charles-street, Middlesex Hospital, and John Alford, of 46. James-street, Oxford-street, agents respectively for more than twelve months last past of the League Bread Company, do severally and solemnly declare that we have never, since we have acted for the said company, sold any other bread than that which has been delivered to us by the said company. And we further say, that we believe a statement which has been published in The Lancet journal on the 25th day of October instant, to the effect that alum was contained in three samples of bread purchased at our depôts, is entirely unfounded. And we severally make this solemn declaration, conscientiously believing the same to be true, and by virtue of the provisions of an Act made and passed in the sixth year of the reign of his late Majesty king William the Fourth, entitled an Act to repeal an Act of the present Session of Parliament, entitled an Act for the more effectual abolition of Oaths and Affirmations taken and made in various Departments of the State, and to substitute Declarations in lieu thereof, and for the more entire suppression of voluntary and extrajudicial Oaths and Affidavits, and to make other Provisions for the Abolition of unnecessary Oaths.

Eleanor Myers.
J. H. Burfield.
John Alford."

*** "We simply stated that *alum* was present in the bread, and made no imputation as to *who* put it there. It will be seen elsewhere that we *adhere* to the *accuracy* of the Report."—*Ed. of Lancet.*

ISINGLASS, AND ITS ADULTERATIONS.

Isinglass is the air-bag, or swimming-bladder, sometimes called the sound, of various fish, chiefly of the sturgeon tribe, and belonging to the genus *Acipenser*.

This bag is a membrane filled with air, situated near the spine, above the centre of gravity. In most fish it communicates with the œsophagus, or stomach, by a duct, which is known as the *ductus pneumaticus*; in others, the duct is imperforate; occasionally there are two sacs, one anterior to the other, and communicating by a short tube.

The air-bag is made up of an external or peritonæal covering, a middle, fibrous, and in some cases muscular coat, and an internal, highly vascular membrane.

The following are the principal species of fish from which Russian isinglass is derived:—*Acipenser Huso* or the *Beluga*, *A. Gouldenstadtii* or the *Osseter*, *A Ruthenus* or the *Sterlet*, *A. Stellatus* or the *Sewruga*, *Silurus Glanis*, and *Siprinus Carpio*.

In addition to the above, isinglass is obtained in different parts of the world from several other kinds of fish. In New York, from the *Labrus Squeteague*, of Mitchell. In New England it is procured from the intestines of *Morrhua vulgaris*, or the common cod, this form being denominated *ribbon isinglass*. In the Brazils, it is obtained from a large fish, probably a species of *Silurus*; and in Iceland, from the *Cod* and *Lota Moloa* or *Ling*.

The Fisheries.

The Caspian and Aral Seas yield the various kinds of the genus *Acipenser* in great abundance; they are also to be found in the waters several hundred miles beyond Astrakhan, in the Wolga, Yaik, Don, and even in the rivers as far as Siberia. The fisheries to the extent of three lazens, or twenty-one feet depth of water, belong to the proprietors of the coast. The Hon. Captain Keppell, in his "Travels," describes one merchant as holding thirty fisheries, for one only of which, at Karmaziack, he paid an annual rental of 450,000 roubles.

For the high seas a licence is given, stating the number of boats each fishery is permitted to employ.

The Beluga, *A. Huso*, is caught with harpoons and drawn to the coast. It is taken in the deepest waters of the Caspian Sea, about or beyond one hundred versts from the shore. The fish is a kind of small whale, often exceeds ten or twelve feet, and sometimes reaches twenty-five feet in length, and weighs from one hundred to five hundred English pounds.

Occasionally, on the capture of the beluga, the sounds are immediately removed, to allow of their drying before reaching the shore; in this case, however, the isinglass obtained is inferior to that which is dried on the land. The finest and whitest isinglass is that which is prepared on shore, especially where speed is used in cleaning and drying the sounds.

The smaller species are caught in amazing quantities at a less distance from the coast. Captain Keppel, in the volume before quoted, gives a graphic sketch of the manner in which the smaller fish are caught in the fishery of Karmaïzack.

"Two persons are in each boat: one, generally a female, rows, while the other hauls in the fish. The instruments used consist of a mallet, and a stick with a large unbarbed hook at the end. Every fisherman has a certain number of lines; one line contains fifty hooks; these are placed at regular distances from each other; they are without barbs, sunk about a foot under water, and are kept in motion by small pieces of wood attached to them.

"The sturgeon generally swims in a large shoal near the surface of the water, and, upon being caught with one hook, he generally gets entangled with one or two others in his struggles to escape.

"Immediately on our arrival, the boats pushed from shore. Each fisherman proceeded to take up his lines. On coming to a fish, he drew it with his hooked stick to the side of the boat, hit it a violent blow on the head with the mallet, and after disengaging it from the other hooks, hauled it into the boat.

"On every side the tremendous splashing of the water announced the capture of some huge inhabitant of the deep."

The sterlet, *A. Ruthenus*, is peculiar to the Wolga, although it is occasionally caught in the Don. The fish is of a brownish colour, having red spots on the sides, and the body shielded by a triple series of hard tubercles.

The sterlet is not very abundant; it is much smaller than the beluga or any other of the genus, and affords isinglass of the first quality. Its roe furnishes "caviare," and the fish is described as the most delicious ever eaten, and is esteemed a favourite dish for the imperial table.

The cost of conveying it to St. Petersburgh, on account of the fish requiring a daily supply of fresh water, is very great. The excessive heat of the weather in July causes a cessation of fishing during that month; the only exception being in favour of the *sterlet*, the fishing for which lasts the whole year round, and which is therefore an article supplied to the various markets for constant consumption.

Method of Preparation.

Having thus described the process of capturing the fish, we will now turn to the subsequent preparation.

The fish is brought up to the market-house on the banks of the river, where a clerk is ready to take account of the number caught. Seventy copecks are given for each fish. They are next taken from the boats, with instruments somewhat resembling boat-hooks, and laid in a row. The head of each fish is then split in two, and the caviare and air-bladder immediately separated. The latter is at once slit open, and placed in cold water. After a short time they are cleaned, divested of a certain outside skin or membrane, which envelopes the sounds, nailed to a board, and exposed to the sun to dry. This preparation, however, has reference only to *leaf isinglass*.

That known as *short staple*, *long staple*, and *book isinglass*, has each its distinctive method of preparation.

Short staple is formed of a thin Astrakhan isinglass, which is rolled to something under the thickness of a finger, or cord, and the length varying according to the intended size of the staple. A thin membrane is generally selected for the centre of the roll, round which the rest is folded; about half an inch of each extremity being mostly turned inwards; the two ends of the roll are then drawn together, and pinned with a small peg. The middle of the roll being pressed downwards, the staple assumes a heart shape, and without further preparation it is left to dry.

Samovey short staple, prepared from an inferior isinglass, is likewise imported:—indeed, this description is received in the three forms of *staple*, *leaf*, and *book*.

The manufacture of *long staple* varies a little from that just described. The operator lengthens the staple at will by interfolding the ends of the pieces with the portion ready for twisting. The required dimensions being thus attained, the ends are fastened together in the same manner, but it is afterward subjected to a heavier pressure from the middle; then, in order to preserve the shape of the three obtuse angles consequently formed, a cane or stick about a quarter of an inch in diameter, is fastened in each angle, with small wooden pegs at each extremity, to keep them in position. When sufficiently dried to retain their form, the pegs, &c., are removed, and on the drying being completed, the pieces are colligated in rows by the passing of a string through the peg-holes; this is done for the convenience of package and exportation.

The isinglass known as *book*, is of an inferior quality, and requires far less preparation.

The larger bladders, when cut open, cleaned, and partly dried, are merely folded up square, in the same manner in which book-folding is conducted—a resemblance that points out the origin of its name.

It may be asked, why all this evidently useless system of preparation is resorted to, when much expensive trouble might be dispensed with, and the article exported of equal value in its natural and unprepared state?

It may be inferred that the system of twisting isinglass into *staples*, or folding it into *books*, was originally practised to disguise the article, and keep other nations in the dark as to the source of isinglass.

There is, however, a kind of isinglass exported from St. Petersburg, which receives little or no preparation. This description is taken from the *Silurus glanis* and the *Siprinus carpio*. These produce the kind of isinglass called *purse*.

It consists of the sounds or swimming-bladders dried, just as taken from the fish, being neither cut open nor folded, but merely dried and collected together, by a string passed through the upper part of each bladder. It is gathered together by certain collectors, and by them brought to the Irbiter fair, held in January and February in each year. It is there bought up by the various dealers, cleaned, and carried to St. Petersburgh, where it arrives during the months of May and July.

The entire quantity of isinglass shipped during the seasons of the past seven years, was as follow—viz.,

In 1844	the total amount shipped was	5300 poods.
1845	,, ,, ,,	4200 ,,
1846	,, ,, ,,	5100 ,,
1847	,, ,, ,,	3600 ,,
1848	,, ,, ,,	3200 ,,
1849	,, ,, ,,	4900 ,,
1850	,, ,, ,,	5100 ,,

By the above figures it will be seen that the average annual exportation of isinglass from the Russian capital, during the period mentioned, was 4500 poods. The Russian pood being equal to thirty-six English pounds, it follows that 152,000 pounds of isinglass, on the average, are shipped every season (a period seldom lasting more than six months), and that in the course of seven annual seasons, 31,400 poods were exported, a weight equal to one million, one hundred and thirty thousand, four hundred pounds.

In addition to the isinglass imported from Russia, a vast quantity is annually received from the Brazils, and the East and West Indies. It is, however, greatly inferior to the descriptions we have noticed. Indeed, *Brazilian isinglass* is only fit for fining purposes, and for such it is almost wholly bought up by the proprietors of large brewing establishments, who consume nearly the entire quantity imported.

Some of the better kinds of Brazilian isinglass are manufactured in the same way as Russian, and sold at a cheaper rate. No doubt, in some instances, this is mixed with, or sold as, the best, and it has been ascertained that acids and other chemicals have been used to improve the colour of Brazilian isinglass; but the test of good isinglass is in the jelly made therefrom.

The jelly made from Russian isinglass dissolves readily, furnishes scarcely any sediment, and is remarkably firm, pure, and translucent.

On the other hand, Brazilian isinglass makes a far inferior jelly, with these remarkable differences: that whilst Russian isinglass is firm, and free from deposit, Brazilian isinglass leaves a deposit of insoluble matter amounting to twenty or thirty per cent., is less readily dissolved, and the jelly is opalescent, and assumes the appearance of milk.

On making *blanc-mange* with the purest Russian isinglass, milk is needed to impart the snow-white colour of that jelly; but in the case of Brazilian isinglass, hot water alone will render it nearly of that colour. It is almost needless to add that the *blanc-mange* is much inferior in quality, and the large per-centage of insoluble matter renders the jelly proportionately weak.

The quality of any isinglass may easily be tested by dissolving a small portion in a glass vessel, with about a table-spoonful of boiling water. The best Russian isinglass will instantly dissolve, and scarcely a particle of sediment remain; the soluble matter in this article being, according to the best authorities, ninety-eight grains in every hundred.

The same test applied to Brazilian isinglass will extract the gelatine, but the shreds, from their fibrous character, do not entirely dissolve; they turn white and retain their form, unless disturbed, in which case they break up, and form a deposit at the bottom of the vessel.

If Russian isinglass be adulterated with Brazilian, the admixture may easily be detected by the insoluble shreds, or white deposit, which is sure to appear in proportion to the amount of Brazilian isinglass that may be introduced. The smell of the latter also is strong, far from pleasant, and forms a great contrast with the faint, inoffensive, seaweed-like odour of Russian isinglass.

Manufacture of Isinglass.

On the arrival of the isinglass into this country, the best kinds are submitted to a course of preparation before they are ready for consumption.

The Beluga leaf is closely examined, and all discoloured parts cut away; the cuttings, and other pieces not deemed good enough for the *best*, are placed aside as *seconds* or *thirds*. These, in some cases, are used for fining the better description of ales, but more generally for wines, liqueurs, &c. It is also rolled and cut into shreds for domestic purposes, where colour is not an immediate object.

Purse isinglass is mostly sold to the brewers, who consume a vast quantity in the fining of their several beverages.

Long and short staple isinglass is extensively demanded by cider makers, confectioners, and others, to whom it is sold in the same state as imported into this country.

Leaf isinglass taken from the Beluga, after having been picked from all impure or discoloured pieces, constitutes the very best article, either for dietetical use, or for the higher class of clarifying purposes. This description of isinglass has to undergo a process of manufacture before it is ready for use. What are termed perfect specimen leaves are nearly round, the bladder having been opened longitudinally, about two feet in circumference, and weigh from eight to sixteen ounces, according to the thickness of the sound. It is not uncommon, however, to meet with heavier samples, some having been known to reach four pounds.

A steam-engine of some eight or ten-horse power is generally used under the present method of preparing isinglass, the adjunct machinery consisting of a series of powerful rollers, arranged in pairs in a manner resembling those used for expressing the juice from the sugar-cane. The rollers when in motion are fed with leaf isinglass as fast as possible, which, in passing between the two rollers, becomes amalgamated and spread out, and is expelled from the opposite side of the rollers in one continuous sheet. The isinglass thus rolled is called "ribbon," but it is not yet ready for the process of cutting.

The sheet or "ribbon" is probably a sixth, eighth, or tenth part of an inch in thickness, and as it is necessary to reduce it until it is as thin as writing-paper, it is passed through rollers more closely set, until, as the thickness diminishes, the desired result is obtained; the width of the "ribbon" of course increasing.

It is to be remarked, that in rolling, the ribbon being confined to the width of the rollers, generally about two feet, increases only lengthways, and when completed, can be folded or rolled up in the same manner as a length of common linen.

After a brief delay, for the purpose of drying, the next and last process of cutting is effected. By the introduction of modern machinery, this part of the preparation of isinglass is performed with surprising celerity, and the material is cut into very fine shreds.

The cutting machine is a cylinder with some five or six keen-edged blades fixed in a tangential direction to the cylinder. The same engine which serves to roll out the isinglass, as already described, suffices to turn this little machine at the rate of some 800 or 1000 revolutions per minute; taking a low estimate, we will suppose it turns 800 times. On examining the cylinder we find five or six blades set in it, and as each of these knives severs a shred from the width of the "ribbon," while the cutting process is going on, it follows that four or five thousand shreds are cut in the short space of one minute.

Such is the plain and simple method of preparing cut isinglass.

There are, however, many consumers who still prefer the old-fashioned style of hand-cut isinglass. In this case, the thin leaf is pulled to pieces with the fingers or divided into strips with scissors, a work mostly performed by women.

The isinglass is of course in much thicker pieces, but nevertheless it is still preferred by some, not on account of its cheapness, as the cost of preparation is much about the same as machine-cut isinglass.

We have now given a general description of isinglass, enumerated the fish from which it is obtained, described the fisheries, the preparation of isinglass, and its manufacture.

From a paper by Dr. Pereira, in the fifth volume of the *Pharmaceutical Journal*, page 66., we learn that the *Samovy* isinglass referred to is obtained from the *Silurus glanis*, the Russian name for which fish is *Som*, whence the word *Samovy* or *Somovy* is no doubt derived.

A difference of opinion has been entertained as to which coat of the air-bladder yields the isinglass. The several layers which enter into the composition of the swimming-bladder, commencing from without, are—1st, a peritonæal coat; 2nd, a middle coat, composed principally of a modification of what is known as white fibrous tissue; and 3rd, an internal epithelial lining.

Bloodvessels ramify through both the external and middle coats, but are most abundant on the inner surface of the latter. These vessels are sometimes described as forming a distinct *vascular* layer. Some also make mention of a *muscular* coat entering into the formation of the air-bladders of certain of the fish from which isinglass is obtained; and it is probable that more or less muscular fibre of the unstriped kind is present in nearly all cases.

Of these coats, the external, or peritonæal covering, is, we believe, usually stripped off; while the internal, which is very thin, and forms but little of the substance of the air-bladder, is also generally removed in the washing and cleansing to which the isinglass is subject; in the case of purse isinglass it is not removed, however. There remains, then, only the *middle* coat; and it is this we believe which furnishes the isinglass—a view entertained by Dr. Pereira, as appears from the second edition of his *Materia Medica.*

The accuracy of this opinion has been, however, called in question by Dr. Edward Martiny, who describes the air-bladder as consisting of only two membranes—an *outer*, strong, shining, and fibrous membrane, and an *inner*, soft, mucous coat. "The inner membrane — namely the mucous membrane"—writes Dr. Martiny, "is the isinglass." To this description, Dr. Martiny appends the following note:—

"Pereira ('Elements of Materia Medica,' vol. ii., second edition, p. 1861.) erroneously regards the middle coat as yielding gelatine."

It appears, from the description of Dr. Martiny, as well as from the above remark, that he has overlooked the epithelial lining altogether, and has not therefore enumerated this as one of the coats of the air-bladder. The "isinglass membrane" of Dr. Pereira, and the "mucous membrane" of Dr. Martiny, there is therefore reason to believe, are one and the same.

The epithelial layer is insoluble in boiling water, and in some instances it is so thick, as in purse isinglass, as materially to deteriorate the value of the article.

When dry, isinglass is transparent, but when immersed in cold water for a few minutes, it becomes white and opaque. Under the microscope, it presents a fibrous structure, which immediately disappears on the addition of dilute acetic acid, the isinglass swelling up, and again becoming very transparent. Examined with the microscope after the action of acetic acid, the walls of the bloodvessels, sometimes the white corpuscles of the blood, and scattered nucleated fibres of fibro-elastic tissue, may be seen.

Now, in all these particulars, isinglass resembles very closely *white fibrous tissue*, a modification of which it is evidently to be considered.

The jelly made even from the best Russian isinglass is, when cold, slightly opalescent. This is due to the presence of a small quantity of albumen. The whiteness of the jelly of *Brazilian* isinglass, which is so remarkable, results from the presence of a much greater amount of albuminous matter.

GELATINE.

Isinglass is made up, to a considerable extent, of the proximate principle, gelatine, which is present in bones, and almost all animal membranes, in large amount. The knowledge of this fact has led to the adoption of numerous processes for the separation of the gelatine.

Now, as gelatine is obtained from these substances, and is extensively employed as a substitute for isinglass, we will, in the next place, proceed to give a description of the preparation of gelatine.

From Pereira's "Materia Medica" we learn that "gelatine is extracted from the bones of the ox and the sheep. It is obtained by boiling bones in water under pressure. It is more readily procured by employing bones which have been previously digested in hydrochloric acid to extract the phosphate of lime. In this way a nutritious soup is prepared in Paris for the hospitals and other pauper habitations. The *patent gelatine* of the shops is obtained, I presume, from bones. It is sold either plain or coloured, and is used as a substitute for isinglass. Gelatine has been extracted from antediluvian bones. A soup was prepared from the bones of the great mastodon by a préfet of one of the departments of France."

In the *London Journal of Arts and Sciences*, a publication which contains the specification of new patented inventions, we find the following description of a patent granted to George Philbrick Swinborne, of Pimlico:—

"The patentee commences his specification by stating that heretofore, in manufacturing gelatine, it has been usual (with one exception) to act on large pieces of hides or skins, and to employ acids and alkalies, together with mechanical and other processes, which occupy considerable time, and are likewise costly; and in the excepted case above referred to, it has been the practice to reduce the pieces of hide into the state of pulp in a paper machine, and then to employ blood to purify the product obtained.

"This invention consists in the following more simple mode of manufacturing gelatine. The patentee takes hides or skins, or parts thereof, as fresh and sweet as possible, and free from hair, and he reduces the whole into shavings or thin slices or films, by any suitable instrument; he soaks the shavings or films for about five or six hours in cold water, and then changes the same; he repeats such changing of the water two or three times each day, until no smell or taste is to be detected, either in the water or in the shavings, and then he removes the shavings from the water. If this product is intended for soup, it is dried on nets, and is then ready for use. If gelatine is to be extracted, the shavings, after the above soaking, are put into a suitable vessel, with a quantity of water, sufficient to cover them when pressed down, and they are subjected to a heat not exceeding boiling water. When dissolved, the gelatine is to be strained through linen or other fabric, subjected to slight pressure with the hands or otherwise, or the solution may be permitted to run off from the vessel without straining, by which means much of the gelatine will be separated from the fibrous matters. The product of gelatine thus obtained is run in thin films on to a smooth surface of slate, or other suitable material, to set; it is then removed on to nets to dry, and when dry it is cut up with an isinglass cutter or other suitable apparatus. The residue, dried or not, may be used for thickening soup, and other culinary purposes."

"Another manufacture of gelatinous substances is produced by the following process, from cod sounds, or other fishy matters capable of yielding gelatine:—These matters are reduced to shavings or thin films, soaked in water, subjected to the action of heat, and the gelatine strained or run off as above described. The patentee obtains a first, second, and third product of gelatine, which he forms into sheets, and when dry cuts up the same with an isinglass cutter. This manufacture of gelatine will be found highly useful as a cheap substitute for isinglass for clarifying liquids."

As gelatine is in many respects inferior to isinglass, is also much cheaper, and as it is sometimes used to adulterate isinglass, and very commonly sold as a substitute for it, it becomes of importance that it should be known in what particulars isinglass and gelatine differ from each other. The distinction we will next proceed to point out.

Isinglass and gelatine differ very considerably from each other in many of their characters, and especially in the following:—

The shreds of isinglass, when immersed in cold water, become white, opaque, soft, and swollen.

The swelling of the shreds is equal in all directions, so that, when viewed with a low power of the microscope, they appear more or less quadrangular.

In boiling water, they dissolve nearly without residue.

The smell of the dissolved isinglass, when hot, is somewhat fishy, but not unpleasant.

The moistened shreds, or the solution, exhibit to test-paper a neutral, or faintly alkaline, and rarely a slightly acid reaction.

Under the microscope, the filaments exhibit a well-marked fibrous structure.

In acetic acid they swell up, and become soft and jelly-like, the greater part of the structure being lost.

Lastly, "The ash which results from the incineration of good Russian isinglass is of a *deep red* colour: it contains but a small portion of carbonate of lime, and never amounts to more than nine per cent. of the isinglass used."*

The shreds of gelatine, on the contrary, when placed in cold water, swell up, acquire increased transparency, and become translucent and glass-like.

The form which the threads take in swelling is peculiar: they do not, like those of isinglass, swell equally, and remain quadrilateral, but become expanded, flat, and ribbon-like, the broad surfaces corresponding to the incised margins.

The dry threads on the uncut surfaces frequently present a peculiar, shining lustre, not unlike that of tinsel.

In boiling water, the shreds do not entirely dissolve, but in most cases a copious deposit falls to the bottom of the glass.

The smell of the hot infusion is like that of glue, and therefore disagreeable.

The moistened filaments, or the solution of gelatine, usually exhibit a strong acid reaction: this in some cases is due to the substances used in bleaching it.

They show no structure under the microscope, but only the marks of the instrument employed in cutting them.

Immersion in dilute acetic acid hardens gelatine.

Lastly, the ash is different from that of isinglass in amount, colour, and composition. "100 grains of gelatine give from 2·3 to 2·6 grains of ash, which is *white*, contains much carbonate of lime, with some chlorides and sulphates."—*Letheby.*

* Dr. Letheby, Pharmaceutical Journal, vol. x. p. 127.

Dr. Letheby, who has paid considerable attention to the subject of isinglass, and has drawn up an excellent summary of its chief characters, regards the differences above noticed between the ashes of isinglass and gelatine as very important and distinctive.

It thus appears, that between isinglass and gelatine there are several well-marked distinctions, some of these sufficiently simple to enable the ordinary observer to distinguish for himself the one from the other.

The action of a little cold water on a few of the filaments spread out on glass, is all that is necessary for the discrimination.

Results of the Microscopical Examination of Twenty-eight Samples of Isinglass, purchased at the Establishments of Grocers and Italian Warehousemen resident in the Metropolis.

1*st Sample.*—Purchased of Brocksopp & Co., 234. High-street, Borough. Price 1*s.* per oz.
Analysis.—Genuine isinglass.

2*nd Sample.* — Purchased of Harrington & Lucas, 113. High-street, Borough. Price 8*d.* per oz.
Analysis. — Genuine isinglass.

3*rd Sample.* — Purchased of White & Co., 107. High-street, Borough. Price 8*d.* per oz.
Analysis. — Genuine isinglass.

4*th Sample.* — Purchased of Russell & Co., 72. High-street, Borough. Price 8*d.* per oz.
Analysis. — Genuine isinglass.

5*th Sample.* — Purchased of R. Jones, 16. High-street, Borough. Price 10*d.* per oz.
Analysis. — Genuine isinglass.

6*th Sample.* — Purchased of Mr. Pringle, 35. Blackman-street, Borough. Price 1*s.* per oz.
Analysis. — Gelatine.

7*th Sample.* — Purchased of Dannan & Co., 2. Walworth-road. Price 1*s.* per oz.
Analysis. — Genuine isinglass.

8*th Sample.* — Purchased of Field & Co., 9. Walworth-road. Price 1*s.* per oz.
Analysis. — Genuine isinglass.

9*th Sample.* — Purchased of Horwood & Co., 69. Newington-causeway. Price 1*s.* 4*d.* per oz.
Analysis. — Gelatine.

10*th Sample.* — Purchased of C. Hart, 4. Newington-causeway. Price 10*d.* per oz.
Analysis. — Genuine isinglass.

11*th Sample.* — Purchased of Fisher & Co., 24. Crown-row, Walworth. Price 1*s.* per oz.
Analysis. — Genuine isinglass.

12*th Sample.* — Purchased of J. Clarke, 8. Crown-row, Walworth. Price 1*s.* per oz.
Analysis. — Gelatine.

13*th Sample.* — Purchased of Hawthorne & Co., 38. Tottenham-court-road. Price 10*d.* per oz.
Analysis. — Gelatine.

14*th Sample.* — Purchased of Mr. Warton, 13. North Audley-street. Price 1*s.* per oz.
Analysis. — Gelatine.

15*th Sample.* — Purchased of J. Christmas, 34. South Audley-street. Price 1*s.* 2*d.* per oz.
Analysis. — Gelatine.

16*th Sample.* — Purchased of Mr. Clifford, 82. Lower Grosvenor-street. Price 1*s.* 2*d.* per oz.
Analysis. — Gelatine.

17th Sample. — Purchased of Walker & Co., 21. Goodge-street, Tottenham-court-road. Price 10*d.* per oz.
Analysis. — Genuine isinglass.
18th Sample. — Purchased of Payne & Sons, 328. Oxford-street. Price 1*s.* per oz.
Analysis. — Genuine isinglass.
19th Sample. — Purchased of R. H. Feltoe, 298. Oxford-street. Price 1*s.* per oz.
Analysis. — Genuine isinglass.
20th Sample. — Purchased of E. Frost, 288. Oxford-street. Price 1*s.* per oz.
Analysis. — Genuine isinglass.
21st Sample. — Purchased of M. Jones, 166. Oxford-street. Price 10*d.* per oz.
Analysis. — Genuine isinglass.
22nd Sample. — Purchased of Westbrooke & Co., 21. Oxford-street. Price 1*s.* per oz.
Analysis. — Genuine isinglass.
23rd Sample. — Purchased of Hedges & Butler, 155. Regent-street. Price 1*s.* 4*d.* per oz.
Analysis. — Gelatine.
24th Sample. — Purchased of E. Lazenby & Co., 6. Edwards'-street, Portman-square. Price 1*s.* per oz.
Analysis. — Gelatine.
25th Sample. — Purchased of Fortnum & Mason, Piccadilly. Price 1*s.* 2*d.* per oz.
Analysis. — Genuine isinglass.
26th Sample. — Purchased of W. Holland, 127. Oxford-street. Price 10*d.* per oz.
Analysis. — Genuine isinglass.
27th Sample. — Purchased of Sidney, Manduell, & Wells, 8. Ludgate-hill. In packets. Price 1*s.* $1\frac{1}{2}$*d.* per oz.

"By her Majesty's Royal Letters Patent.
SWINBORNE'S
PATENT REFINED
ISINGLASS,
Extra quality,
For invalids and confectionary purposes."

Analysis. — Gelatine.

28th Sample. — Purchased of W. Holland, 127. Oxford-street. In sealed packages. Price 1*s.* 2*d.* per oz.

"VICKERS'
GENUINE RUSSIAN ISINGLASS,
FOR INVALIDS, AND CULINARY USE.

"This article is guaranteed to be prepared from the pure Russian isinglass, as imported, and has not undergone any other process besides being passed through rollers and cut into shreds, for the purpose of rendering it more soluble. Purchasers who are desirous of protecting themselves from the *adulteration* which is now so extensively practised are recommended to ask for "VICKERS' GENUINE RUSSIAN ISINGLASS," *in sealed packets* (containing one ounce, two ounces, a quarter of a pound, or one pound), that being the surest guarantee for their always obtaining a really PURE AND UNADULTERATED ARTICLE.
FACTORY, 23. LITTLE BRITAIN, LONDON."

Analysis. — Genuine isinglass.

From the above Table, it appears that out of the twenty-eight samples of isinglass submitted to examination, *ten, or more than one-third,* of the samples consisted entirely of gelatine.

That the price of the genuine isinglass varied from 8*d.* to 1*s.* 4*d.* per ounce; while that of the gelatine ranged between 10*d.* and 1*s.* 4*d* per ounce.

Now, as isinglass is very different from gelatine in many of its properties, and as it is undoubtedly much the superior of the two, it is evident, from these inquiries, that the public are seriously imposed upon and injured by the substitution for isinglass of such an article as *gelatine.*

There is one adulteration of isinglass, which we believe to be not unfrequently practised—viz., the incorporation of different amounts of gelatine with the genuine isinglass. On this subject we may have some remarks to offer on a future occasion.

VINEGAR, AND ITS ADULTERATIONS.

General Remarks on Acetification.

Acetic acid is the volatile principle, to the presence of which, diluted with variable proportions of water, vinegar owes its aroma and pungency.

This acid exists, ready formed, in notable quantity in certain plants, as *Sambucus niger* or *black elder*, *Phœnix dactylifera* or *Date tree*, and *Rhus typhenus.*

It may be readily generated by the fermentation of various vegetable and animal substances, especially the former.

For commercial purposes it is made from certain vegetable and spirituous infusions, as those of the grape, malt, and the sugar-cane; but any vegetable infusion capable of yielding alcohol will also, when exposed to the necessary conditions, furnish vinegar. In most cases, and indeed whenever vinegar is manufactured on a large scale, the vinous or alcoholic fermentation precedes the acetous, and the vinegar is formed entirely at the expense of the alcohol.

But the conversion of alcohol into acetic acid, it is said, ought not to be regarded as essential to acetification, since some vegetable and animal infusions become sour, from the formation of acetic acid, without any previous generation of alcohol.

Acetic acid may be formed directly from the vapour of crude alcohol or spirits of wine in communication with the atmosphere, through either an ignited platinum wire, or by means of the black powder obtained by boiling protochloride of platinum and potash with alcohol. In Germany, where the price of alcohol is very low, vinegar has been manufactured on a large scale on this principle. The process is thus described by Dr. Ure:—

"Under a large case, which for experimental purposes may be made of glass, several saucer-shaped dishes of pottery or wood are to be placed in rows upon shelves over each other, a few inches apart. A portion of the black platina powder, moistened, being suspended over each dish, let as much vinous spirits be put into them as the oxygen of the included air shall be adequate to acidify. This quantity may be inferred from the fact, that 1000 cubic inches of air can oxygenate 110 grains of absolute alcohol, converting them into 122 grains of absolute acetic acid, and sixty-four grains and a half of water.

"The above simple apparatus is to be set in a light place (in sunshine if convenient), at a temperature of from 68° to 86° Fahr., and the evaporation of the alcohol is to be promoted by hanging several leaves of porous paper in the case, with their bottom edges dipped in the spirit. In the course of a few minutes a most interesting phenomenon will be perceived. The mutual action of the platina and the alcohol will be displayed by an increase of temperature and a generation of acid vapours, which, condensing on the sides of the glass case, trickle in streams to the bottom. This striking transformation continues till all the oxygen of the air be consumed. If we wish then to renew the process, we must open the case for a little, and replenish it with air. With a box of twelve cubic feet in capacity, and with a provision of seven or eight ounces of platina powder, we can in the course of a day convert one pound of alcohol into pure acetic acid, fit for every purpose, culinary or chemical. With from twenty to thirty of the platina powder (which does not waste), we may transform daily nearly 300 pounds of bad spirits into the finest vinegar. Though our revenue laws preclude the adoption of this elegant process upon the manufacturing scale in this country, it may be regarded as one of the greatest triumphs of chemistry, where art has rivalled nature in one of her most mysterious operations."

Certain conditions are either essential to acetification, or else promote greatly the rapidity of the process; thus the presence of atmospheric air is one of the conditions indispensable to the change, the reason of which is made apparent by the subjoined formulæ: —

One atom of alcohol consists of

$$C_4 H_5 O + H O;$$

One atom of anhydrous acetic acid of

$$C_4 H_3 O_3.$$

Now, one atom of alcohol absorbs four atoms of oxygen from the air, to form one atom of anhydrous acetic acid, and three atoms of water — a change which is thus explained by chemical symbols.

$$C_4 H_6 O_2 \text{ and } 4 O = C_4 H_3 O_3 \text{ and } 3 H O;$$
$$\text{or } C_4 H_5 O + H O \text{ and } 4 O = H O, C_4 H_3 O_3 + 2 H O.$$

Thus, when alcohol is converted into acetic acid, two of the atoms of the oxygen are directly absorbed to form the acid, and the remaining two atoms convert two atoms of the hydrogen of the alcohol into water; the atom of water of the alcohol and the two fresh atoms of water produced are all retained, and form a terhydrate of acetic acid.

Such are the changes, by atom, of alcohol into acetic acid.

It is therefore evident that much of the success of any process adopted for the manufacture of vinegar will depend upon the manner in which the mother liquor is exposed to the atmosphere — that is, upon the constant renewal of the air, and the extent of surface exposed to its action, the conversion of alcohol into acetic acid taking place only on the surface of the liquid.

The knowledge of the fact that atmospheric air is indispensable to acetification explains why wine and beer, which, when inclosed in air-tight vessels, undergo no change, as soon as they are exposed to the air, rapidly pass into the acetous fermentation.

A second necessary condition is the presence of a substance capable of exciting fermentation — that is, a ferment.

In vegetable infusions, as those of the grape and malt, the nitrogenised principles contained in them, chiefly gluten, act as the ferment. Vinegar itself, vinegar yeast, lees, beer yeast, leavened bread, and many other similar matters, all of which contain gluten, are capable of exciting fermentation, and so promoting the generation of acetic acid. Experience has shown that the best ferment for inducing the transformation of alcohol into acetic acid is a portion of ready-made vinegar itself.

A third condition, which, though not, like the former, essential, yet greatly hastens the conversion, is an increased temperature, varying considerably in different cases, but sometimes reaching as high as 100° Fahr.

When any spirituous liquor is exposed under the conditions requisite for acetification, the following phenomena are observed to occur in succession.

However clear the liquid may have been at first, it quickly becomes turbid, currents or movements are soon visible in it; it is said, in common language, to be "on the work." Slimy particles collect on the surface, gradually forming a scum, and which, after a time, falls as a sediment to the bottom. The Germans call this scum "vinegar mother," since it is capable of exciting acetification in fresh portions of liquid. During the process the temperature of the liquid rises, and the peculiar aroma of vinegar becomes diffused in the surrounding air; as soon as all the alcohol has become converted into acetic acid, the temperature falls to that of the atmosphere, the motion ceases, the liquid becomes clear and bright, and its conversion into vinegar is complete.

The Different Kinds of Vinegar, and their Manufacture.

The four principal kinds of vinegar met with in commerce are — *wine vinegar*, *malt vinegar*, *sugar vinegar*, and *wood vinegar*. The first three of these depend upon fermentation, and result from the change of alcohol into acetic acid; while wood vinegar is obtained without the intervention of fermentation, by the destructive distillation of wood.

Not unfrequently more than one substance is combined in the manufacture of vinegar; thus, mixtures of malt, corn, and sugar or treacle are occasionally employed; in which case the resulting vinegar is of course a combination of two or more kinds of vinegar.

In some parts of England vinegar is made from either *cider* or *perry;* these kinds are distinguished by the presence of malic acid.

Distilled vinegar may be obtained by the distillation of any kind of vinegar; what is commonly sold however as this, is generally nothing more than diluted acetic acid, and in some cases even pyroligneous acid.

Wine Vinegar. — The room in which this description of vinegar is manufactured is usually constructed for the especial purpose; the walls are built of brick, the roof is low, and the apartment provided with a number of holes, by which the air can be constantly renewed, and which admit of being more or less closed, according to the external temperature and the state and direction of the wind; while the heat of the room is maintained at a uniform degree by means of either flues or hot-water pipes. In France these fermenting rooms are called *vinaigraires*, and have always a southern aspect, so that they may receive the influence of the sun.

The process of fermentation is carried on in casks; these are placed in rows one above the other, the acetification being soonest complete in the highest row, in consequence of the greater degree of heat in the upper part of the chamber.

The casks are laid horizontally, and pierced at the upper part of their front end with two holes; one of these, named the *eye*, is two inches in diameter, and serves for charging the cask, and for drawing off the vinegar when made; the other is much smaller, and is merely for the escape of air.

When new vessels are employed, they must be filled to one-third with good vinegar, which acts as the ferment, or *mother*, to the wine subsequently added to it.

"At the ordinary rate of work," says Dr. Ure, "they put at first upon the mother, which occupies one-third of the vessel, a *broc* of ten litres of red or white wine; eight days afterwards they add a second *broc;* then a third and a fourth, always observing the same interval of time — eight days. After this charge they draw off about forty litres of vinegar, and then recommence the successive additions."

The cask should always be about one-third empty, to admit freely of the action of the air; but as tartar and lees gradually accumulate, it becomes, after a time, necessary to clean out the casks and to commence afresh; this, however, is usually not required until after the casks have been in use for about ten years.

As the process of the conversion of wine into vinegar is not always accomplished in a given time, it is necessary, before drawing off the vinegar, to test it, and ascertain whether the conversion is complete. For this purpose a white rod is introduced into the liquor, and then drawn out in a horizontal direction. If it be covered with a thick white froth, it is judged that the operation is complete; but if the wort be red, the process is considered to be incomplete.

The temperature of the fermenting room, Dr. Ure states, is constantly kept up, by wine vinegar makers, from 75° to 77° Fahr.

The wine, before being added to the casks, itself usually undergoes a process of clarification. For this purpose it is poured into a cask filled with chips of beechwood; the impurities, termed lees, are arrested by the chips, and the wine passes off quite clear.

In some cases, when this precaution has not been observed, and especially when the wine itself is weak, it often becomes requisite to clarify the vinegar; this is effected usually in the same manner, but sometimes a small quantity of isinglass is employed instead.

The wine vinegars are made principally in the wine-growing countries of France and Germany. Most of the French wine vinegar which makes its way into this country is manufactured at Bordeaux and Orleans.

It is, when pure and of good quality, the best description of vinegar; it is liable, however, to adulteration with pyroligneous acid. It is sometimes flavoured by the addition of wine, and is distinguished from all other vinegars by the presence of bitartrate of potash, called simply tartar or wine-stone. The presence of the alcohol increases its aroma and pungency.

According to the above-described method, the process of acetification extends over several weeks before it is complete. A system has been devised, however, so rapid, that the conversion is effected often in a few days. This important result is obtained by the peculiar construction of the fermenting vessels, whereby an immensely extended surface of the liquor is exposed to the action of the air. We shall presently describe this process more fully.

Malt Vinegar. — The chief part of the vinegar made in this country is prepared from malt, or malt and corn mixed either with or without sugar; the following is the process as described by Dr. Ure. "One boll of good barley malt, properly crushed, is to be mashed with water at 160° Fahr.; the first water should have that temperature; the second must be hotter than 160°; and the third water, for the extraction of all the soluble matter, may be boiling hot. Upon the whole, not more than 100 gallons of wort should be extracted. After the liquor has cooled to 75° Fahr., three or four gallons of beer yeast are poured in, and well mixed with a proper stirrer. In thirty-six or forty hours, according to the temperature of the air and the fermenting quality of the wash, it is racked off into casks, which are laid upon their sides in the fermenting apartment of the vinegar work, which should be kept at a temperature of 70° at least; in summer, partly by the heat of the sun, but in general by the agency of proper stoves, as above described. The bung-holes should be left open, and the casks should not be full, in order that the air may act over an extensive surface of the liquor. It would be proper to secure a free circulation to the air, by boring a hole in each end of the cask near its upper edge. As the liquor, by evaporation, would be generally a few degrees colder than the air of the apartment, a circulation of air would be established, in at the bung-hole, and out by the end-holes. By the ordinary methods, three months are required to make this vinegar marketable, or fit for the manufacture of sugar of lead."

"In making vinegar for domestic purposes, the casks are usually set on their ends, and they have sometimes a false bottom pierced with holes, placed about a foot above the true one. On this bottom a quantity of *rape*, or the refuse raisins, &c., from the making of British wines, is laid. The malt liquor has a proper quantity of yeast added to it. In about twenty-four hours it becomes warm, and is then racked off into another similar cask. After some time this racking process is discontinued, and the vinegar is allowed to complete its fermentation quietly. The proper temperature must always be kept up, by placing the cask in a warm situation. A little wine-stone (*argol*) added to the malt-wash, would make the vinegar liker that made from wine. Sometimes a little isinglass is employed to clarify vinegar. A portion of sulphuric acid is often added to it."

Sugar vinegar. — "By pursuing the following plan, an excellent sugar vinegar (states Dr. Ure) may be made. In 158 quarts of boiling water dissolve ten pounds of sugar, and six pounds of wine-stone; put the solution into a fermenting cask, and when it is cooled to the temperature of from 75° to 80° Fahr., add four quarts of beer yeast to it. Stir the mixture well, then cover the vessel loosely, and expose it for six or eight days to the vinous fermentation, at a temperature of from 70° to 75° Fahr. When it has become clear, draw off the vinous liquor, and either acetify it in the graduation-tub above described, or by the common vinegar process. Before it is finished we should add to it twelve quarts of strong spirits (brandy), and fifteen quarts of good vinegar, to complete the acetous fermentation. With a graduation-tub which has been used, this addition of vinegar is unnecessary."

The following simple directions for making sugar vinegar deserve attention: — "For every gallon of hot water, take eighteen ounces of sugar; and when the syrup has cooled to 75°, add four per cent., by measure, of yeast. When the vinous fermentation is pretty well advanced, in the course of two or three days, rack off the clear wash from the lees into a proper cask, and add one ounce of wine-stone, and one of crushed raisins, for every gallon of water. Expose it in a proper manner, and for a proper time, to the acetifying process, and then rack off the vinegar, and fine it upon beech chips. It should be afterwards put into bottles, which are to be well corked.

"Vinegar obtained by the preceding methods has always a yellowish or brownish colour. It may be rendered colourless by distillation. For nicer chemical purposes, this is done in a glass retort; but on a large scale, it is usually performed in a clean copper still, furnished with a capital and worm refrigeratory, either of silver or block-tin."

Wood Vinegar.—Wood vinegar is made, as already observed, by the destructive distillation of certain kinds of wood.

The rationale of the formation of the acetic acid is as follows:—

The water is first driven off in the form of vapour; the various constituents of the wood, as the fibre, albumen, &c., are decomposed into their ultimate elements, carbon, hydrogen, oxygen, and nitrogen; these elements reunite, and form, by their combination, a variety of totally different compounds, as water, carbonic acid, carburetted hydrogen, carbonic oxide, and pyroligneous acid, which consists of a portion of the carbon of the wood, in union with oxygen and hydrogen.

The proportions of these several products vary, not only with the nature of the wood, but particularly with the degree of heat employed. Towards the end of the process, the carbon being predominant, empyreumatic oil, of a dark colour, and laden with that substance, will pass over.

The apparatus employed in this country for the manufacture of wood vinegar, consists of large iron cylinders, placed horizontally in a furnace; the extremities project a little beyond the brickwork of the furnace; "one end has a disc or round plate of cast-iron, well fitted, and firmly bolted to it, from the centre of which disc an iron tube, about six inches in diameter, proceeds, and enters, at a right angle, the main tube of refrigeration; the diameter of this tube may be from nine to fourteen inches, according to the number of cylinders. The other end of the cylinder is called the mouth of the retort; this is closed by a disc of iron, smeared round its edges with clay lute, and secured in its place by fir wedges. The charge of wood for such a cylinder is about eight cwt. The woods used are principally those of the oak, ash, birch, and beech. The heat is kept up during the daytime, and the furnace is allowed to cool during the night. Next morning the door is opened, the charcoal removed, and a new charge of wood is introduced. The average product of crude vinegar, called pyroligneous acid, is thirty-five gallons."

The manufacture of pyroligneous acid is sometimes carried on in connection with the preparation of gunpowder, as a matter of economy. Charcoal entering so largely into the composition of gunpowder, the pyroligneous acid formed during the reduction of the wood to the state of charcoal, is, by some makers, carefully collected, although others suffer it to go to waste.

The Quick Vinegar Process.

According to the old and usual method of making vinegar by exposing the alcoholic mixture to the air in casks, several months elapse before the acetification is complete, and a great loss of alcohol and of acetic acid of course ensues. It therefore became an important desideratum in the manufacture of vinegar to invent some process whereby this long period might be shortened and waste of material lessened.

With this object in view, and remembering that the great impediment to quick acetification was the slow and imperfect manner in which the oxygen of the air was supplied to the liquid to be acidified, it occurred to the late Mr. Ham, of Norwich, that if he could succeed in feeding the liquid more effectually and quickly with oxygen, that the process of acetification would be greatly abridged thereby, and a considerable saving of material effected. He therefore contrived an apparatus by which the alcoholic solution was made constantly to pass over, in a shower of drops, layers formed either of chips or faggots of beech-wood, a great extent of surface of liquid being thus continually exposed to the action of the atmosphere. The actual and practical results of this method of proceeding fully equalled those which, from theory alone, might have been anticipated.

In the work of Dr. Ure already quoted, 1st edition, we meet with the following description of the fermenting vessels, and of the process of acetification called the "quick vinegar work," as practised in Germany:—

"An oaken tub, somewhat narrower at the bottom than the top, from six to seven feet high, and three feet in diameter, is furnished with a well-fitted, grooved, but loose cover. About half a foot from its mouth, the tub has a strong oak or beech hoop fitted to its inside surface, sufficiently firm to support a second cover, also well fitted, but moveable. The space under this second cover is destined to contain the vinous liquor; and in order to bring it very amply into contact with the atmosphere, the following contrivances have been resorted to:—This cover is perforated, like a sieve, with small holes, of from one to two lines in diameter, and about an inch and a half apart. Through each of these holes a wick of packthread or cotton is drawn, about six inches long, which is prevented from falling through by a knot on its upper end, while its under part hangs free in the lower space. The wicks must be just so thick as to allow of the liquor poured above the cover passing through the holes in drops. The edges of the lid must be packed with tow or hemp, to prevent the liquor running down through the interval.

" The whole lower compartment is now to be filled with chips of beechwood up to nearly the perforated cover. The liquor, as it trickles through the holes, diffuses itself over the chips, and sinking slowly, collects at the bottom of the tub. The chips should be prepared for this purpose by being repeatedly scalded in boiling water, then dried, and imbued with hot vinegar. The same measures may also be adopted for the tub. To provide for the renewal of the air, the tub is perforated, at about a foot from its bottom, with eight holes, set equally apart round the circumference, two-thirds of an inch wide, and sloping down, through which the air may enter into this lower compartment, without the trickling liquor being allowed to flow out. In order that the foul air which has become useless may escape, four large holes are pierced in the sieve-cover, at equal distances asunder and from the centre, whose united areas are rather smaller than the total areas of the holes in the side of the tub. Into these four holes open glass tubes must be inserted, so as to stand some inches above the cover, and to prevent any of the liquor from running through them. This air may afterwards pass off through a hole of two inches and a half diameter in the uppermost cover, in which a funnel is placed for the supply of liquor as it is wanted to keep up the percolation.

" The temperature of the fermenting compartment is ascertained by means of a thermometer, whose bulb is inserted through a hole through its side, and fastened by a perforated cork. The liquor collected in the under vessel runs off by a syphon inserted near its bottom, the leg of which turns up to nearly the level of the ventilating air-pipes before it is bent outwards and downwards. Thus the liquor will begin to flow out of the under compartment only when it stands in it a little below the sieve-cover, and then it will run slowly off at the inclined mouth of the syphon, at a level of about three inches below the lower end of the glass tubes. There is a vessel placed below upon the ground to receive it. The tub itself is supported upon a wooden frame, or a pier of brick-work, a foot or eighteen inches high."

Dr. Ure*, in a later edition of his work, gives the following description of the apparatus originally employed by Ham.

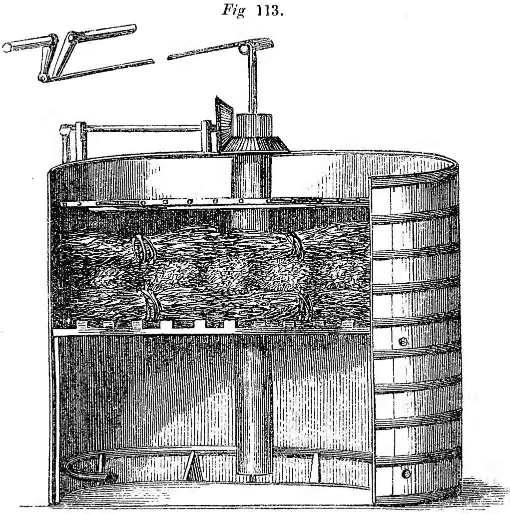
" This is a wooden vat or vessel about 12 feet in height, and from 7 to 8 feet in diameter, closed at top and bottom, except at the openings for the introduction of the wash and the exit of the vinegar. The sides are perforated by a few small holes for the admission of air, and within are three floors or partitions perforated with numerous holes for the passage of the wash through them. Upon these floors are laid bundles of birch-twigs, to favour the dispersion and division of the fluid which passes through the acetifier, and is thus brought into the most intimate contact with the oxygen contained in the vessel, or admitted through the openings in its sides. The fluid or wash is of course admitted at the top of the acetifier, and suffered to trickle slowly through the masses of birch-twigs, and through the partitions, thus causing a rapid absorption of oxygen and consequent production of vinegar, which, with any undecomposed wash, flows out at the bottom of the vessel, and is again pumped up to the top, and so on, until the process is finished."

But a very great improvement upon the processes as above described consisted in the adaptation of steam machinery, as in the extensive vinegar works of Messrs. Hill, Evans, & Co., of Worcester, where we recently had the opportunity of seeing the improved process in full operation.

* Dictionary, 4th edition.

In the manufactory of the firm above named the process is conducted in large vats capable of each holding from 6,000 to 10,000 gallons of wash; each vat is half filled with the liquid to be acidified, and the upper half with bundles of birch, such as are in general use for brooms or besoms. The pump in the centre elevates the liquor, and, by means of its rotative motion, disperses it in a shower over the surface of the bed of birch, and in descending through the same it is met by a small ascending current of atmospheric air, which, coming in contact with the multiplied surfaces of the liquor trickling through the twigs, speedily acidifies it; the whole being kept up to the proper heat by a steam pipe of pure tin passing through the vat. The acidification is generally completed in twenty days, but varies in inverse ratio to the proportion of birch to the wort to be acidified; and the whole operation, mechanical and chemical, being performed by steam, no manual labour of any kind is required, save the occasional inspection of the manager to ascertain when the process is finished.

Fig 113.



ACETIFIER MODEL.

This apparatus is capable of acidifying any fermented liquor whatever, and even distilled spirit, with a complete control over any waste.

The process will be more clearly comprehended by an examination of the accompanying engraving, which was made from a model prepared by Messrs. Hill, Evans, & Co., and shown at the Great Exhibition.

The upper circular opening in the side of the vat is for the admission of atmospheric air, the lower is the termination of the steam pipe. It should be mentioned that the principle of the process was discovered quite independently, and about the same time, in Germany. Mr. Ham patented his process, which has been employed for many years by Messrs. Hill, Evans, & Co.

THE ADULTERATION OF VINEGAR.

The principal adulterations of vinegar are: —

Dilution with water; the addition of sulphuric acid; the substitution of pyroligneous for acetic acid; the use of burnt sugar as a colouring agent, and occasionally the addition of acrid substances, as chillies and grains of Paradise.

The presence of sulphuric acid in British vinegar is not in itself to be regarded as an adulteration, since the addition of one part to a thousand is permitted by law. It is only when the quantity present exceeds this, that it is to be considered as constituting an injurious and illegal adulteration.

Vinegar made from malt is apt, when kept for any length of time, to undergo decomposition, and it is in order to prevent this putrefactive tendency, that the addition of a small amount of sulphuric acid has been allowed. Nevertheless, it is questionable how far this acid is necessary for the preservation of well-made vinegar, since it is not contained in wine-vinegar, and since some English manufacturers dispense with it, or any other analogous acid, altogether, in the preparation of their home-made malt vinegars. It is to the poorer and weaker vinegars especially that this acid is most largely added.

Whether sulphuric acid is capable of exerting an injurious action on the coats of the stomach in the small proportion of one part in a thousand, may be doubted, but there can be no question that when contained in vinegar in large amount it exerts a prejudicial effect.

We have found some samples of vinegar to consist of little else but sulphuric acid, coloured with burnt sugar: it is in low coffee-houses and oyster-stalls, that such vinegar is not uncommonly met with.

All the deep-brown and red British vinegars owe the greater part of their colour to the presence of burnt sugar. We are surprised that manufacturers should desire to increase the colour of their vinegars by such means, as we should have thought that depth of colour would have been no recommendation, and that their object would rather have been to keep their vinegars as pale as possible, so that they might resemble in tint pale amber sherry, a colour much more agreeable to the eye than the deep, heavy brown of ordinary vinegar.

It is in the stronger vinegars principally that acetic and pyroligneous acids are found, but nearly all the weak and lowest class vinegars are adulterated with the latter acid, some samples indeed consisting entirely of dilute pyroligneous acid coloured.

Other adulterations described in books, but which are certainly of very unfrequent occurrence, consist in the addition of nitric, hydrochloric, and tartaric acids, alum, common salt, spurge flax, mustard seeds, pellitory root, and long pepper.

As in the preparation of acetic acid, and distilled vinegar, copper stills, lead, zinc, or tin pipes are sometimes, though by no means commonly used, vinegar is occasionally found to be contaminated to a dangerous extent with those metals. As vinegar is capable of acting very energetically, in the course of a few minutes, on most metals, their use in its manufacture ought to be strictly prohibited: many fatal accidents have resulted from the impregnation of vinegar with metallic poisons. The metal which is however most frequently found in vinegar is iron.

On the Determination of the Amount of Acetic Acid present in Vinegar.— The amount of acetic acid present in vinegar is ascertained by saturation with known quantities of an alkali.

The acid may be first separated from the other constituents, impurities, or adulterations of the vinegar, by distillation; being volatile, it passes off on the application of heat, and is thus procured not only separately, but also in a more concentrated form. The quantity of vinegar to be employed is half a pint, which should be distilled almost to dryness; the acid obtained then being neutralised, and its amount thus determined.

The process of distillation, however, is tedious, and does not admit of easy application, except in the laboratory of the chemist. The same end can be attained by a different method; thus, the alkali may be added directly to the vinegar. The alkali usually employed is soda; it may be used either in the form of the pure crystals of carbonate, the recently-ignited carbonates of soda, which is preferable, or a solution of caustic soda may be prepared by means of caustic lime. The dried carbonate is prepared by submitting any of the carbonates, in a crucible, to the action of the fire. The whole of the water of crystallisation should be driven off, and the white powder left heated to redness.

Weighed quantities of the soda should be dissolved in known bulks of distilled water. In this way the re-agent may be applied in even decimal portions of a grain.

Further, it is not only necessary to prepare such a solution, but also to have the means of employing this in definite minute quantities, an object which is effected by an instrument termed an alkalimeter.

An alkalimeter is an elongated and graduated glass tube, terminating above in two apertures, the one large, by which the instrument is replenished, and the other small, and drawn out into a point to regulate the escape of the fluid in drops. The instrument which we employ is one of Griffin's septimal alkalimeters; the scale is marked into ten principal divisions, which are again subdivided into ten lesser degrees or spaces, each of which is denominated a "septem," from its being made to contain seven grains of distilled water. The entire measure, therefore, holds, as will be perceived, seven hundred grains of distilled water.*

* An improved alkalimeter of Mohr is now made by Mr. Griffin, by means of which definite quantities of the solution may be added with greater accuracy.

In many chemical works, we are directed to mix a few drops of a strong solution of litmus with the vinegar, previous to using the soda solution, and to add this until the colour of the reddened litmus is restored. These directions are erroneous, and lead to serious miscalculations, for the litmus does not again become blue until the saturating point has been long passed, and the liquid has acquired a decided alkaline reaction; we therefore recommend the operator not to rely upon the indications afforded by the solution of litmus.

Again: we are told to continue adding the soda solution until the litmus-paper immersed in the vinegar ceases to turn red. There is here a source of error equally great as in the former case, for the litmus-paper will be reddened long after the acetic acid has been neutralised, this arising from the disengaged carbonic acid of the soda absorbed and retained by the fluid.

This fallacy is guarded against by repeatedly drying, in the course of the process, the litmus-paper before the fire or the flame of a candle, when, if the redness be due to carbonic acid, it will vanish on the application of the heat; but if to acetic acid, it will be permanent. Other ways of guarding against any fallacy arising out of the presence of free carbonic acid is to heat the vinegar, and so expel the acid, or to set it aside for a few hours and thus allow of the escape of the carbonic acid. The saturation is complete, then, when the litmus-paper neither retains the *slightest shade* of redness, nor has its blue tint in the least degree heightened, this latter indicating of course alkalinity. By the use, however, of the solution of caustic soda the source of fallacy arising out of the disengagement of carbonic acid is avoided. The great objection to the caustic solution is, that it very quickly absorbs carbonic acid, and therefore will not keep for any length of time.

Mr. Mitchell, in his treatise on the Falsification of Food, states,—"That if a drop or two of pure vinegar be placed upon blue litmus-paper, the latter will be reddened; but when dried before a fire, the red colour disappears, and the original blue again presents itself."

Although, from the volatile character of acetic acid, it might be inferred that this statement was correct, we have yet found that the redness produced by this acid is not dissipated by the degree of heat which is employed to dry the litmus-paper, but on the contrary remains fast.

The strength of the solution should be determined by atom: one atom, or 1·03 of the recently-ignited carbonate of soda corresponds to, and will saturate one atom of, anhydrous acetic acid.

The soda should be added to the water in the proportion of six equivalents to one hundred grains of distilled water. If a pound of the solution be prepared, the same weight of water should be poured into a white glass bottle, the level of the liquid in the vessel being exactly ascertained and marked; the bottle should then be emptied, the soda dissolved in a portion of the water, and returned into the bottle, the remaining water being added up to the mark previously made, and any water that may be over being rejected.

An ammonia solution is free from the objections attached to the solution of carbonate of soda, when the precaution pointed out with respect to the use of the litmus-paper is not strictly observed.

It is extremely difficult, however, to obtain a definite solution of ammonia, and when procured, to maintain it of uniform strength. Mr. Griffin, of Finsbury Square, perceiving the advantages of the ammonia solution, proposes to prepare it in such a manner as entirely to obviate these objections. An ingenious plan has been devised for noting loss of strength in a solution of ammonia. Two nicely-balanced beads are immersed in it: the one, so long as the solution is of the proper strength, remains at the bottom, but gradually ascends as the liquid becomes heavier; the other lies just under the surface of the fluid, and of course emerges from it, and makes its appearance above, under the same circumstances.

Some experimenters determine the amount of acetic acid by weighing the quantity of carbonic acid evolved. This method requires a special apparatus; and it is questionable whether, unless very carefully employed, it gives such accurate results as the soda solution.

There is one process for the determination of the amount of acid in vinegar, which may be briefly noticed, less from its intrinsic value, than from the ingenuity attached to it.

A weighed and perfectly dry piece of marble or chalk is to be introduced into a known quantity of vinegar; the acid of the vinegar acts upon a portion of either of these, forming a soluble acetate of lime; the remaining marble or chalk is then to be removed, carefully washed in distilled water, redried, and its weight again ascertained; the loss indicates the amount of acetic acid present. It will be observed that there is one great objection to this process as applied to the analysation of vinegar containing sulphuric acid; since the surface of the marble or chalk becomes coated with a crust of sulphate of lime, which impedes, if it do not altogether prevent, the action of the acetic acid.

A convenient quantity of vinegar to be operated upon is 500 grains.

On the Determination of Sulphuric Acid in Vinegar.—Sulphuric acid, as we have said, is very commonly added to the malt and other vinegars made in this country, ostensibly for the purpose of making it keep the better, but also unquestionably to augment its strength.

We have already expressed doubts as to whether this addition is at all necessary to well-manufactured vinegar, since some makers dispense with it altogether; as, however, the law has allowed of the addition of a certain amount of sulphuric acid, the presence of this can hardly be treated as an adulteration, although strictly it really is so. By it the acidity of the vinegar is not only increased, but the cost of the article much reduced, and in place of a volatile and aromatic acid, such as is natural to the gastric juice, we are made to consume a harsh mineral acid, having none of these properties, and in no way concerned in digestion.

Several statements are contained in books which treat of adulterations, respecting the detection of sulphuric acid in vinegar. Thus it is said:—

First. If a pen be charged with vinegar containing sulphuric acid, and words written with it, when dried before the fire, they turn black.

Second. When such vinegar is dropped on paper, the spots also become black when dried.

Third. That towards the conclusion of the evaporation of a portion of vinegar containing sulphuric acid, dense fumes of sulphureous acid will be evolved, and the residuum charred.

Fourth. If a drop of the vinegar be allowed to fall into a hot solution of cane-sugar, an intense black spot will instantly appear, resulting from the carbonisation of the sugar.

Fifth. That starch or dextrine being boiled in vinegar containing sulphuric acid, will be converted into glucose, or grape-sugar.

These methods, although specious, are but little applicable, in practice, to the question of the adulteration of vinegar with sulphuric acid, since we have never met with any samples containing so large a proportion of the acid as to give any of the indications referred to.

The presence of sulphuric acid, and its amount, may be determined by means of a solution of chloride of barium, prepared in the same manner as the soda solution; every 2·4 parts of the crystals of chloride of barium correspond to one part of commercial sulphuric acid. The solution should be made very weak, so as not to contain more than 1·2 of the crystals of chloride of barium in one hundred grains of distilled water—a quantity which represents half a grain of commercial sulphuric acid.

Five hundred grains of vinegar should be poured into a tall precipitating glass, and the solution added in minute portions of a grain, so long as any precipitate falls. The vinegar should be well agitated after each addition, and an interval of three or four hours must elapse, to allow of the subsidence of the sulphate of baryta, before a fresh quantity of the solution be added. A more exact method is to add excess of the solution, the precipitated sulphate of baryta being collected, ignited, and weighed.

But as sulphuric acid in the combined state exists in all vinegars, even the purest, usually in minute quantity only, although occasionally, where gypseous water has been employed in the manufacture, in considerable amount, it is proper in all cases to determine whether the acid be *free* or *combined*, as, of course, it only constitutes an adulteration when in the free state. The combined sulphates present in vinegars are derived partly from the grain and partly from the water employed. Whether the acid be free or combined may be ascertained in the following manner. If the liquid remains acid after the removal of the acetic acid by distillation, the acidity is most probably due to free sulphuric acid, the amount of which must be ascertained thus: —

A given quantity of the vinegar is first precipitated with chloride of barium, in order to get the total quantity of sulphuric acid present.

A similar quantity is evaporated to dryness, incinerated, and the white ash, after treatment with a few drops of nitric acid, tested for sulphuric acid. If the acid is in the combined state there will be no difference in the proportions obtained in the two cases.

Further: the quantity of acid contained in the vinegar before and after distillation may be determined, and if the results agree, we obtain additional evidence of the absence of free sulphuric acid.

Another way is to evaporate the vinegar to the consistence of a syrup, and to separate the free sulphuric acid by means of alcohol, and then to proceed to determine its amount in the usual way.

On the Detection of Metallic Impurities in Vinegar.—Ten ounces of vinegar should be evaporated to dryness in a porcelain capsule, and the residue reduced to a white ash; if the ash be brown or rust-coloured, in place of white, it contains iron. The ash should be treated with a few drops of pure nitric acid, distilled water being added after the lapse of a few hours; the solution should be filtered, and a portion of it tested with sulphuretted hydrogen. If it turn black, the vinegar most probably is contaminated with lead; if dark brown, with copper; and if yellow, with tin. If there be no change of colour, it may be concluded that no metallic substance is present. It is proper, however, not to rely for the determination of the metal present upon the colour of the liquid, but to test for that, the presence of which is suspected, by the appropriate reagents.

Results of the Chemical Analyses of Thirty-three Samples of Vinegar of various kinds, purchased for the most part of different Oilmen, Publicans, and Grocers, resident in the Metropolis.

In order that the purport of the analyses about to be given may be better comprehended, we shall preface them with a few explanatory observations.

The quantity of sulphuric acid, or oil of vitriol, as already noticed, permitted to be added to vinegar, for the avowed purpose of making it keep, is one part in a thousand. But sulphuric acid, as met with in commerce, is by no means of standard or uniform strength, but is diluted with variable quantities of water.

The sulphuric acid indicated in the analyses, is what is termed monohydrated sulphuric acid, which is in general very much stronger than the commercial acid; every part of the former, therefore, corresponds to a much larger quantity of the latter.

Again, it should be particularly remembered that the acidifying power of the mineral sulphuric acid is very much greater than that of the vegetable acetic acid: one part of sulphuric acid acidifies a much larger quantity of a fluid than the same amount of acetic acid, so that the sulphuric acid present in vinegar does not simply take the place of a similar quantity of acetic acid, but represents several times the amount of that acid.

Although the method of obtaining the amount of sulphuric acid in vinegar, by precipitation with a solution of chloride of barium of known strength, when carefully applied, furnishes tolerably satisfactory results, yet where it is desirable to determine exactly the total amount of sulphuric acid present in a considerable quantity of vinegar, a different method may be adopted with advantage.

To half a pound or more of the vinegar, a concentrated solution of chloride of barium should be added in excess; the precipitate is to be collected on a filter, the weight of the ash of which is known, burned in a platinum crucible, and the sulphate of baryta carefully weighed; 27·19 parts of the powder represent 11·44 parts of monohydrated sulphuric acid. It will be seen that in some cases we have followed this method of analysis for sulphuric acid. For estimating the quantity of free and combined sulphuric acid we must proceed by the methods described on the previous page.

Vinegars are made by the manufacturer of several different strengths, and sold of course at corresponding prices. These are distinguished by certain numbers, as Nos. 16, 17, 18, 20, 22, and 24, the strength increasing with the numbers; but these numbers do not usually afford any exact indication of the real strength of the vinegars; and hence at least one firm does not use them to distinguish the several qualities, but employs the letters A, B, C, D, E, and F, taking care to ascertain by analysis that these letters invariably correspond to certain definite strengths. This system is the same as that to which we particularly adverted on a former occasion, in our "Report on Mustard," in which it was shown that the mustard-maker prepared no less than four different qualities of mustard, as "fine," "seconds," "superfine," and "double superfine,"—the fine, by the way, indicating the worst or lowest quality.

Although we believe it is the universal custom of the manufacturer to adopt this system, yet it is open to great objections from the facility it affords for imposition, by the substitution of an article of inferior quality for the superior.

It is generally stated that good vinegars, such as all Nos. 24 ought to be, should contain *five per cent.* of anhydrous or pure acetic acid. It will be seen, from the analyses, that this percentage is for the most part too high, probably owing to the inaccurate manner in which the soda test for ascertaining the acetifying power is usually applied.

The No. 24 vinegars, at the time that a duty was levied on the article, were taken by the excise as standards, and hence they have been called "Revenue proof vinegars."

In order, therefore, to judge of the quality of the vinegars sold in the shops, it is necessary to institute certain preliminary analyses of vinegars of different kinds and strengths, to serve as standards of comparison. This we have done.

It is to be regretted that the specific gravity of the several samples of vinegar subjected to analyses was not ascertained, as this affords in many cases an excellent and simple means of arriving at a tolerably correct conclusion as to the quality. The stronger the vinegar is, of course the greater is its specific gravity. No. 24 vinegar of good quality should have a specific gravity of not less than 1022; No. 22 of 1020; No. 20 of 1019; No. 18 of 1017; and No. 16 of 1015.

French Wine Vinegar.

1*st Sample.*—*Vinaigre de Bordeaux.*— Imported by Messrs. Kent and Sons, Upton-on-Severn.

Analysis.— Smell, refreshing, aromatic; taste, pungent, vinous, and agreeable; 1000 grains contain 51·02 parts of *pure acetic acid*, which is equal to upwards of 5·10 *per cent.*; traces only of *combined sulphuric acid*, and a small quantity of *bitartrate of potash*, or *wine-stone.*

We may here observe, that when dried carbonate of soda is added in considerable quantity to genuine wine-vinegar, it undergoes a remarkable change of colour, becoming dark and inky; this forms an excellent test, and one which answered well when applied to the above vinegar.

2*nd Sample.*— *Vinaigre d' Orleans.*

Analysis.— 1000 grains contain 34·69 parts of *acetic acid*, or 3·46 *per cent.*; a small quantity only of *combined sulphuric acid* and *bitartrate of potash.*

It will be perceived that there is a great difference in the strengths of these two vinegars; the first contains upwards of one and a half per cent. more of real acid.

Vinegar made from Malt, Cider, and Treacle.

Messrs. Kent & Sons, Nos. 17 to 24 inclusive.

3*rd Sample.*—No. 17.

Analysis.— 1000 grains contain 31·39 grains of *acetic acid*, or 3·13 *per cent.*; traces only of *combined sulphuric acid.*

4*th Sample.*— No. 18.

Analysis.— 1000 grains contain 34·69 grains of *acetic acid*, or 3·46 *per cent.*

5th Sample.— No. 20.

Analysis.— 1000 grains contain 36·41 grains of *acetic acid*, or 3·64 *per cent.*

6th Sample.— No. 22.

Analysis.— 1000 grains contain 38·14 grains of *acetic acid*, or 3·81 *per cent.*; traces of *combined sulphuric acid.*

7th Sample.— No. 24.

Analysis.— 1000 grains contain 39·88 grains of *acetic acid*, or just 4 *per cent.*

It will be observed that the last five samples contain no free sulphuric acid, but traces only in a state of combination, derived entirely from the ingredients out of which the vinegars were made, and yet these vinegars are bright to the eye, sharp to the taste, and show not the least tendency to change. We deem this to be an important fact, and hope that it will lead vinegar-makers to try whether they cannot adopt a process of manufacture by which the use of sulphuric acid may be altogether dispensed with.

Malt Vinegars.

8th Sample.— Standard, No. 24.

Analysis.— 1000 grains contain 36·86 grains of *acetic acid*, or 3·68 *per cent.*: and 3·62 grains of *free sulphuric acid* in the 1000 grains.

3500 grains, or half a pound of this vinegar, chloride of barium having been added in excess, furnished a precipitate of sulphate of baryta, which, when well dried, weighed 37·82 grains, a quantity which contains 15·91 grains of monohydrated sulphuric acid.

It will be noticed that this vinegar, while it is not greatly deficient in acetic acid as compared with sample 7, yet contains four times the amount of sulphuric acid formerly authorised by the excise authorities, and of course much more than is required to make it keep.

9th Sample.— Standard No. 24.

Analysis.— 1000 grains contain 46·26 grains of *acetic acid*, or 4·62 *per cent.*, nearly 5 parts in the 100; and traces of *combined sulphuric acid.*

10th Sample.— Standard No. 24.

Analysis.— 1000 grains contains 43·24 grains of *acetic acid*, or 4·32 *per cent.*, and 1·28 of *sulphuric acid* in 1000 parts.

Samples purchased of Dealers in the Metropolis.

11th Sample.— Purchased of W. Perrin, Oilman, 42. New Church-street, Paddington.

Analysis.—1000 grains contain 36·49 grains of *acetic acid*, or 3·64 *per cent.*, and ·68 of *sulphuric acid.*

12th Sample.— Purchased of W. Simpson, Oilman, 1. Portman-place, Edgware-road.

Analysis.— 1000 grains contain 41·99 parts of *acetic acid*, or 4·19 *per cent.*, and traces of *combined sulphuric acid.*

13th Sample.—Purchased of R. Goodman & Co., Grocers, 52. Crawford-street.

Analysis.— 1000 grains contain 38·73 parts of *acetic acid*, or 3·87 *per cent.*, and 2·56 of *sulphuric acid.*

14th Sample.—Purchased of B. Harvey, Oilman, 53. Crawford-street.

Analysis.— 1000 grains contain 36·20 grains of *acetic acid*, or 3·62 *per cent.*, and ·97 or nearly one grain of *sulphuric acid.*

15th Sample.—Purchased of W. Gilbert, Oilman, 58. Crawford-street.

Analysis.— 1000 grains contain 23·84 parts of *acetic acid*, or 2·38 *per cent.*, and 2·31 of *sulphuric acid* in 1000 grains, the amount of acid having been determined in this case from the quantity of sulphate of baryta precipitated on the addition of chloride of barium.

16th Sample.—Purchased of J. Marden, Grocer, 88. Lisson-grove.

Analysis.— 1000 grains contained 39·23 grains of *acetic acid*, or 3·92 *per cent.*, and traces only of *combined sulphuric acid.*

17th Sample.— Purchased of J. Edmonds, Grocer, 49. Seymour-place.

Analysis.— 1000 grains contain 24·05 parts of *acetic acid*, or 2·40 *per cent.*, and 1·66 parts of *sulphuric acid* in 1000 parts.

18th Sample.—Purchased of Mr. Chambers, Grocer, 39 A, Upper Seymour-street.

Analysis.— 1000 grains contain 35·10 parts of *acetic acid*, or 3·51 *per cent.*, and traces of *combined sulphuric acid.*

19*th Sample.* — Purchased of J. Williams, Oilman, 33. Upper Seymour-street.

Analysis.— 1000 grains contain 22·92 parts of *acetic acid*, or 2·29 *per cent.*, and 1·05 grains of *sulphuric acid* in 1000 parts.

20*th Sample.*—Purchased of J. Owtram, Italian Warehouseman, 6. Edgware-road.

Analysis.— 1000 grains contain 46·61 parts of *acetic acid*, or 4·66 *per cent.*, and ·88 of *sulphuric acid* in 1000 parts.

21*st Sample.*—Purchased of E. B. Minton, Publican, 17. Edgware-road.

Analysis.— 1000 grains contain 35·01 parts of *acetic acid*, or 3·50 *per cent.*, and 3·15 of *sulphuric acid* in 1000 grains, the amount of acid having been determined in this case from the quantity of sulphate of baryta precipitated on the addition of chloride of barium.

22*nd Sample.*— Purchased of H. Gooch, Publican, 55½. Edgware-road.

Analysis.— 1000 grains contain 41·29 grains of *acetic acid*, or 4·12 *per cent*, and traces of *combined sulphuric acid.*

23*rd Sample.*— Purchased of J. Compton, Publican, 84. Edgware-road

Analysis.— 1000 grains contain 41·29 parts of *acetic acid*, or 4·12 *per cent.*, and traces of *combined sulphuric acid.*

24*th Sample.*— Purchased of J. Veal, Oilman, 103. Edgware-road.

Analysis.— 1000 grains contain 41·92 parts of *acetic acid*, or 4·19 *per cent.*, and ·84 of *sulphuric acid.*

25*th Sample.*— Purchased of John Williams, Oilman, 104. Edgware-road.

Analysis.— 1000 grains contain 26·35 parts of *acetic acid*, or 2·63 *per cent.*, and 2·56 of *sulphuric acid.*

3500 grains, or half a pound of this vinegar, chloride of barium having been added in excess, furnished a precipitate of sulphate of baryta, which, when well dried, weighed 27·19 grains, a quantity which contains 11·44 grains of mono-hydrated sulphuric acid.

26*th Sample.*— Purchased of J. Gill, Publican, 28. Edgware-road.

Analysis.— 1000 grains contain 31·83 parts of *acetic acid*, or 3·18 *per cent.*, and 1·81 of *sulphuric acid.*

27*th Sample.*— Purchased of T. Whatmore, Publican, 5. Edgware-road.

Analysis.— 1000 grains contain 29·45 grains of *acetic acid*, or 2·94 *per cent.*, and 4·37 of *sulphuric acid.*

3500 grains, or half a pound of this vinegar, chloride of barium having been added in excess, furnished a precipitate of sulphate of baryta, which, when well dried, weighed 38·69 grains, a quantity which contains 16·27 grains of mono-hydrated sulphuric acid.

28*th Sample.*— Purchased of Hardstaff & Co., Grocers, 104. Edgware-road.

Analysis.— 1000 grains contain 25·61 of *acetic acid*, or 2·56 *per cent.*, and 3·30 grains of *sulphuric acid.*

29*th Sample.*— Purchased of J. & W. Mullins, Publicans, Edgware-road.

Analysis.— 1000 grains contain 27·70 parts of *acetic acid*, or 2·77 *per cent.*, and 1·21 parts of *sulphuric acid.*

30*th Sample.*— Purchased of G. Mills, Oilman, 124. Edgware-road.

Analysis.— 1000 grains contain 37·27 parts of *acetic acid*, or 3·72 *per cent.*, and 1·96 or just two grains of *sulphuric acid.*

31*st Sample.*— Purchased of H. & J. Wilshin, Oilmen, 133. Edgware-road.

Analysis.— 1000 grains contain 46·05 parts of *acetic acid*, or 4·60 *per cent.*, and ·88 of *sulphuric acid.*

32*nd Sample.*— Purchased of R. Lowe, Publican, 134. Edgware-road.

Analysis.— 1000 grains contain 41·71 parts of *acetic acid*, or 4·17 *per cent.*, and ·88 of *sulphuric acid.*

33*rd Sample.*— Purchased of Harvey & French, Italian Warehousemen, 227. Oxford-street.

Analysis.— 1000 grains contain 48·10 parts of *acetic acid*, or 4·81 *per cent.*, and ·75 of *sulphuric acid.*

We will now arrange the above analyses in a tabular form, so that they may be more readily understood and contrasted : —

TABLE SHOWING THE RESULTS OF THE ANALYSES OF THIRTY-THREE SAMPLES OF VINEGAR.

Sample.	Name.	Dried Carbonate of Soda required to neutralise 1000 Grains.	Pure Acetic Acid in 1000 Grains.	Acetic Acid, Per Cent.	Crystallised Chloride of Barium to precipitate the Sulphuric Acid in 1000 Grains.	Monohydrated Sulphuric Acid in 1000 Grains.
1	Vinaigre de Bordeaux.	52·94	51·02	5·10	- -	traces.
2	Vinaigre d'Orleans.	36·00	34·69	3·46		—
3	Kent and Sons, No. 17.	32·57	31·39	3·13		—
4	Ditto ,, 18.	36·00	34·69	3 46		—
5	Ditto ,, 20.	37·80	36·41	3·64		—
6	Ditto ,, 22.	39·60	38·14	3·81		—
7	Ditto ,, 24.	41·40	39·88	3·98		—
8	Standard 24.	42·00	36·86	3·68	9·01	3·62
9	Ditto.	48·00	46·26	4·62	- -	traces.
10	Ditto.	46·20	43·24	4·32	3·00	1·28
11	W. Perrin.	37·17	36·49	3·64	1·71	·68
12	W. Simpson.	43·57	41·99	4·19	- -	traces.
13	R. Goodman.	42·85	38·73	3·87	6·37	2·56
14	B. Harvey.	37·17	36·20	3·62	2·42	·97
15	W. Gilbert.	27·14	23·84	2·38	5·73	2·31
16	J. Marden.	40·71	39·23	3·92	- -	traces.
17	J. Edmonds.	25·71	24·05	2·40	4·12	1·66
18	Mr. Chambers.	36·42	35·10	3·51	- -	tra es.
19	J. Williams.	24·88	22·92	2·29	2·61	1·05
20	J. Owtram.	49·28	46·61	4·66	2·20	·88
21	E. B. Minton.	39·60	35·01	3·50	7·77	3·15
22	H. Gooch.	42·85	41·29	4·12	- -	traces.
23	J. Compton.	42·85	41·29	4·12		
24	J. Veal.	45·00	41·92	4·19	2·09	·84
25	John Williams.	30·00	26·35	2·63	6·37	2·56
26	J. Gill.	35·40	31·83	3·18	4·50	1·81
27	T. Whatmore.	35·10	29·45	2·94	10·87	4·37
28	Hardstaff and Co.	30·00	25·61	2·56	8·22	3·30
29	J. W. Mullins.	30·00	27·70	2·77	3·01	1·21
30	G. Mills.	40·71	37·27	3·72	4·87	1·96
31	H. & J. Wilshin.	47·14	46·05	4·60	2·20	·88
32	R. Lowe.	43·28	41·71	4·17	2·20	·88
33	Harvey and French.	51·42	48·10	4·81	1·87	·75

By the attentive consideration of the above analyses, several important conclusions may be arrived at. Thus it will be seen : —

1st. That the amount of acetic acid, the most important constituent of vinegar, varies greatly in different samples, the highest per-centage being 5·10, and the lowest 2·29, or less than half the first amount.

2nd. That, since the standard No. 24 vinegars, submitted to analysis, range for the most part considerably over four per cent., vinegar to be deemed good ought to contain certainly *not less* than four per cent. of real acid.

3rd. Judged by this standard, out of twenty-three samples of vinegar purchased of dealers in London, seven reached this strength, and contained from four per cent. upwards of acetic acid ; the per-centage of seven of the vinegars ranged between three and four, while in the remaining nine the amount of acid varied from two to three per cent., it being in two instances — samples 17 and 19, the weakest of the whole,—as low as 2·40 and 2·29.

4th. That twelve samples out of the thirty-three analysed contained no free sulphuric acid — a fact affording convincing proof that the use of this acid, so objectionable in many respects, is not necessary for the preservation of well-made vinegar.

5th. That in eight samples the quantity of sulphuric acid present did not exceed the amount formerly permitted to be added.

6th. That in the remaining cases the amount exceeded this, and in some instances was three or four times as great.

7th. Since the manufacturers prepare and sell vinegar of different qualities, some being very weak, and, as the analyses have shown, and is also well known, they frequently add sulphuric acid, it is clear that the blame of the present unsatisfactory condition of the article lies with them, although, no doubt, in some cases the retailer as well takes his part in the work of adulteration and deterioration, by the addition of water and further quantities of sulphuric acid.

"It will be remembered, that in our Report on this subject, we expressed our conviction that sulphuric acid is not necessary to the preservation of well-manufactured vinegar, in proof of which we cited the example of Messrs. Kent and Sons. It now appears that there are other parties who sell vinegar free from any contamination with sulphuric acid.

"*The Declaration of W. Smethurst, of the firm of Wilkinson and Smethurst.*

"William Smethurst, of the firm of Wilkinson and Smethurst, Vinegar and British Wine Merchants, Nag's Head buildings, High-street, Borough, Southwark, do solemnly and sincerely declare, that the samples of 16, 18, 20, and 22 vinegar, left with the Editor of The Lancet on Monday, Feb. 2. 1852, are *bonâ fide* samples of the vinegar we have been, and are, sending out to our customers, free from sulphuric acid and all other adulterations.

"And I make this solemn declaration, conscientiously believing the same to be true, and by virtue of the provisions of an Act made and passed in the sixth year of the reign of his Majesty King William the Fourth, intituled 'An Act to repeal an Act of the present session of Parliament, intituled An Act for the more effectual abolition of Oaths and Affirmations taken and made in various departments of the State, and to substitute Declarations in lieu thereof, and for the more entire suppression of voluntary and extrajudicial oaths and affidavits, and to make other provisions for the abolition of unnecessary oaths.'

"Declared at Southwark Police Court, in the county of Surrey, this 5th day of February, 1852, "W. Smethurst.

"Before me,

"G. A. A'Beckett."

"We have submitted the samples of vinegar referred to in the above affidavit, as well as others, purchased of parties supplied by Messrs. Wilkinson and Smethurst, to careful examination, and now make known the results of the analyses, for the sake of the public, the honest trader, and as an act of justice to the merchants by whom the article is supplied.

"The vinegars are clear and bright, sharp, pungent, and aromatic; they contain no free sulphuric acid, and in proportion to their respective qualities are of considerable strength.

"It thus appears that Messrs. Wilkinson and Smethurst, as well as Messrs Kent and Sons, are honourably distinguished in selling vinegars free from so injurious an admixture as oil of vitriol."

It will be seen by reference to our Second Report on Vinegar and its Adulterations that several other manufacturers, as well as Messrs. Kent and Sons, and Messrs. Wilkinson and Smethurst, do not use sulphuric acid in the preparation of their vinegars, and are therefore equally favourably distinguished.

PICKLES, AND THEIR ADULTERATIONS.

To persons unacquainted with the subject, the title of this report, "Pickles and their Adulterations," may appear somewhat singular; and they may be disposed to ask — Are not the girkins, cabbages, beans, &c., which we see in the bottles, what they appear to be? And are other vegetables than those commonly known to us mixed with the ordinary kinds? To these questions we thus reply: — "Girkins," on close examination, often turn out to be but shrivelled or sliced cucumbers; the "young tender beans" to be old and tough; the "cauliflowers" to have run to seed; and the "red cabbage" to be nothing more than white cabbage turned into red by colouring matter, as a dyer would change the colour of a dress; further, that amongst the vegetables not unfrequently employed for the purpose of pickle-making are some which do not enter into the calculation of the epicure, as vegetable marrows, — which, when cut into pieces, form a very respectable imitation of cucumbers, — and sliced turnips, the identification of which would be apt to puzzle even a botanist, as well as certainly all those who are uninitiated in the secrets of a pickle-manufactory.

But the adulterations to which we more especially allude, and to the consideration of which our attention will be particularly directed in the following remarks, are those which refer to the quality and composition of the vinegar used for pickling, as well as to the means employed for preserving and heightening the colour of green pickles.

In Accum's celebrated work, "Death in the Pot," under the head Poisonous Pickles, we obtain the following information in relation to the "greening" of pickles: —

"Vegetable substances preserved in the state called pickles by means of the antiseptic power of vinegar, whose sale frequently depends greatly upon a fine lively green colour, and the consumption of which, by seafaring people in particular, is prodigious, are sometimes intentionally coloured by means of copper. Girkins, French beans, samphires, the green pods of capsicum, and many other pickled vegetable substances, oftener than is perhaps expected, are met with impregnated with this metal. Numerous fatal consequences are known to have ensued from the use of these stimulants to the palate, to which the fresh and pleasing hue has been imparted according to the deadly *formulæ* laid down in some modern cookery books; such as boiling the pickle with halfpence, or suffering them to stand for a considerable period in brazen vessels."

Dr. Percival (*Medical Transactions*, vol. iv. p. 80.) has given an account of "a young lady who amused herself while her hair was dressing with eating samphire pickles impregnated with copper. She soon complained of pain in the stomach, and in five days vomiting commenced, which was incessant for two days. After this her stomach became prodigiously distended, and in nine days after eating the pickles death relieved her from her suffering."

Among many recipes which modern authors of cookery books have given for imparting a green colour to pickles, the following are particularly deserving of censure; and it is to be hoped that they will be suppressed in future editions of the works from which they are extracted: —

"*To pickle Girkins.** — Boil the vinegar in a bell-metal or copper pot; pour it boiling hot on your cucumbers.

"*To make Greening.*† — Take a bit of verdigrise the bigness of a hazel-nut, finely powdered, half-a-pint of distilled vinegar, and a bit of alum powder, with a little bay salt. Put all in a bottle, shake it, and let it stand till clear. Put a small tea-spoonful into codlings, or whatever you wish to green."

Mr. E. Raffeld directs: "To render pickles green, boil them with halfpence, or allow them to stand for twenty-four hours in copper or brass pans."‡

"To detect the presence of copper, it is only necessary to mince the pickles, and to pour liquid ammonia, diluted with an equal bulk of water, over them in a stopped vial: if the pickles contain the minutest quantity of copper, the ammonia assumes a blue colour."

The above remarks and quotations convey a somewhat fearful picture of the colouring of pickles. It will be our object to ascertain how far the statements made apply to their present condition.

It will be seen that the same method of analysis for determining the amount of acetic acid has been followed which was adopted in the Report on Vinegar; and that the sulphuric acid has in all cases been determined by the quantities of sulphate of baryta formed on the addition of an excess of chloride of barium.

As the *combined* sulphuric acid by this process, as well as that which is *free*, are thrown down, it becomes necessary to ascertain the quantity of sulphuric acid in the state of combination present in genuine vinegar. With this view we have analysed different samples, of 1000 grains each, of pure vinegar, and obtained the following amounts of sulphate of baryta: — from Kent's Bordeaux, ·61 hundredths of a grain; Kent's No. 17., ·57; and from Gilbert's pickling vinegar, ·46 hundredths; the first corresponding with ·25; the second with ·24; and the third with ·19 hundredths of sulphuric acid. In all calculations, therefore, the average quantity of combined sulphuric acid should be deduced from the total amount of that acid present. In some few instances where very hard well waters are used in making the vinegar it will be necessary to test separately for the combined and free sulphuric acid, as directed in the Report on Vinegar.

* The Ladies' Library, vol. ii. p. 203.
† Modern Cookery; or, the English Housewife, 2nd edition, p. 94.
‡ The English Housekeeper, pp. 352, 354. This book has run through 18 editions.

Lastly, for the detection of the copper the following processes were adopted: — About 3 oz. of the green vegetables of each of the pickles, after having been sliced with a glass knife, were incinerated, care being taken to avoid every source of contamination: the ash, having been pulverised, was treated with 20 drops of pure nitric acid; 1 oz. of distilled water, after the lapse of a short time, was added, the solution filtered, and treated with excess of ammonia; if copper was present, the solution became more or less blue, according to the amount of the metal present.

The results obtained by the above method were also, in all cases, confirmed by a second process.

Results of the Chemical Analysis of Twenty Samples of Pickles of different kinds purchased of various Pickle-makers and other Tradesmen in London.

Mixed Pickles.

1*st Sample.*—Purchased of E. H. Wood, Italian warehouseman, 88. Oxford-street.

Analysis.—1000 grains of the *vinegar* in which the pickles were preserved contain 19·37 parts of *acetic acid*, or 1·93 per cent., and 1·67 of *sulphuric acid; pickles* themselves impregnated with *a very considerable quantity of copper*, evidenced both by the *blue colour* of the solution of the ash on the addition of ammonia, as well as by the deposition of *a very well-marked coating of copper* on a polished rod of iron.

2*nd Sample.* — Purchased of Timberlake & Priestley, Wax Chandlers and Pickle-makers, 311. Oxford-street.

Analysis.—1000 grains of the *vinegar* contain 21·62 parts of *acetic acid*, or 2·16 per cent., and ·58 of *sulphuric acid; pickles* contaminated with *rather much copper*, as shown by the ammonia test, as also by the formation of *a coating of the metal* on a polished bar of iron.

3*rd Sample.* — Purchased of S. Fowler, Oilman, 31. Lisle-street, Newport-market.

Analysis. — 1000 grains of the *vinegar* contain 17·07 parts of *acetic acid*, or 1·70 per cent., and 1·55 of *sulphuric acid; pickles* impregnated with *rather much copper*, as shown by the ammonia test, and also by the deposition of *a well-marked crust of copper*.

4*th Sample.* — Purchased of Edmonson & Co., Grocers, 29. Tottenham-court-road.

Analysis. — 1000 grains of the *vinegar* contain 17·50 parts of *acetic acid*, or 1·75 per cent., and 1·00 of *sulphuric acid; pickles* impregnated with *rather much copper*, as shown by the ammonia test, and also by the deposition of *a well-marked coating of copper*.

5*th Sample.* — Purchased of E. Frost, Grocer, 288. Oxford-street.

Analysis. — 1000 grains of the *vinegar* contain 18·84 parts of *acetic acid*, or 1·88 per cent., and ·59 of *sulphuric acid; pickles* contaminated with *a small quantity of copper*, the solution of the ash becoming *slightly blue* on the addition of ammonia, and *a very evident deposition of the metal* taking place on the bar of iron.

6*th Sample.* — Purchased of Westbrooke & Co., Grocers, 21. Oxford-street.

Analysis.— 1000 grains of the *vinegar* contain 23·44 parts of *acetic acid*, or 2·34 per cent., and ·84 of *sulphuric acid; pickles* impregnated with *a considerable quantity of copper*, as shown by the ammonia test, as also by *a well-marked deposition of copper* on the polished rod of iron.

7*th Sample.* — Purchased of S. Levy, Oilman, 3. Crown-street, Soho.

Analysis.— 1000 grains of the *vinegar* contain 21·98 parts of *acetic acid*, or 2·19 per cent., and ·57 of *sulphuric acid; pickles* impregnated with *a very considerable quantity of copper*, evidenced by the ammonia test, as also by the deposition of a *very well-marked coating of copper*.

8*th Sample.* — Purchased of R. Green, Oilman, 32. Little Newport-street.

Analysis. — 1000 grains of the *vinegar* contain 26·07 parts of *acetic acid*, or 2·60 per cent., and 1·03 of *sulphuric acid; pickles* contaminated with *rather much copper*, as indicated by the ammonia test, and by the formation of *a well-marked metallic coat.*

9*th Sample.* — Purchased of W. G. Nixey, Oilman, 22. Moor-street, Soho.

Analysis. — 1000 grains of the *vinegar* contain 14·65 parts of *acetic acid*, or 1·46 per cent., and ·38 of *sulphuric acid; pickles* contaminated with *a very small quantity of copper*, as shown by *the slight deposition of the metal* on the bar of iron.

10*th Sample.* — Purchased of W. Gilbert, Tallow-chandler, 64. Tottenham-court-road.

Analysis. — 1000 grains of the *vinegar* contain 15·49 parts of *acetic acid*, or 1·54 per cent., and *traces of combined sulphuric acid; pickles* contaminated with *rather much copper*, as shown by the ammonia and galvanic tests.

Girkins.

11*th Sample.* — Purchased of Messrs. Crosse & Blackwell, pickle manufacturers, 11. King-street, Soho.

Analysis. — 1000 grains of the *vinegar* contain 29·11 parts of *acetic acid*, or 2·91 per cent., and ·96 of *sulphuric acid; pickles* contaminated with *rather much copper*, as shown by the *bluish colour* of the solution of the ash when treated with ammonia, as well as *by the formation of a well-marked metallic incrustation.*

In reference to the above analysis, we think it right to publish the following remarks relating to the establishment of Messrs. Crosse & Blackwell, of 21. Soho-square, extracted from the supplement to Ure's "Dictionary of Arts."

"I have examined the apparatus in the great fish-sauce, pickle, and preserved fruit establishment of Messrs. Crosse & Blackwell, Soho-square, and find it arranged on the principles most conducive to economy, cleanliness, and salubrity; no material employed there is even allowed to come in contact with *copper.*"

12*th Sample.* — Purchased of W. Bowley, Oilman, 110. Tottenham-court-road.

Analysis. — 1000 grains of the *vinegar* contain 23·69 parts of *acetic acid*, or 2·36 per cent., and ·59 of *sulphuric acid; pickles* contaminated with *rather much copper*, as shown by the tests referred to.

13*th Sample.* — Purchased of J. Oulds, Oilman, Henry-street, Hampstead-road.

Analysis. — 1000 grains of the *vinegar* contain 15·18 parts of *acetic acid*, or 1·51 per cent., and 1·47 of *sulphuric acid; pickles highly impregnated with copper*, the solution of the ash when treated with ammonia, becoming of a *deep blue colour, and a strong metallic crust being instantly deposited* on the bar of iron.

The pickles in this case contained so large a quantity of copper, that they might be pronounced absolutely poisonous.

14*th Sample.* — Purchased of Messrs. Freeman, Pickle-makers, 3. Wigmore-street.

Analysis. — 1000 grains of the *vinegar* contain 28·19 parts of *acetic acid*, or 2·81 per cent., and 1·29 of *sulphuric acid; pickles* impregnated *with a very considerable quantity of copper*, as evinced by the ammonia test, and by the formation of *a very well-marked coating of copper* on the iron bar.

Beans.

15*th Sample.* — Purchased of E. Lazenby & Sons, Pickle-makers, 6. Edward-street, Portman-square.

Analysis. — 1000 grains of the *vinegar* contain 22·94 parts of *acetic acid*, or 2·29 per cent., and ·76 of *sulphuric acid; pickles highly impregnated with copper*, as shown by the *decided blue colour* of the solution of the ash, on the addition of ammonia, as well as *by the immediate deposition of a strong crust of the metal*, on immersion in the liquid of a bright bar of iron.

With the exception of samples 13 and 16, these pickles contained more copper than any of the others.

16*th Sample.* — Purchased of B. Malden, Oilman, 226. Tottenham-court-road.

Analysis — 1000 grains of the *vinegar* contain 25·32 parts of *acetic acid*, or 2·53 per cent., and 70 of *sulphuric acid; pickles highly impregnated with copper*, the solution of the ash when treated with ammonia becoming of a *deep blue colour, and a strong metallic crust being instantly deposited* on the bar of iron.

The pickles in this case contained a still larger quantity of copper than was present in sample 13, and therefore they are to be regarded as still more pernicious than the former.

Red Cabbage.

17*th Sample.*— Purchased of W. King, Oilman, 17. Marylebone-lane.
Analysis— 1000 grains of the *vinegar* contain 25·00 parts of *acetic acid*, or 2·50 per cent., and 2·52 of *sulphuric acid.*

18*th Sample.* — Purchased of E. Vezey, Oilman, 1. James-street, Oxford-street.
Analysis— 1000 grains of the *vinegar* contain 26·65 parts of *acetic acid*, or 2·66 per cent., and 2·52 of *sulphuric acid.*

The colour of the vinegar in both the samples of pickled red cabbage, was of a bright and madder-like red, very much brighter than the bluish-red which we observe in home-made pickled cabbage. We believe that it is common to produce this bright colour by means of beet-root, and we suspect that this means has been had recourse to in the present cases. So powerful is the colouring matter of beet-root, that white cabbage steeped for some time in a strong decoction of it, assumes very much the appearance of red cabbage; and we have been informed that what is sold as red pickled cabbage is often nothing more than white cabbage thus artificially coloured.

19*th Sample.*—Purchased of J. Revell, Oilman, 50. James-street, Oxford-street.
Analysis— 1000 grains of the *vinegar* contain 26·65 parts of *acetic acid*, or 2·66 per cent., and 1·67 of *sulphuric acid.*

20*th Sample.*—Purchased of R. Davey, Grocer, 21. Marylebone-lane.
Analysis.— 1000 grains of the *vinegar* contain 20·83 parts of *acetic acid*, or 2·08 per cent., and 1·19 of *sulphuric acid.*

Many of our readers may have noticed, in their visits to Covent-garden Market during the walnut season, the care with which the shells of the walnuts are preserved. These are employed generally to make walnut-ketchup, but sometimes are used for pickling, being of course much inferior for the purpose to the young walnuts themselves.

The results comprehended in the above analyses are more clearly brought under review in the annexed table.

TABLE SHOWING THE RESULTS OF THE CHEMICAL ANALYSES OF THE ABOVE TWENTY PICKLES OF DIFFERENT DESCRIPTIONS.

Sample.		Ignited Carbonate of Soda to neutralise 1000 Grains.	Acetic Acid in 1000 Grains.	Acetic Acid Per Cent.	Sulphate of Baryta in 1000 Grains.	Sulphuric Acid in 1000 Grains.	Copper.
1	E. H. Wood.	21·84	19·37	1·93	3·98	1·67	A very considerable quantity.
2	Timberlake & Priestly.	23·04	21·62	2·16	1·38	·58	Rather much.
3	S. Fowler.	19·32	17·06	1·70	3·69	1·55	Rather much.
4	Edmonson & Co.	19·20	17·50	1·75	2·39	1·00	Rather much.
5	E. Frost.	20·16	18·84	1·88	1·41	·59	A small quantity.
6	Westbrooke & Co.	25·20	23·44	2·34	2·01	·84	A considerable quantity.
7	S. Levy.	23·40	21·98	2·19	1·37	·57	A very considerable quantity.
8	R. Green.	28·20	26·07	2·60	2·45	1·03	Rather much.
9	W. G. Nixey.	15·60	14·65	1·46	·91	·38	A very small quantity.
10	W. Gilbert.	16·08	15·49	1·54	- -	traces.	Rather much.
11	Crosse & Blackwell.	31·20	29·11	2·91	2·30	·96	Rather much.
12	W. Bowley.	25·20	23·69	2·36	1·42	·59	Rather much.
13	J. Ould.	17·28	15·18	1·51	3·44	1·47	In poisonous amount.
14	Messrs. Freeman.	30·60	28·19	2·81	2·85	1·29	A very considerable quantity.
15	E. Lazenby & Sons.	24·60	22·94	2·29	1·81	·76	In highly deleterious amount.
16	B. Malden.	27·00	25·32	2·53	1·68	·70	In poisonous amount.
17	W. King.	28·56	25·00	2·50	6·00	2·52	No analysis made.
18	E. Vezey.	28·56	26·65	2·66	6·00	2·52	,, ,,
19	J. Revell.	29·40	26·65	2·66	3·97	1·67	,, ,,
20	R. Davey.	22 80	20·83	2·08	2 83	1·19	,, ,,

On an attentive consideration of the above table, the following general conclusions may be deduced :—

1st. That the *vinegar* used for pickling is of *a very weak description*, the percentages of *acetic acid* ranging between 1·48 and 2·91. It will be remembered, that, in our last Report, we stated that *vinegar of good quality ought to contain from four to five per cent. of pure acetic acid.*

2nd. That *nineteen* out of twenty *of the vinegars* submitted to analysis, poor as they were, yet *owed a portion of their acidity to sulphuric acid*, the amount of which varied, in the different samples, from ·38 to 2·52 in the 1000 grains; *the largest quantity of this acid being detected in the vinegars in which the red cabbages were pickled.*

3rd. That *in the whole of the sixteen different pickles analysed for copper*, THAT POISONOUS METAL *was discovered in various amounts: two of the samples contained a small quantity; eight, rather much; one, a considerable quantity; three, a very considerable quantity; in one, copper was present in highly deleterious amount; and in two, in poisonous amounts.*

4th. It will be observed, that *the pickles which contain the largest quantity of copper, are those which consist entirely of green vegetables, as girkins and beans.*

Notwithstanding the statements made in books, some of which we have noticed at the commencement of this Report, when we entered upon these inquiries, we felt convinced that so poisonous a metal as copper was now rarely, if ever, employed for the mere purpose of heightening and preserving the colour of green pickles; we are therefore both surprised and grieved at the really fearful character of the results to which our investigations have conducted us. We trust, however, now that conclusive evidence of this scandalous practice has been adduced, and that the public are put upon their guard, a remedy will be found for this great evil.

Pickles, doubtless, when properly prepared, are not very digestible; but we now see that much of the ill effects so generally attributed to their use, must result from their impregnation with so poisonous a contamination as copper.

It is not alone in the pickles that this poison is present, for it may be detected with remarkable readiness and certainty, in the vinegar in which the pickles are preserved, by the immersion in a small quantity of the vinegar—half an ounce is sufficient—for a few hours, of a piece of thick iron wire, having a smooth and polished surface. This test is of such ready applicability that we recommend the public to make use of it, and so ascertain for themselves whether the pickles they are using contain the poison or not. If an exceedingly small quantity of copper be present it will be quickly deposited on the surface of the iron.

We have ourselves tried this simple proceeding, first with half an ounce of the vinegars in which the pickles, purchased of Messrs. Lazenby and Sons, Oulds, and Malden, were contained; in each case, after the lapse of three or four hours, a well-marked coating of copper had formed upon the iron rod. We next tried it with the two vinegars previously ascertained to contain the smallest quantity of copper—that is, those purchased of Messrs. Nixey and Frost; in these cases also, after the lapse of a few hours, an incrustation of copper was formed.

Another very simple and efficient method of detecting the presence of copper in pickles, is the following:—Put three or four drops of the suspected vinegar on the blade of a knife; add one drop of sulphuric acid, and heat the under surface of the knife over the flame of a candle; the vinegar, in evaporating, will deposit the copper upon the iron, if any be present.

One of the worst features of this abominable practice is, that the employment of copper is wholly unnecessary, as the colour of green vegetables may be very well preserved by other means, as by the use of pure vinegar, and the addition of a proper quantity of salt.

Since then, as we have now proved, pickles are all but constantly contaminated, and even rendered poisonous, by copper, the only safety for the public is, that all housekeepers should take the matter into their own hands, and become themselves the makers of their pickles.

In order to arrive at the results detailed in the above report, it was necessary—1st, To make twenty analyses to ascertain the acidifying power or strength of each vinegar; 2nd, To make twenty analyses to determine the different amounts of sulphuric acid contained in each vinegar; lastly, To analyse sixteen of the pickles for copper. This statement does not include the purchase of the samples, the working of the calculations, the putting together in order of the different facts, nor the occasional repetition of the analyses, on account of uncertainties, or failures, arising from one cause or another.

It is in the vinegar employed for pickle-making especially that we should expect to find acetic and pyroligneous acids; the latter acid is usually detectable by the slight odour of creosote, from which it is almost impossible to free it. It is of importance that the effect of the action of the sulphuric acid contained in many of the pickling vinegars on the colour of the pickles should be determined. Our own impression is, that it would be found to be injurious.

A visit to a large pickle warehouse, such as that of Messrs. Crosse and Blackwell, during the season of pickle and preserve making, is not without interest. The vast piles of vegetables and fruit ready to be sorted, cut, boiled, &c., is really astonishing.

It appears, however, that pickle-making is, to a great extent, independent of the seasons, and that most of the different kinds of pickles may be made at any period of the year. This the makers are enabled to do by keeping a large stock of the various sorts of vegetables immersed in brine and packed in barrels. In some of our largest establishments many hundred barrels thus filled may be seen. We are informed that the greater part of these vegetables come from abroad. It is alleged that these vegetables are kept in brine for the sake of economy, and that they would keep far better in vinegar.

Since this Report was published, it occurred to me it was desirable that certain other kinds of pickles, not included amongst those previously examined, should likewise be subjected to analysis, in order to ascertain whether they also contained COPPER, as East India pickles, green chillies, and capers.

East India Pickles. — Purchased of Mr. Hart, Holborn.

These pickles are remarkable for their bright green colour; the ash left on incineration was of *a decided pink colour*, and furnished a solution which, with ammonia, became of a blue colour, indicating the presence of COPPER in *considerable amount.*

Green Chillies. — Purchased of Wix & Co., Leadenhall-street.

These pickles were of a still deeper green colour, and the ash was *deep pink;* the solution of this, on the addition of ammonia, became deep blue, from the presence of COPPER *in amount still more considerable.*

Capers.—Purchased of Mr. Clunn, Corner of Liquorpond-street, Grays'-Inn Road.

These capers, when seen through the bottle, appeared bright green, but on removing them from the bottle the greater part of their colour disappeared, and it was then ascertained that their greenness was principally due to the bottle in which they were put up. The ash was quite white, and did not contain copper.

This result is different from what was to have been anticipated, seeing that the different qualities of capers, dependent chiefly upon size, are obtained by sifting through copper sieves.

SPICES, AND THEIR ADULTERATIONS.

WE come now to the consideration of the important subject of Spices, and their Adulterations.

When it is remembered that many spices are sold in the state of powder, that they bear a high price, and that they are all subjected to an excise duty, which in some cases is very considerable, it might be supposed that they would be peculiarly liable to adulteration.

Notwithstanding these facts, however, little or no attention has hitherto been bestowed upon this subject by writers on the sophistication of food, or even on the part of the Excise authorities, whose duty it is to protect the revenue from fraud. We have therefore obtained from books but little information to aid us in the investigations the results of which we are now about to make known.

Following the plan which we have adopted from the commencement of these Reports, before treating of adulteration, we shall give a description, illustrated by figures, of the microscopic structure of each kind of spice treated of. A knowledge of the minute organisation of the various kinds of vegetable substances liable to adulteration, constitutes the only safe and scientific basis for inquiries of this nature.

The spices which we propose to examine, in the following Reports, are— Ginger, Turmeric, Cinnamon, Cassia, Nutmegs, Mace, Cloves, Allspice or Pimento, Mixed Spice, Curry Powder and Paste.

GINGER, AND ITS ADULTERATIONS.

The ginger-plant, *Zinziber officinale*, belongs to the very useful natural order, *Zinziberaceæ*, from which turmeric, East India arrow-root, and some other productions, are obtained.

Ginger grows and is cultivated in the tropical regions of Asia, America, and Sierra Leone.

The stem reaches generally three or four feet in height, and is renewed yearly; while the root, which is the part known as ginger, botanically termed a *rhizome*, is biennial.

The roots, or rhizomes, are dug up when about a year old; in Jamaica, this occurs in January or February, and after the stems are withered. They are well washed, freed from dirt, and in some cases, especially with the better kinds, the epidermis or outer coat is stripped off; and hence the division of ginger into white, scraped or uncoated, and into black, unscraped or coated.

In estimating the quality of ginger, a variety of particulars have to be taken into consideration—as whether the rhizomes are coated or uncoated, their form, colour, and consistence.

The rhizomes of ginger of *good quality* have no epidermis, are plump, of a whitish or faint straw-colour, soft and mealy in texture, with a short fracture, exhibiting a reddish, resinous zone round the circumference; the taste should be hot, biting, but aromatic.

The rhizomes of ginger of *inferior quality* are frequently coated with the epidermis, are less full and plump, often contracted and shrivelled; of darker colour, being of a brownish-yellow; of harder texture, termed *flinty*; and more fibrous; while the taste is inferior, and less aromatic.

The principal *uncoated* sorts of ginger, according to Dr. Pereira, are—

1. Jamaica ginger, "imported in barrels holding one cwt. each. It is an uncoated, pale sort; and when of fine quality, occurs in large, bold, fleshy races, which cut soft, bright, and pale-coloured. Inferior samples are small in the race, darker coloured, more or less flinty and shrivelled."

2. Uncoated Malabar ginger; new sort of Malabar ginger; Tellicherry ginger; Calicut ginger; Cochin ginger, "a pale uncoated sort, imported in chests, casks, or bags, sometimes from Tellicherry, but usually from Calicut or Cochin." It resembles Jamaica ginger, both in external appearance and flavour; but has, externally, more of a brownish or reddish tint. It first appeared in English commerce about the year 1841.

3. Uncoated Bengal ginger; scraped Bengal ginger; new sort of Bengal ginger; Calicut sort of Bengal ginger, " imported in chests of about one and a half cwts. It is an uncoated sort, darker than Jamaica ginger; it is not so large as the uncoated Malabar sort, and is harder and darker."

The chief *coated* gingers are—

1. Barbadoes ginger, "imported in bags of about sixty or seventy pounds. It is a coated sort—in short, flat races, which are darker coloured than Jamaica ginger, and are covered with a corrugated epidermis."

2. Malabar ginger; unscraped Malabar; old sort of Malabar ginger; common Malabar ginger; Bombay ginger, "imported from Bombay in bags or packets. It is a coated, dark, and small sort."

3. Bengal ginger; common Bengal ginger; old sort of Bengal ginger; "imported in bags. It is a coated or unscraped dark sort, which cuts flinty and brownish, but is plumper and less wormy than common Malabar ginger."

4. Sierra Leone ginger; African ginger; "imported in casks or bags. It is a coated sort, the races being generally larger, less flat and less plump, than those of the Barbadoes sort, which in other respects they resemble."

According to the authority above referred to, the uncoated gingers—viz. the Jamaica, uncoated Malabar, and uncoated Bengal—are assorted for commercial purposes, according to their qualities, thus:—

1. Bold, soft, and bright ginger.
2. Smaller, but soft and bright.
3. Flinty and dark.
4. Shrivelled, and only fit for grinding.

The Barbadoes, African, and coated Malabar and Bengal gingers, are usually sold unassorted.

Besides the two kinds of ginger above noticed, other descriptions occur.

Thus what is called *green* ginger, is sometimes imported from Jamaica; it consists of soft and juicy rhizomes with buds, and appears to have undergone but little preparation beyond picking and washing.

"The young shoots put forth every spring by the perennial rhizome are used in the manufacture of the delicious *preserved ginger* (*conditum zingiberis*). These shoots are carefully picked, washed, scalded, scraped, peeled, and then preserved in jars with syrup. (Dr. P. Browne.)

"The finest preserved ginger is imported from Jamaica, usually in jars. Barbadoes preserved ginger is seldom brought over. The China preserved ginger is stringy. It is sometimes imported in the dried state."

We have been informed that dried ginger of good quality, soft and mealy, may, by the following process, be converted into excellent preserved ginger:—

The rhizomes, selected with care, are to be immersed for three or four weeks in very weak syrup, scarcely stronger than sugar-and-water, to which a small portion of carbonate of potash has been added; this addition being made to give them a fresher and greener tint, and also to assist in softening them. As soon as the ginger has become sufficiently soft, it is put up in very strong syrup of white sugar.

Examined with the microscope, the rhizome of ginger is found to present a well-marked and characteristic structure.

The outer coat or epidermis, consists of several layers of large, angular, transparent cells, of a brownish colour, adhering firmly together, forming a distinct membrane, and when macerated in water, becoming soft and somewhat gelatinous.

Fig. 114.

A portion of the *epidermis* of the rhizome of ginger, showing the cells of which it is composed, as well as the oil-globules, *a a*; also the turmeric-like cells, *b b*; and *c c*, crystals very commonly noticed in great numbers lying beneath the epidermis.

Lying upon the under surface of this membrane, and scattered irregularly over it, are generally to be detected oil-globules of various sizes, and of a deep yellow colour, as well as a few cells, identical in structure and tint with those of turmeric.

In the substance of the rhizome itself several structures have to be described.

It consists principally of cells having delicate transparent walls minutely punctated, and adhering together so as to form a connected tissue. These cells contain in their cavities starch-corpuscles, which are very abundant, and many of which, as the cell-walls are easily broken, are seen in most sections to have become effused.

Lying here and there in the midst of the above-described cells, are other cells of nearly similar size and form, but of a bright yellow colour; these are in no respect distinguishable from the coloured cells of turmeric.

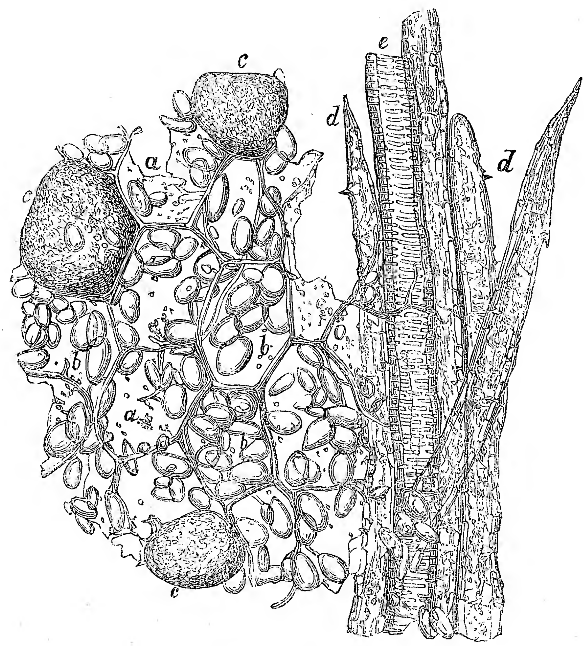
It is to the presence of these cells that ginger owes its colour, which varies with the number of such cells contained in it.

Traversing the rhizome in a longitudinal direction are bundles of woody fibre, sometimes inclosing, usually one, but occasionally two or even more, dotted ducts or vessels.

The starch-corpuscles resemble in some respects those of East India arrowroot, *Curcuma angustifolia*, but are yet characterised by several distinct features. Although, like those of *C. angustifolia*, they are usually elongated and flattened, they yet differ from the starch-granules of that plant in being somewhat smaller, less elongated, and in the greater obscurity of the hilum and curved lamellæ.

The structures above described are shown in the following drawing:—

Fig. 115.



This engraving represents the several tissues observed entering into the formation of the ginger rhizome, deprived of its epidermis: *a a*, cells containing the starch-corpuscles; *b b*, starch-granules; *c c*, turmeric-like cells; *d d*, woody fibre; *e*, dotted duct.

The following are the analyses of ginger by Bucholz and Morin:—

Bucholz's Analysis, 1817.

Pale yellow volatile oil	1·56
Aromatic, acrid, soft resin	3·60
Extractive, soluble in alcohol	0·65
Acidulous and acid extractive, insoluble in alcohol	10·50
Gum	12·05
Starch (analogous to bassorin)	19·75
Apotheme, extracted by potash, (ulmin ?)	26·00
Bassorin	8·30
Woody fibre	8·00
Water	11·90
White ginger	102·31

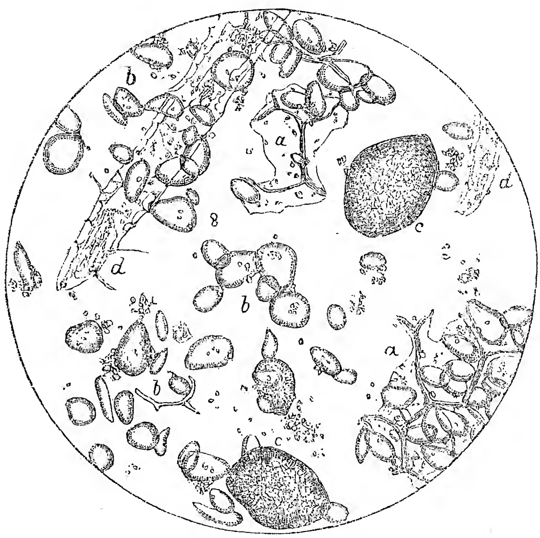
Morin's Analysis, 1823.

Volatile oil.
Acrid, soft resin.
Resin insoluble in ether and oils.
Gum.
Starch.
Woody fibre.
Vegeto-animal matter.
Osmazome.
Acetic acid, acetate of potash, and sulphur.
The ashes contained carbonate and sulphate of potash, chloride of potassium, phosphate of lime, alumina, silica, and oxides of iron and manganese.
Ginger.

The *volatile oil* possesses the odour of ginger; the taste, although mild at first, is afterwards acrid and hot. The *soft resin* has an aromatic odour, and a burning aromatic taste.

In ground ginger the above structures are separated from their proper connection, and occur variously intermixed, and more or less broken and comminuted. See

Fig. 116.



Genuine ground ginger: *a a*, cells which contain the starch-corpuscles; *b b*, loose starch-granules; *c c*, turmeric-like cells; *d d*, woody-fibre.

Adulteration.

But little information is to be obtained from books, relating to the adulteration of powdered ginger.

In order to improve the colour of ginger, and, according to some, to protect it from the attacks of insects, it is frequently rubbed over with lime; in other cases it is washed in chalk and water, when it is called *white-washed ginger:* lastly, the surface of ginger is occasionally bleached by means of a solution of chloride of lime, and sometimes even by exposing it to the fumes of burning sulphur, and thus made to present a white and floury appearance. By these processes an inferior ginger is often made to assume the appearance of the better descriptions.

Strong and pungent as ginger is, it is still subject to the attacks of insects —acari and larvæ. East India ginger, including the Malabar and Bengal sorts, is more liable to be wormy than either the West India or African kinds.

The only remark with which we are acquainted is the following, which occurs in the second edition of Pereira's "Materia Medica:"—

"Powdered ginger is said to be sometimes admixed with flour, and other amylaceous substances. The microscope would readily detect the adulteration, except in the case of East India arrow-root, the particles of which are similar in appearance to those of ginger."

Results of the Microscopic Analysis of Twenty-one Samples of Ground Ginger, purchased of various London Tradesmen, Grocers, and Oilmen.

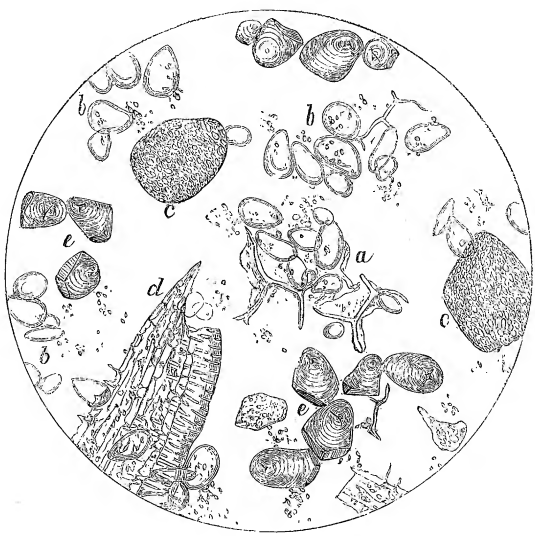
1st Sample.—Purchased of M. Harmer, Battle-bridge.
Adulterated—with *farina*, which consists principally of the starch-granules of the *potato*, the greater number of the grains being much changed by heat.

2nd Sample.—Purchased of F. Ibbetson, 10. Brewer-street, Somers-town.
Adulterated—with *wheat-flour*, and containing a large quantity of *Cayenne pepper*.

3rd Sample.—Purchased of J. Crouch, 57. Chapel-street, Somers-town.
Adulterated—consisting chiefly of *sago-meal*, with some *wheat-flour*, coloured with *turmeric*.

4th Sample.—Purchased of W. Hopkinson, 45. Barbican.
Adulterated—consisting principally of *sago-powder*, with numerous *turmeric*-like cells.

Fig. 117.

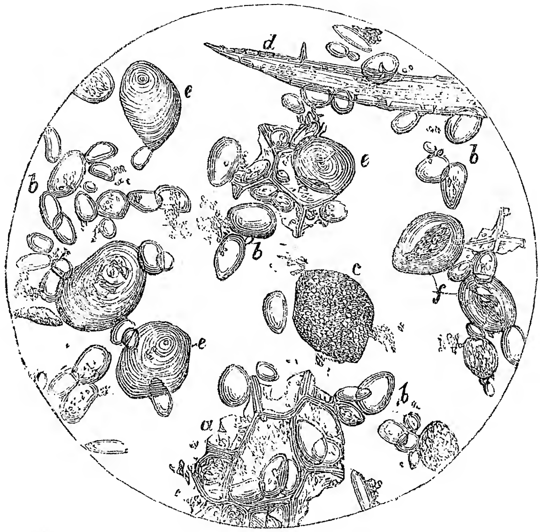


A portion of ground ginger purchased of Mr. Hopkinson, exhibiting the appearance of the article under the microscope, showing it to consist, in part, of powdered ginger, but principally of *sago-meal*. *a a*, cells of ginger; *b b*, starch-granules of ginger; *c c*, large yellow corpuscles analogous to those of turmeric; *d d*, fragment of woody fibre; *e e*, starch corpuscles of *sago-meal*.

5th Sample.—Purchased of Liquorish and Co., 50. Beech-street, Barbican.
Adulterated—consisting in great part of *sago-meal*, the majority of the granules being altered by heat; containing also much *wheat-flour*, and numerous fragments of *mustard-husk*.

6*th Sample.*—Purchased of S. Hiram, Mandarin Tea Warehouse, 176. Whitecross-street.
Adulterated—admixed with a very considerable quantity of *farina*, consisting principally of the starch-granules of *sago-meal*, much changed by heat, as well as some of those of the *potato*, and of *wheat-flour*.

Fig. 118.



a a, cells of ginger; *b b*, starch-granules of ginger; *c*, large yellow cell, analogous to those of turmeric; *d*, woody fibre; *e e*, starch-granules of *potato*; *f f*, starch-corpuscles of *sago*, altered by heat.

The above engraving exhibits a portion of the ground ginger purchased of S. Hiram. It is seen to consist of ginger, intermixed with two different forms of starch-corpuscles, those of *sago* and the *potato*.

7*th Sample.*—Purchased of Stevenson & Co., 159. Whitecross-street.
Genuine.

8*th Sample.*—Purchased of W. Earl, 128. Whitecross-street.
Adulterated—with much *wheat-flour*.

9*th Sample.*—Purchased of H. Weldon, 111. Whitecross-street.
Adulterated—with much *wheat-flour*, and containing a small quantity of *Cayenne pepper*.

10*th Sample.*—Purchased of G. W. Turner, 215. Whitecross-street.
Adulterated—a very considerable proportion, fully one-half the article, consists of *ground rice*; the pungency of the ginger being mainly attributable to *Cayenne pepper*.

11*th Sample.*—Purchased of W. Clarke, 216. Whitecross-street.
Adulterated—containing a very large quantity of *wheat-flour*.

12*th Sample.*—Purchased of C. Cullingham, 84. Snow-hill.
Genuine.

13*th Sample.*—Purchased of N. Yarrow, 42. King-street, Snow-hill.
Genuine.

14*th Sample.*—Purchased of E. Spiller, 98. Holborn.
Adulterated—consisting chiefly of *sago-powder*.

15*th Sample.*—Purchased of J. Hopkinson, 132. Holborn.
Genuine.

16*th Sample.*—Purchased of W. Edmundson, 29. Tottenham-court-road.
Adulterated—consisting chiefly of *sago-powder*, with a proportion of *turmeric*.

17*th Sample.*—Purchased of W. Cockman, 122. Tottenham-court-road.

Adulterated—consisting chiefly of *sago-powder*, with a proportion of *wheat-flour*, as well as numerous *turmeric-like* cells.

18*th Sample.*—Purchased of G. and E. Back, 123. Tottenham-court-road.
Genuine.

19*th Sample.*—Purchased of Westbrook and Co., 21. Oxford-street.
Adulterated—containing *wheat-flour*.

20*th Sample.*—Purchased of H. Sparrow, 371. Oxford-street.
Genuine.

21*st Sample.*—Purchased of T. Taylor, Whitecross-street.
Adulterated—containing a large quantity of *wheat-flour*.

From an examination of the above Table of Analyses, it appears:—

1st.—That out of *twenty-one* samples of ginger submitted to examination, no less than *fifteen*, being more than two-thirds of the whole, were found to be *adulterated.*

2nd.—That the substances detected were various in character, including *sago-meal, potato-flour, wheat-flour, ground rice, Cayenne pepper, mustard-husks*, and *turmeric-powder*,—these occurring in various quantities, but in the majority of cases constituting the principal part of the article.

The Cayenne pepper and mustard-husks are no doubt added, with the view of concealing the other adulterations, and of giving apparent strength to the ginger.

Since Cayenne pepper and mustard-husk possess well-marked structural peculiarities there is no difficulty whatever in identifying them under the microscope; but in those cases in which the quantities present are but small, these adulterations are very apt to be overlooked.

The adulteration with wheat-flour is one which might readily escape detection. The observer is therefore cautioned, before proceeding to the examination of powdered ginger, to study carefully the structure of genuine ground ginger and wheat-flour.

On another occasion, we shall insert drawings, exhibiting the characters of ground ginger adulterated with Cayenne pepper and mustard-husks.

The above Report affords most convincing evidence of the extraordinary power of the microscope, in the hands of qualified observers, in bringing to light the secret arts and practices of vile tricksters with our food.

The duty is 5*s.*, British possessions; 10*s.* Foreign. *There is no 5 per cent.* The quantities entered for home consumption were, in 1850, 16,543 cwt.; in 1851, 19,855 cwt.; in 1852, 18,691 cwt. The duty for 1849 amounted to 4449*l.* 11*s.* 7*d.*, in 1850 to 5818*l.* 11*s.* 11*d.*, and in 1851 to 7362*l.* 0*s.* 9*d.* It therefore follows that, on this small article, the revenue suffers a loss, through adulteration, of several hundreds of pounds yearly.

TURMERIC, AND ITS ADULTERATIONS.

Turmeric-powder consists of the ground tubers of *Curcuma longa*, a plant which is extensively cultivated in the neighbourhood of Calcutta, in Bengal, as also in China and Cochin China.

The bulbs are small and furnished with numerous long palmate tubers, internally of a deep orange-colour. There are two descriptions of tubers—the one round, the other long; but both are yielded by the same plant.

"The first are round, oval, or ovate, about two inches long, and one inch in diameter, pointed at one end, and marked externally with numerous annular wrinkles. The second are cylindrical, not exceeding in thickness the little finger; two or three inches long, somewhat contorted, tuberculated. Both kinds are yellowish externally, internally more or less orange-yellow, passing into reddish-brown. The fractured surface has a waxy appearance. The odour is aromatic, somewhat analogous to ginger, but peculiar; the taste is aromatic. When chewed, it tinges the saliva yellow. Its powder is orange-yellow. The tubers are frequently worm-eaten." *

* Pereira's Materia Medica, 3rd Edition, p. 1122, Part I.

The following varieties of turmeric are known in the English markets, and are thus described by Dr. Pereira:—

"1. *China Turmeric.*—This sort consists of smooth, plump, round, and long tubers, of a greenish hue externally. They yield a bright powder, and on that account are much preferred for medical purposes. Hence they fetch a higher price than any other sorts of turmeric. Probably if much of it were brought to market it would not fetch more than the Bengal sort.

"2. *Bengal Turmeric.*—This sort consists of thin or narrow long tubers, which are moderately smooth externally, and of a greyish dull yellow colour. They break with a deep reddish fracture. Although, from the dull appearance of its narrow tubers, it is not a very inviting sort to the inexperienced eye, yet it fetches a higher price than the Madras sort, on account of its being a much stronger dye.

"3. *Madras Turmeric.*—This is the most showy of all the kinds of turmeric. It consists principally of large long tubers, but mixed with transverse sections of round tubers. Externally the tubers are marked by longitudinal wrinkles, the surface of which is rubbed and bright yellow; internally the colour is that of a fresh-fractured surface of gamboge.

"4. *Malabar Turmeric, Bombay Turmeric.*—This sort is not constantly found in the market. It consists principally of long tubers, the round tubers being few, and of a very inferior quality. This sort of turmeric is smaller and more shrivelled than the Madras sort, but otherwise somewhat resembles it.

"5. *Java Turmeric.*—Not frequently found in the English market. In a general way it may be said to resemble the China sort. It consists of both round and long tubers, but chiefly the latter. They have a greenish-yellow hue.

"Under the name of *bulbs of Batavian Turmeric*, I have received a sample of round tubers, said to be from Java. Dr. T. Martius notices this sort as having been brought, for many years, from Batavia, and adds that it contains much colouring matter, and is probably the produce of *curcuma viridiflora*."

Examined with the microscope, the tubers are found to display a characteristic and beautiful organization.

The epidermis consists of a single layer of transparent cells, which, in the dried tuber, exhibit a shrunken appearance; these being firmly adherent to each other, form a continuous membrane.

The tuber itself is made up of several distinct structures. Thus, first, we notice a connected tissue, formed of angular, transparent, and *colourless cells*, having thin membranous walls.

Secondly, these cells contain, in their interior, large *masses of a yellow colour*, which take the form of, and in most cases accurately fill, the cavities of the cells. It is in these masses that the colouring matter of turmeric is principally located.

When broken up and carefully examined, the masses are found to consist not only of colouring matter, but of numerous starch-corpuscles, which approximate, in their form and appearance, to those of the allied plant *curcuma angustifolia*, but are much less numerous, less developed, and separable from the other constituents of the masses only with difficulty.

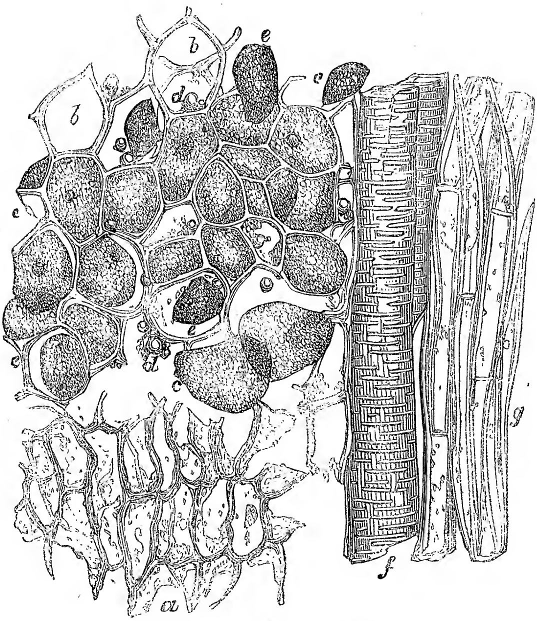
In thin sections of the tuber, the above-described characters, as well as others to be presently noticed, are well seen. In some cases the transparent cells, filled with their coloured contents, are visible, in others the coloured masses have escaped from the cells in which they were contained, and both may be seen lying side by side.

Lastly, scattered amongst the cells, are to be observed a few *coloured oil-globules*, as well as numerous *deep reddish-brown masses* of irregular size and form, which are evidently of a resinous nature, and upon the presence of which the resinous fracture of the tubers depends.

Lastly, dotted ducts, which approach in character to spiral vessels surrounded by woody fibre, which exhibits a jointed and cellular structure, complete the organization of the tuber.

The whole of the above particulars are well displayed in the annexed illustration.

Fig. 119.



SECTION OF TUBER OF TURMERIC.

a a, Epidermis; *b b*, transparent cells; *c c*, yellow masses; *d d*, oil-globules; *e e*, resinous masses; *f*, dotted duct; *g*, elongated cells of woody fibre, lying by the side of the duct.

The composition of turmeric is shown in the following analysis:—

John's Analysis.

Yellow volatile oil - - - - -	1
Curcumin - - - - - -	10 to 11
Yellow extractive - - - - -	11 to 12
Gum - - - - - -	14
Woody fibre - - - - -	57
Water and loss - - - - -	7 to 5
	100

Vogel and Pelletier's Analysis.

Acrid volatile oil.	Starch.
Curcumin.	Woody fibre.
Brown colouring matter.	Chloride of calcium.
Gum (a little).	Turmeric.

The word *curcumin* is applied to the resinous colouring matter of turmeric, which is soluble only in ether.

RESULTS OF THE MICROSCOPICAL ANALYSIS OF TEN SAMPLES OF TURMERIC POWDER, PURCHASED OF DIFFERENT LONDON TRADESMEN.

1*st Sample.*—Purchased of T. F. Probin, Oilman, 17. Cross-street, Walworth-road.

Genuine.

2*nd Sample.*—Purchased of C. Roads, Oilman, 11. Black Prince-row, Walworth.

Genuine.

3rd Sample.—Purchased of S. Jackson, Oil and Italian Warehouseman, 75. Blackman-street, Borough.
Genuine.
4th Sample.—Purchased of G. Pike, Oilman, 77. High-street, Borough.
Genuine.
5th Sample.—Purchased of H. North, Oilman, 135. High-street, Borough.
Genuine.
6th Sample.—Purchased of J. Woolmer, Italian Warehouseman, 80. Goswell-road.
Genuine.
7th Sample.—Purchased of Glucken and King, Oilmen, 17. Mount-row, Islington.
Genuine.
8th Sample.—Purchased of C. Young, Oilman, 8. High-street, Islington.
Genuine.
9th Sample.—Purchased of W. I. Brown, Oilman, 12. High-street, Islington.
Genuine.
10th Sample.—Purchased of H. Davis and Co., Oil and Italian Warehouseman, 23. High-street, Islington.
Genuine.

It thus appears that we have at length the rare satisfaction of meeting with an article not subject to adulteration. Inasmuch as turmeric enters largely into the composition of curry powder and some other condiments, it was necessary to ascertain whether it was liable or not to sophistication.

The cheapness of turmeric-powder, and the comparatively small quantity of it used, explain the reason of its having hitherto escaped the hands of the adulterator.

Turmeric is free of duty. Wholesale price, 9*s.* to 14*s.* per cwt.

CINNAMON, AND ITS ADULTERATIONS.

Cinnamon is the bark of the *Cinnamomum Zeylanicum,* one of the Lauraceæ, or Laurel family, to which also belong Cassia and Camphor, as well as some other plants possessing medicinal properties, especially Clove-bark.

Cinnamon is cultivated principally in Ceylon.

" The cinnamon-bark of Ceylon is obtained by the cultivation of the plant. The principal *cinnamon gardens* lie in the neigbourhood of Columbo. The bark peelers or *choliahs,* having selected a tree of the best quality, lop off such branches as are three years old, and which appear proper for the purpose. Shoots or branches, much less than half an inch, or more than two or three inches in diameter, are not peeled. The peeling is effected by making two opposite, or, when the branch is thick, three or four longitudinal incisions, and then elevating the bark by introducing the peeling-knife between it. When the bark adheres firmly, the separation is promoted by friction with the handle of the knife. In twenty-four hours the epidermis and greenish pulpy matter (rete mucosum) are carefully scraped off. In a few hours the smaller quills are introduced into the larger ones, and in this way a congeries of quills formed, often measuring forty inches long. The bark is then dried in the sun, and afterwards made into bundles with pieces of bamboo-twigs.

" Cinnamon is imported in bales, boxes, and chests, principally from Ceylon; but in part also from Madras, Tellicherry, and rarely from Java and other places.

" In order to preserve and improve the quality of the bark, black pepper is sprinkled amongst the bales of cinnamon in stowing them at Ceylon (Percival). Mr. Bennet states that ships are sometimes detained for several weeks, through the want of pepper to fill the interstices between the bales in the holds.

" When cinnamon arrives in London, it is unpacked and examined; all the mouldy and broken pieces are removed from it. It is then re-made into bales. These are cylindrical, three feet six inches long, but of variable diameter, perhaps sixteen inches on the average. These bales are enveloped by a coarse cloth called *gunny*. The cinnamon in boxes and chests is usually the small, inferior, and mouldy pieces.

" Four kinds of cinnamon are distinguished in the London markets; namely, *Ceylon*, *Tellicherry*, *Malabar*, and *Java* cinnamon. The latter, however, is rarely met with. A fifth kind, called *Cayenne*, occurs in French commerce.

" 1. *Ceylon cinnamon.*—This is the most esteemed kind. The fasciculi or compound quills, of which the bales are made up, are about three feet six inches long, slender and shivery, and are composed of several smaller quills, inclosed one within the other. The bark is thin (the finest being scarcely thicker than drawing-paper), smooth, of a light yellow-brown, or brownish-yellow colour, moderately pliable, with a splintery fracture, especially in the longitudinal direction. The inner side, or *liber*, is darker and browner, and contains, according to Rees, small medullary rays filled with a red juice, and which he regards as the peculiar bearers of the aroma. The odour of the bark is highly fragrant. The flavour is warm, sweetish, and agreeable. Inspection and tasting are the methods resorted to for ascertaining the qualities of cinnamon.

" Ceylon cinnamon is characterized by being cut obliquely at the bottom of the quill, whereas the other kinds are cut transversely. In the London market, three qualities of Ceylon cinnamon are distinguished; viz., *first*, *seconds*, and *thirds*, Inferior kinds are thicker, darker, browner, and have a pungent, succeded by a bitter, taste.

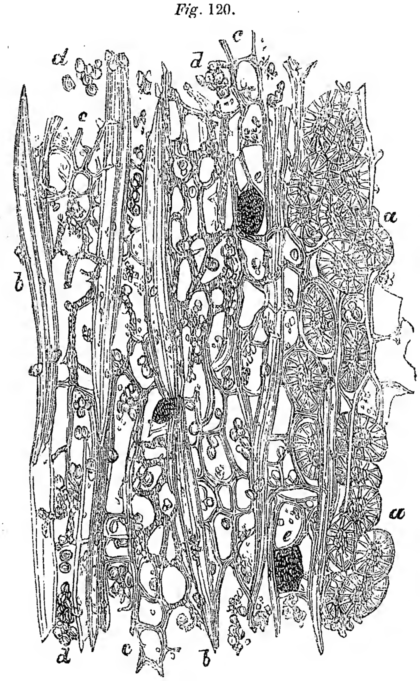
" 2. *Tellicherry or Bombay Cinnamon*, is grown on one estate only, at Tellicherry, by Mr. Brown, and is wholly consigned to Messrs. Forbes & Co.; only 120 or 130 bales are annually imported. In appearance, it is equal to the Ceylon kind; but the internal surface of the bark is more fibrous, and the flavour is inferior. It is superior to the Malabar variety.

" 3. *Madras or Malabar Cinnamon*, is of inferior quality. It is grown, I am informed, on the Coromandel coast. It is coarser and inferior in flavour to the other kinds. In thickness, it approximates to cassia lignea. Its quality has annually deteriorated since its introduction into the market. It does not meet with a ready sale, and it is expected that its importation will cease.

" 4. *Java Cinnamon.*—This is said to be equal in quality to the Ceylon sort.

" 5. *Cayenne Cinnamon.*—This is unknown in the London market. Its volatile oil is more acrid and peppery than the oil from Ceylon cinnamon."

Fig. 120.



Longitudinal section of *cinnamon* carried transversely through the bark, magnified 140 diameters.
a a, stellate cells; *b b*, woody fibre; *c c*, starch-cells; *d d*, starch-granules; *e e*, granular cinnamon-coloured cells or bodies.

Cinnamon, under the microscope, presents a complicated and very distinct organization, which is best seen in longitudinal sections carried through the thickness of the bark.

On the outer or external surface of the section are observed numerous stellate cells, separable readily from each other, and similar to those which we have so often before described as occuring in other vegetable structures. These cells lie one upon the other in several layers, and form a considerable part of the thickness of the bark. They are situated in the intervals between the woody fibres; they are of a quadrangular or oval form, having the long axes placed usually transversely to the bark;

their breadth being greater than their depth. In whatever position they are viewed, both the central cavities and the rays which proceed from them are visible. Occasionally, though not usually, a few starch-granules may be seen in the cavities of these cells. Proceeding from without inwards, these cells are succeeded by others, which are distinguished from the first by the absence of rays, by the thinness of their walls, and by the firmness with which they adhere to each other; they generally contain a few starch-corpuscles. These cells, which form several series, complete the thickness of the bark.

Interspersed between both the first and second kinds of cells are numerous woody fibres, which are rather short, pointed at either extremity, and furnished with a central canal. It is these which impart the fibrous character to cinnamon, particularly observable in fractures of the bark.

The starch-corpuscles of cinnamon are small, more or less globular, and furnished with a very distinct hilum, which has the appearance of a central depression. They usually occur singly, but sometimes united in twos or fours.

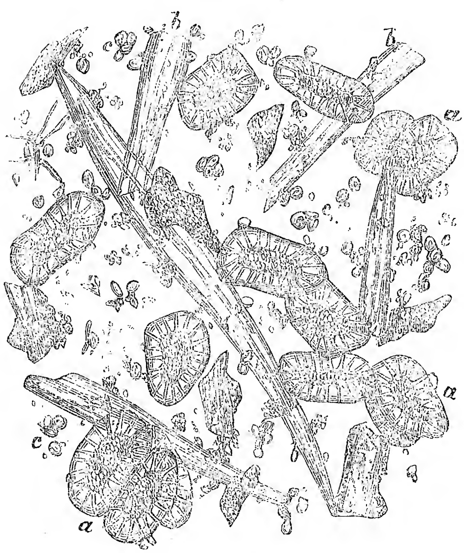
The quantity of starch in cinnamon is so small, that the decoction of the bark does not become blue on the addition of iodine.

Lastly, lying in the cavities of the most external of the second order of cells, are frequently to be observed deep cinnamon-coloured masses of granular texture.

The above structural particulars are all shown in *fig.* 120.

In ground cinnamon the several structures are disunited and broken. The stellate cells occur singly, or in groups of two, three, or more; the woody fibre is disengaged, and is scattered about, resembling somewhat, in form and appearance, the hairs which occur on many plants; the starch-corpuscles are set free from their cells; and lastly, the cinnamon-like masses may be seen in the field of the microscope, dispersed here and there. (*Fig.* 121.)

Fig. 121.



Genuine CINNAMON *powder*, magnified 220 diameters. *a a*, stellate cells; *b b*, woody fibre; *c c*, starch-granules.

ADULTERATION OF CINNAMON.

But little precise information has been obtained hitherto in reference to the adulteration of cinnamon. It is known that the bark, after the abstraction of the greater part of its active principles, as by the distillation of cinnamon-water and oil of cinnamon, is re-dried and offered in the market as ordinary cinnamon. But no certain means have, up to the present time, been pointed out for the detection of this fraud, although it may be discovered in a very ready and simple manner.

The starch-corpuscles of all vegetables, when subjected to the action of boiling water, enlarge considerably in size, and undergo a great change in form.

In order, then, to ascertain whether the cinnamon has been tampered with in the manner above described, nothing more is necessary than to powder a portion of the cinnamon in a mortar, and to examine carefully with the microscope the condition of the starch-granules. If these are larger than natural, have lost their proper form, and appear distorted and irregular, the cinnamon has unquestionably been subjected to the action of boiling water, which only could have been for the purpose of extracting its essential oil. If the cinnamon has been subjected to the prolonged action of the water, the starch-granules will have become so broken up and dissolved that they can no longer be detected.

We have ourselves made trial of the above method, with the barks of both cinnamon and cassia, with complete success.

A very common practice, as we shall see hereafter, is to substitute cassia for cinnamon, either in the bark or in powder.

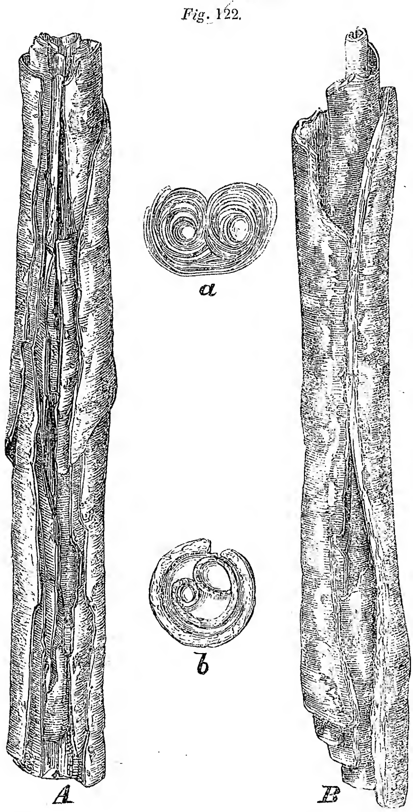
Not to anticipate, however, the results of the analyses to be given hereafter, we omit for the present to refer to several other adulterations of cinnamon which we have detected in the course of our investigations.

Since cassia is so frequently substituted for cinnamon, it becomes necessary, before we shall be able to undertake the examination of the latter, that we should acquaint ourselves intimately with the nature and structure of cassia bark, and to the consideration of which we will next proceed.

CASSIA, AND ITS ADULTERATIONS.

Since cassia — *Cinnamomum Cassia* — belongs to the same genus of plants as the true cinnamon, it is not very surprising that they should resemble each other so closely as they do. Notwithstanding their striking resemblances, there are characters, however, by which they may be discriminated.

Fig. 122.



A, Stick of CINNAMON of the natural size and appearance, showing the thinness of the bark, and the manner in which the layers are enclosed one within the other; *a*, cross section of same, exhibiting more completely the number of the layers, and their disposition.

B, Stick of CASSIA of the natural size and appearance, showing the thickness of the bark, and the manner in which the layers are enclosed within each other; *b*, cross section of same, exhibiting the disposition of the layers.

The bark of cinnamon is scarcely thicker than drawing-paper, and breaks with an uneven and fibrous margin: while each stick consists of eight, ten, or more pieces or *quills* of bark inserted one within the other.

Cassia bark is much stouter, being often as thick as a shilling; it breaks short, and without splintering. By these characters alone it is easy to distinguish cinnamon from cassia when in the whole state, as shown by the accompanying drawing.

But these barks differ also in colour and taste. Cinnamon is paler and browner than cassia, which is usually redder and brighter. The taste of the one is sweet, mild, and aromatic, leaving no unpleasant impression on the tongue, while that of the other is less sweet, stronger, and is followed by a bitterness.

These characters, however, vary in different samples, so that it is impossible by these means alone to distinguish cinnamon from cassia when in powder, and we are not aware that any certain means have been pointed out for effecting the discrimination, especially when the two are mixed in different proportions; but here again, as in so many other cases, the microscope affords us invaluable assistance.

Sections of cassia bark, viewed under the microscope, bear a close general resemblance to those of cinnamon, but differ in their greater width and the relative proportions of the several structures, particularly in the size and number of the starch-corpuscles.

We observe on the outer surface, as in cinnamon, the peculiar stellate cells, the cavities of which, however, much more commonly than those of cinnamon, are filled with well-developed starch-corpuscles.

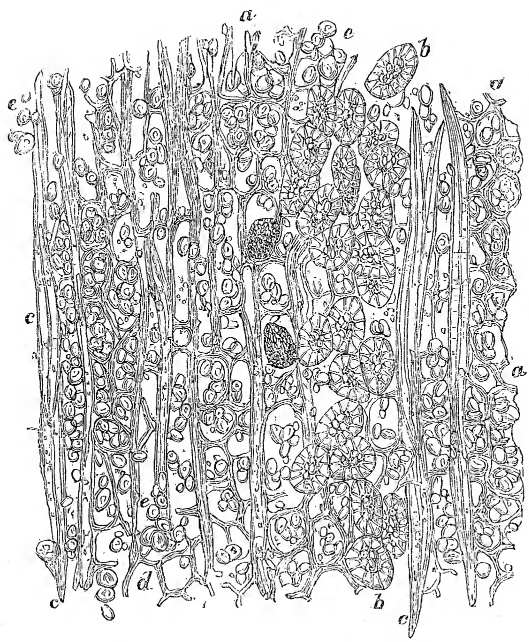
Lying next to these, we notice what may be termed the proper starch-cells, usually crammed quite full of starch-corpuscles, which, while they have the same general form as those of cinnamon, are yet two or three times larger, as well as many times more numerous.

The woody fibre occurs, as in cinnamon, interspersed between both descriptions of cells, and it does not appear to differ appreciably from that of cinnamon.

Of the entire thickness, about one-fourth is formed by the stellate cells; the remaining three-fourths being made up of the starch-bearing cells.

In powdered cassia, therefore, as contrasted with powdered cinnamon, the stellate cells and woody fibre are much less abundant, while the starch-granules are at the same time much larger, and far more numerous.

Fig. 123.



Longitudinal section of CASSIA, carried transversely through the bark, magnified 140 diameters.
a a, Cells of epidermis; *b b*, stellate-cells; *d d*, starch-cells; *e e*, starch-granules; *f f*, granular, cinnamon-coloured masses.

Powdered cassia may then at all times be discriminated from powdered cinnamon by the size and abundance of the granules of starch, the amount of which is so considerable, that iodine turns the decoction of a blue colour.

The several kinds of cassia are thus described in Pereira's "Materia Medica:"—

"1. *China cassia-lignea* (sometimes called *China* cinnamon) is the best kind. It is usually imported from Singapore, rarely from Canton direct. Mr. Reeves says vast quantities of both cassia buds and cassia-lignea are annually brought to Canton from the province of Kwang-se, whose principal city (*Kwei Lin Too*), literally the city of the forest (or grove) of cassia trees, derives its name from the forests of Cassia around it.

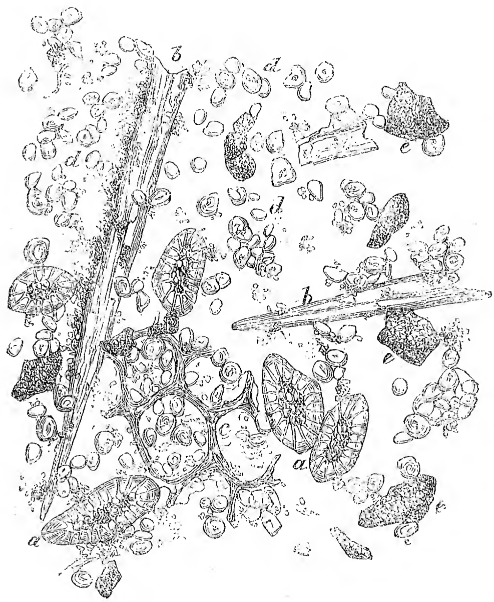
"The Chinese themselves use a much thicker bark (which they call *Gan Kwei Pe*), unfit for the European market. Mr. Reeves informs me that they esteem it so highly as to pay nearly ten dollars per pound for it. A very fine quality is occasionally met with, and commands the enormous price of 100 dollars per catty (one pound and three quarters). A specimen of it, with which he has kindly furnished me, is straight, semi-cylindrical, eleven inches long, rather more than an inch wide, and about one-sixth or one-eighth of an inch thick. Externally it is warted, and covered with crustaceous lichens. Internally it is deep brown; its odour and flavour are those of cassia. Mr. Reeves also informs me that the best cassia-lignea is cut in the third or fourth moon, the second sort in the sixth or seventh moon.

"2. *Malabar cassia-lignea.*— This is brought from Bombay; it is thicker and coarser than that of China, and is more subject to foul-packing; hence each bundle requires separate inspection. It may, perhaps, be coarse cinnamon; for Dr. White states that the bark of the older branches of the genuine cinnamon plant is exported from the Malabar coast as cassia.

"3. *Manilla cassia-lignea.* — This, I am informed, is usually sold in bond for continental consumption. I have received a sample of bark ticketed 'Cassia vera, from Manilla,' the epidermis from which was imperfectly removed.

"4. *Mauritius cassia-lignea.* — This is occasionally met with."

Fig. 124.



Genuine Cassia *powder*, magnified 220 diameters; *a a*, stellate cells; *b b*, woody fibre; *c c*, starch-cells; *d d*, starch-granules; *e e*, granular masses.

Results of the Microscopic Examination of Thirty-one Samples of Cinnamon purchased of various London Tradesmen, Italian Warehousemen, Grocers, and Oilmen.

Whole Cinnamon.

1*st Sample.*—Purchased of Alexander Braden, Grocer, 13. High-street, Islington. 8*d.* per oz.
Genuine.

2*nd Sample.*—Purchased of Gluckner & King, Oilmen, 17. Mount-row, Islington. 6*d.* per oz.
Genuine.

3*rd Sample.*—Purchased of Pye & Co., Tea-dealers, 37. Little Pulteney-street, Soho. 8*d.* per oz.
All *cassia.*

4*th Sample.*—Purchased of J. Waltham, Oilman, Edward-street, Soho. 8*d.* per oz.
Consisting entirely of *cassia.*

5*th Sample.*—Purchased of S. Austin, Grocer, 3. Old Compton-street, Soho. 8*d.* per oz.
Consisting entirely of *cassia.*

6th Sample. — Purchased of Cooper & Co., Moor-street, Soho. 6*d.* per oz.
Nothing but *cassia*.

7th Sample. — Purchased of E. Holloway, Oilman, 56. Poland-street. 1*s.* per oz.
Nothing but *cassia*.

8th Sample. — Purchased of Mr. Harris, Oilman, —. Poland-street. 1*s.* per oz.
Genuine.

9th Sample.— Purchased of Waller & Co., Grocers, 5. Berwick-street. 1*s.* per oz.
Genuine.

10th Sample. — Purchased of J. Way & Co., Grocers, 272. Oxford-street. 1*s.* per oz.
Genuine.

11th Sample.— Purchased of W. Owtram, Oilman, 7. Wardour-street. 8*d.* per oz.
Genuine.

12th Sample. — Purchased of Jones & Co., Grocers, 166. Oxford-street. 8*d.* per oz.
Genuine.

Powdered Cinnamon.

13th Sample. —Purchased of Brocksopp, Sons, & Co., Grocers, 234. Borough. 6*d.* per oz.
Nothing but *cassia*.

14th Sample. — Purchased of J. Rose & Co., Grocers, 213. Borough. 8*d.* per oz.
Genuine.

15th Sample. — Purchased of Harrington & Lucas, Grocers, 113. High-street, Borough. 8*d.* per oz.
Genuine.

16th Sample. — Purchased of Russell & Co., Grocers, 72. Borough. 6*d.* per oz.
Adulterated — containing an enormous quantity of baked *wheat-flour*, together with some *sago-powder*.

17th Sample. — Purchased of Newsom & Williams, Grocers, 50. High-street, Borough. 6*d.* per oz.
Adulterated — consisting of *cassia*, and containing a portion of *sago-powder*.

18th Sample. — Purchased of R. Jones, Grocer, 16. Borough. 6*d.* per oz.
Adulterated — powder becoming thick and viscid when wetted, from the presence of an enormous quantity of baked *sago-powder*.

19th Sample. — Purchased of Mitchell & Co., 17. Blackman-street, Borough 6*d.* per oz.
Genuine.

20th Sample. — Purchased of Dannan & Co., Grocers, 2. Walworth-road. 8*d.* per oz.
Adulterated — containing a small quantity of *potato-flour*.

21st Sample. — Purchased of W. P. Moore, Grocer, 4. Crown-row, Walworth. 8*d.* per oz.
Adulterated — containing an enormous quantity of *East India arrow-root*.

22nd Sample. — Purchased of W. M. Nicholson, Grocer, 86. Upper-street, Islington. 10*d.* per oz.
Consisting entirely of *mixed spice*, sold probably by mistake.

23rd Sample. — Purchased of R. Rowton, Grocer, 46. Chapel-street, Islington. 8*d.* per oz.
Adulterated — admixed to a very large extent with *sago-powder* and baked *wheat-flour*.

24th Sample. — Purchased of J. Barber, Grocer, 14. Rufford's-buildings, Islington. 8*d.* per oz.
Genuine.

25th Sample. — Purchased of Roberts & Arnold, Grocers, 1. Rosamon-buildings, Islington. 4*d.* per oz.
Adulterated — made up of *cassia* and baked *wheat-flour*.

26th Sample. — Purchased of W. Young & Son, Grocers, 27. High-street, Islington. 8*d.* per oz.
Adulterated — consisting of *cassia* and much baked *wheat-flour*.

27th Sample. — Purchased of Alex. Braden, Grocer, 13. High-street, Islington. 8*d.* per oz.
Consisting entirely of *cassia*.

28*th Sample.* — Purchased of C. Young, Italian Warehouseman, 8. High-street, Islington. 1*s.* per oz.
Genuine.

29*th Sample.* — Purchased of Beckett & Young, Grocers, 3. High-street, Islington. 8*d.* per oz.
Consisting entirely of *cassia.*

30*th Sample.* — Purchased of G. Budd, Grocer, 86. Goswell-road. 8*d.* per oz.
Adulterated — powder when wetted becoming thick and viscid, from the presence of a large quantity of baked *wheat-flour.*

31*st Sample.* — Purchased of J. Woolmer, Grocer, 80. Goswell-road. 8*d.* per oz.
Adulterated — containing a large quantity of baked *wheat-flour* and some *sago-meal.*

32*nd Sample.* — Purchased of C. Legg, Grocer, 18. Wardour-street. 6*d.* per oz.
Genuine.

From an examination of the above Table of Analyses it appears —

1st. That of the *whole* cinnamons, *seven* were *genuine*, and that *five* consisted of nothing but *cassia.*

2nd. That while the prices per ounce for the *whole* cassias varied between sixpence and one shilling, one being charged sixpence; three, eightpence; and one, a shilling; those for the cinnamon also varied between sixpence and one shilling; one being charged sixpence; three, eightpence; and three, one shilling.

3rd. That out of the *nineteen* samples of *ground* cinnamon, *three* consisted entirely of *cassia.*

4th. That *ten* of the samples, more than one-half, were *adulterated*, the articles most frequently employed being either *baked wheat-flour* or *sago-meal*, separately or in combination; but *East India arrow-root* and *potato-flour* were likewise detected, each in one instance.

5th. That of the above adulterated samples, *three* consisted of *cassia*, adulterated; and *seven* of *cinnamon*, adulterated.

6th. That *six* only of the *nineteen* samples were *genuine.*

7th. That the prices given per ounce for the powdered *cassia*, substituted for cinnamon, were sixpence and eightpence, one being sixpence, and two eightpence.

8th. That the prices paid for the genuine powdered cinnamon were sixpence, eightpence, and one shilling per ounce, two being sixpence, three eightpence, and one a shilling.

9th. That the prices charged for the adulterated articles, whether cassia or cinnamon, were fourpence, sixpence, and eightpence per ounce — viz., one at fourpence, three at sixpence, and six at eightpence per ounce.

It thus appears that in the prices charged for cassia and cinnamon, whether whole or in powder, and whether genuine or adulterated, no constant difference is to be observed, and consequently that the public suffer great loss by the substitution of cassia, which is so much cheaper, for cinnamon, and a still greater loss by the other sophistications. Further, it appears that, contrasting the prices of genuine whole with those of genuine ground cinnamon, for some reason unknown to us, the latter are sold at a cheaper rate than the former.

It will be observed that the wheat-flour and sago-powder used for the adulteration of ground cinnamon are stated in the analyses to have been baked; the purpose of this is obvious — namely, that they may assimilate in colour to either cinnamon or cassia, and thus the better escape detection.

From M'Culloch's "Commercial Dictionary," under the head of "*Cinnamon Monopoly*," we meet with the following observations: —

"Down to 1833, the cultivation of cinnamon in Ceylon was restricted to a few gardens in the neighbourhood of Colombo, the production and sale of the article being wholly monopolised by government. Upon the transference of the island from the East India Company to the king's government, the former agreed to pay 60,000*l.* a year for 400,000 pounds, or 4342½ bales of cinnamon: it being stipulated that if the quantity collected exceeded this amount *the surplus was to be burned!*

"But this agreement was afterwards broken off, and the cinnamon was sent to England by government and sold, on its account, at quarterly sales. The nett revenue derived from the cinnamon monopoly in 1831 is said to have amounted to 127,961*l.* As the monopoly could not be enforced, except by confining the culture of cinnamon to certain districts, it necessarily led to the most oppressive interferences with the rights of individuals, to the creation of numberless imaginary offences, and the multiplication of punishments, forming a heavy drawback on the prosperity of the island. A sense of these disadvantages led at length to the abolition of the monopoly system in 1833, when we ceased to be amenable to the charge of upholding, without improving, the worst part of the Dutch policy, and restored to the natives their right to cultivate cinnamon anywhere, and in any way they think fit."

On the abolition of the monopoly system, the exorbitant duty of 3*s.* per pound was imposed on all cinnamon exported, without distinction of quality. The result of this policy was, that the exports declined considerably below what they were during the period of the monopoly; and, notwithstanding a further reduction of duty in 1841 to 2*s.* per pound, the exports in that year amounted to only 323,461 pounds, producing a revenue of 33,111*l.*; this result being attributable partly to the high duty, partly to the culture of cinnamon in other places, but principally by the duty encouraging the use of cassia and other substitutes in place of the genuine article. Since 1841, however, the export duty has been still further reduced. During the three years ending 1842, the *cinnamon* entered for consumption, and the duties, were: —

Quantities.

1840.	1841.	1842.
16,432 lbs.	15,625 lbs.	17,009 lbs.

Duties.

1840.	1841.	1842.
410*l.* 12*s.* 10*d.*	415*l.* 10*s.* 10*d.*	327*l.* 2*s.* 11*d.*

The duty on cassia in 1825 was reduced from 2*s.* 6*d.* to 1*s.*, and in 1829 to 6*d.* per pound. Owing partly to these reductions, and partly to the heavy duty on cinnamon, the consumption of cassia, says Mr. M'Culloch, has more than trebled since 1820.

The quantities of *cassia* returned for home consumption in the United Kingdom, and the amount of duty received thereon in the three years 1840, 1841, and 1842, were as follows: —

Quantities.

1840.	1841.	1842.
74,050 lbs.	83,034 lbs.	119,470 lbs.

Duties.

1840.	1841.	1842.
1933*l.*	2219*l.*	1692*l.*

The import duty on cassia was, in 1851, 9*s.* 4*d.* per cwt., and five per cent., and on cinnamon, 6*d.* per pound, and five per cent.

Taking into consideration the great difference in the import and export duties on the two articles, and the consequent high price of cinnamon, we perceive how strong the inducement is for substituting cassia for cinnamon, and also for adulterating it with wheat flour, sago-meal, &c., in those cases in which cassia is not employed.

The import duty on cinnamon, it will be observed, is the same as that on pepper, notwithstanding which fact, and the frequency with which cinnamon is adulterated, we do not remember that we have ever heard of a prosecution for this common infraction of the excise laws.

The duties in force *at the present time* on cinnamon and cassia are as follow.

The *export* duty on cinnamon in Ceylon was reduced to 1*s.* per lb., in 1843; to 4*d.* per lb. in 1848, and is since abolished altogether. The *import* customs' duty is 2*d.* per lb. Wholesale price, 11*d.* to 1*s.* 10*d.* per lb. Were entered for home consumption in 1852, 36,325 lbs.; in 1853, 37,694 lbs. As the consumption of spices is always greater by far in the second half of the year, it is deceptive to give the first six months of the year. We have therefore omitted them.

Cassia buds and cassia fistula are free of duty. On cassia lignea (or bark) the duty is 1*d.* per lb. Wholesale price about 1*s.* per lb. ex. duty. There were entered for home consumption in 1852, 109,029 lbs.; in 1853, 136,363 lbs.

We have now to treat of the adulteration of Nutmegs, Mace, Cloves, Pimento or Allspice, and Mixed Spice, and to ascertain to what extent the quality and value of these articles are affected by admixture with inferior and foreign ingredients.

We shall treat first of Nutmegs.

NUTMEGS, AND THEIR ADULTERATIONS.

There are three species of *Myristica*, which furnish nutmegs. That which yields the best description, *Myristica fragrans*, forms a tree from twenty to twenty-five feet high, somewhat similar in appearance to a pear-tree.

The fruit is smooth externally, pear-shaped, and about the size of an ordinary peach. It consists, first, of an outer fleshy covering, called the *pericarp*, which when mature separates into nearly equal longitudinal parts, or valves; secondly, of the *aril*, or *mace*, which, when recent, is of a bright scarlet colour; and thirdly, of the seed proper, or *nutmeg*. This is enclosed in a shell, which is made up of two coats: the outer is hard and smooth; the inner, thin, closely invests the seed, sending off prolongations, which enter the substance of the seed, and which, being coloured, impart the marbled or mottled appearance characteristic of nutmeg.

Nutmegs are cultivated in the Molucca Islands, and especially in those called the Banda, or Nutmeg Islands. It is also grown in Java, Sumatra, Penang, Singapore, Bengal, Bourbon Island, Madagascar, and certain of the West India Islands.

There are two kinds of nutmegs met with in commerce. The first, called the *true*, *round*, *cultivated*, or *female* nutmeg, is the product of *Myristica fragrans*. These nutmegs are characterised by their full and rounded form and delicate and aromatic flavour; they are occasionally imported in the shell. There is also a small variety, not larger than a pea, which has been described under the name of the *royal nutmeg*.

Three varieties of true nutmeg are distinguished by dealers, which are thus described in Pereira's "Materia Medica:"—

"1. *Penang nutmegs.*—These are unlimed, or brown nutmegs, and fetch the highest price. They are sometimes limed here for exportation, as on the Continent the limed sort is preferred. According to Newbold, the average amount annually raised at Penang is 400 piculs (of 133½ lbs. each).

"2. *Dutch or Batavian nutmegs.*—These are limed nutmegs. In London they scarcely fetch so high a price as the Penang sort.

3. "*Singapore nutmegs.*—These are a rougher, unlimed, narrow sort, of somewhat less value than the Dutch kind. According to Mr. Oxley, 4,085,361 nutmegs were produced at Singapore in 1848, or about 252 piculs (of 133½ lbs. each); but the greater number of the trees had not come into full bearing, and it was estimated that the amount would, in 1849, be 500 piculs."

The second kind of nutmeg is called the false, *long*, *wild*, or *male* nutmeg, and is the produce chiefly of *Myristica fatua;* but a kind of nutmeg which is also called wild, is obtained from *Myristica Malabarica.*

The seeds of *Myristica fatua* are about half as long again as the true or round nutmeg; they are paler, and less aromatic.

The wild nutmeg obtained from the *Myristica Malabarica* has scarcely any flavour or odour, and, according to Rheede, is of the size and figure of a date. "The Turkish and Jewish merchants," writes Rheede, "mix these nutmegs with the true long ones, and the mace with good mace, selling them together. They also extract from these inferior articles an oil, with which they adulterate that of a more genuine quality."*

In the Banda Islands, three crops or harvests of nutmegs are obtained in the year; the principal gathering is in July or August; the second in November; and the third in March or April.

* Hist. Malab.

The fruit is gathered by means of a barb attached to a long stick; the mace is separated from the nut, and separately cured.

On account of their liability to the attacks of an insect known as the *nutmeg-insect*, considerable care is required in drying them. They should be dried in their shells, as they are then secure from the insect. They are placed on hurdles, and smoke-dried over a slow wood fire for about two months. In the Banda Islands, they are first dried in the sun for a few days. When the operation of drying is complete, the nuts rattle in their shells; these are cracked with mallets, and the damaged, shrivelled, or worm-eaten nuts removed.

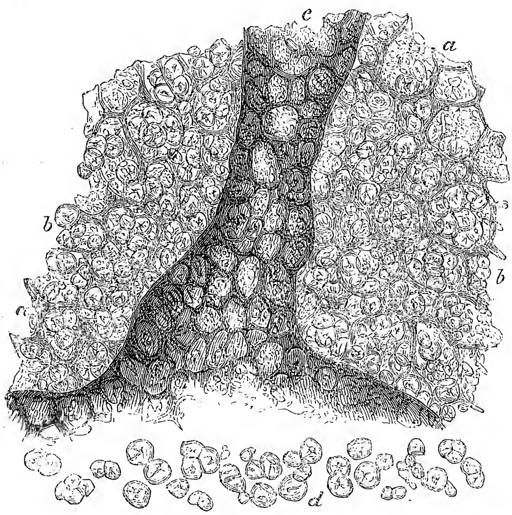
"To prevent the attacks of the insect, the nuts are frequently limed. For the English market, however, the brown or unlimed nutmegs are preferred. The Dutch lime them by dipping them into a thick mixture of lime and water; but this process is considered to injure their flavour. Others lime them by rubbing them with recently-prepared, well-sifted lime. This process is sometimes practised in London." *

Nutmegs, under the microscope, present peculiarities of structure, by which they may be distinguished, even in powder, from most other vegetable productions. A thin section, viewed under an object-glass magnifying 220 diameters, is seen to consist of minute angular cells. Those forming the white or *uncoloured* part of the nut, present, previous to the action of water upon them, an opalescent appearance, from the quantity of oil enclosed in them; their cavities contain in addition much starch, in the form of small but distinct granules, mostly of a rounded shape; but occasionally a few of the granules are angular; and all have well-marked central depressions.

Fig. 125.

SECTION OF NUTMEG.

(Magnified 220 diameters.)



a a. Cells forming the white or uncoloured portions of the nutmeg; they are seen to contain numerous starch-granules. *b b*. The starch-granules. *c*. A portion of one of the veins formed by the inversion of the inner coat of the seed-vessel or *endopleura*; it consists of coloured cells, containing oil only. *d*. Loose starch-granules magnified 420 diameters.

The cells forming the *coloured*, vein-like portion of the nut, differ from the other cells in colour and in being destitute of starch, containing apparently only a small quantity of oil.

Since nutmegs are never sold in the powdered state they are not liable to adulteration by admixture with foreign ingredients, like several of the spices which have been already noticed, as ginger, cinnamon, and cassia; nevertheless, they are subjected to a process which impairs their value and quality as much as though they had been actually adulterated in the same manner.

Nutmegs contain both a fixed and a volatile oil. The *fixed oil* is prepared by beating the nutmegs to a paste; this is subjected, enclosed in a bag, to the vapour of water, and the oil afterwards expressed by means of heated plates. It is imported in cakes which have somewhat the size and form of common bricks, and are covered with leaves. The fixed oil procured in this manner

* Pereira's Materia Medica, 2nd edit., vol. i. part ii. p. 1334.

contains a portion of the volatile oil, and from which its colour and fragrant odour are derived.

The *volatile oil*, on the presence of which the flavour and aroma of nutmegs principally depend, is procured by distillation in water; the produce thus obtained at Apothecaries' Hall, London, is usually 4·5 per cent. Now, nutmegs are frequently deprived of a portion of their essential oil by distillation, and, after being well limed, are again sent into the market in this comparatively valueless state.

When nutmegs feel light, are dry and brittle, and if on the surface small punctures appear, it is certain that a great portion of their essential oil has been abstracted.

It is singular that the starch granules of nutmeg are but little affected by boiling; so that this means of discrimination, so satisfactory in the case of cinnamon, cassia, and some other spices, is of little or no value in the present instance.

Of this remarkable circumstance it is not easy to afford an explanation; it probably depends upon the difficulty with which the boiling water makes its way into the substance of the nut, in consequence of its hard texture and the large quantity of fixed oil contained in it.

The work of M. Chevallier, entitled "Dictionnaire des Altérations et Falsifications des Substances Alimentaires, Médicamenteuses, et Commerciales," in treating of nutmegs, contains the following observations, under the head of "Falsifications:"*—

"Nutmegs are sometimes mixed with riddled nuts, eaten by insects, and become brittle; the small apertures are then closed with a kind of cement, formed of flour, oil, and the powder of nutmegs. This paste has even served to fabricate false nutmegs, inodorous and insipid. The workmen of Marseilles have even made them of bran, clay, and the refuse of nutmegs: these nutmegs, placed in contact with water, soften down in that liquid.

"The worm-eaten nuts are equally insipid, and almost inodorous; sometimes they have a mouldy odour."†

"The jealous policy of the Dutch," writes Mr. M'Culloch, "has reduced the trade in nutmegs to a mere trifle compared to what it would otherwise have been. They have at least, in so far as it was possible, exerted themselves to exterminate the nutmeg plants everywhere except in Banda. They bribe the native princes of the surrounding islands to root out the trees, and annually send a fleet to see that the work of destruction has been effected, and that the bribes have not been bestowed in vain. To engage in an illicit trade in spices is *death* to an inferior person, and *banishment* to a noble; and yet, notwithstanding these tremendous penalties, it is supposed that about 60,000 lbs. of nutmegs and 15,000 lbs. of mace are clandestinely exported each year. In Banda the original inhabitants have been expatriated, and their land parcelled amongst settlers from Holland, under the name of *park-keepers*. These persons, who may be turned out of their farms on the most trifling pretext, have about 2000 slaves, who cultivate and prepare the nutmegs. The prices paid to the cultivators are all fixed by the government; and it deserves to be mentioned, as affording one of the most striking illustrations of the ruinous effects of monopoly, that the fixed price which the government is now obliged to pay for nutmegs is FIVE *times greater than the price at which they bought them when the trade was free.* Such is a rough outline of that system which has reduced what used to be one of the most important branches of Eastern commerce so low, that it is unable to afford employment for the capital of a single wealthy merchant. We cannot conceive how so enlightened and liberal a government as that of Holland should continue to tolerate such scandalous abuses,—abuses destructive alike of the rights of those subjected to its authority in the East, and the commerce and wealth of its subjects at home."—("Modern Universal History," vol. x. p. 457—467, 8vo. edition; and "Crawfurd's Eastern Archipelago," vol. iii. p. 394—413.)

"Mr. Crawfurd estimates the produce of the Banda Islands at about 600,000 lbs. of nutmegs, and 150,000 lbs. of mace.

* Tome ii. p. 76.

† "Some years since, an English captain arrived from Canton with a cargo of Nutmegs made *in white wood*, perfectly imitated."—(JOBARD of Brussels.)

"During the period that the English had possession of the spice islands, nutmeg plants were carried to Penang, Bencoolen, and some of the West India Islands. In the latter, they have altogether failed, at least as far as respects any useful purpose; but very good nutmegs, and in very considerable quantities, are now raised at Penang and Bencoolen. Mr. Crawfurd, however, alleges that the cost of bringing them to market is there so high, that the restoration of a free culture in the native country of the nutmeg would instantly destroy this unstable and factitious branch of industry."

The Dutch even attempted to confine the growth of nutmegs to three of the Banda islands, but in this attempt, strange to say, they were in a great measure frustrated by means of a pigeon called the *nut-eater*, or *nutmeg-bird*. This pigeon, having extracted the nuts, with the mace attached, from their fleshy coverings, swallows them. The mace is digested, but the nuts pass uninjured, and being deposited here and there, and often in distant places, readily take root: the plants thus disseminated are gathered together and transferred to the plantations or nutmeg-parks.

Not content, however, with endeavouring to monopolise the whole trade, in order to keep up the price of this spice, the Dutch were in the habit, whenever the crop was superabundant, of destroying, by burning, large quantities of nutmegs.*

The following account is extracted from M'Culloch's Dictionary of Commerce:—

"An Account of the Quantities of Nutmegs entered for Home Consumption in the United Kingdom in 1840, 1841, 1842, and of the Amount of Duty received thereon:—

Quantities.	lbs.	Duties.	£	s.
1840 - - -	118,664	1840 - - -	15,041	9
1841 - - -	113,411	1841 - - -	14,851	10
1842 - - -	170,064	1842 - - -	22,018	12

In 1842, the duties were fixed at 3*s*. 6*d*. per lb. on those from a foreign, and at 2*s*. 6*d*. per lb. on those from a British possession. The duty on wild nutmegs, in the shell, was then also fixed at 3*d*., without regard to origin."

The distinction of nutmegs into genuine and false, cultivated and wild, is entirely artificial; for they are both cultivated, the differences existing between them being chiefly those of quality.

The great disparity in the duty imposed on each, it might be supposed, would have the effect of bringing into the market, in large quantities, the inferior description, to the exclusion of the superior variety. We believe, however, that but few wild nutmegs are met with in the English markets.

It is to be hoped that government will ere long see the propriety of reducing the exorbitant duty of 3*s*. 6*d*. and 2*s*. 6*d*. per lb., now charged on the best description of nutmegs. We believe that were the duty to be brought down to 1*s*. per lb., the revenue would suffer no diminution in consequence of such reduction.

The wholesale price of nutmegs varies from 1*s*. 3*d*. to 3*s*. 6*d*. per lb.; so that the duty about doubles the cost of the article as charged to the public. (See Note, page 412.)

Results of the Examination of Eighteen Samples of NUTMEGS,

Purchased at the Establishments of various Grocers and Oilmen resident in the Metropolis.

1*st Sample*.— Purchased of —— Field and Co., 9. Walworth-road.
Examination.— Unlimed, volatile oil not extracted.

2*nd Sample*.— Purchased of Dannan and Co., 2. Walworth-road.
Examination.— Unlimed, oil not extracted.

* Hooker's Botanical Magazine, vol. i., N. S. i. 1827, t. 2756-2757; also, Stephenson and Churchill's Medical Botany, vol. iii. pl. 104.

3rd Sample. — Purchased of W. P. Moore, 4. Crown-row, Walworth.
Examination. — Unlimed, oil not extracted.
4th Sample. — Purchased of T. F. Probyn, 17. Cross-street, Walworth-road.
Examination. — Unlimed, oil not extracted.
5th Sample. — Purchased of J. Jackson, 75. Blackman-street, Borough.
Examination. — Limed, oil not extracted.
6th Sample. — Purchased of Mitchell and Co., 17. Blackman-street, Borough.
Examination. — Unlimed, oil not extracted.
7th Sample. — Purchased of Newsome and Williams, 50. High-street, Borough.
Examination. — Unlimed, oil not extracted.
8th Sample. — Purchased of Russell and Co., 72. Borough.
Examination. — Unlimed, oil not extracted.
9th Sample. — Purchased of R. Jones, 16. Borough.
Examination. — Unlimed, oil not extracted.
10th Sample. — Purchased of T. Rose and Co., 213. Borough.
Examination. — Unlimed, oil not extracted.
11th Sample. — Purchased of Gluckner and King, 11. Mount-row, Liverpool-road, Islington.
Examination. — Limed, oil not extracted.
12th Sample. — Purchased of J. Barber, 14. Rufford's-buildings, Islington.
Examination. — Unlimed, oil not extracted.
13th Sample. — Purchased of Mr. Irvine, Camden-passage, Islington.
Examination. — Unlimed, oil not extracted.
14th Sample. — Purchased of William Nicholson, 86. Upper-street, Islington.
Examination. — Unlimed, oil not extracted.
15th Sample. — Purchased of W. Young and Son, 27. High-street, Islington.
Examination — Unlimed, oil not extracted.
16th Sample. — Purchased of Alexander Braden, 13. High-street, Islington.
Examination. — Unlimed, oil not extracted.
17th Sample. — Purchased of C. Young, 8. High-street, Islington.
Examination. — Unlimed, oil not extracted.
18th Sample. — Purchased of S. Austin, 3. Old Compton-street, Soho.
Examination. — Unlimed, oil not extracted.

It thus appears: —

1st. That nutmegs as they reach the consumer are not in general deprived of their essential oil; a result contrary to the opinion commonly entertained on this point.

2nd. That, as met with in the English markets, they are seldom limed.

Note. — The duty *now* is 1*s.* per lb.; on wild nutmegs in the shell, 3*d.* per lb.; not in the shell, 5*d.* per lb. Wholesale price, 1*s.* 9*d.* to 4*s.* Were entered for home consumption in 1852, 239,200 lbs.; in 1853, 208,198 lbs.

MACE.

Mace, as already noticed, forms around the shell of the nutmeg a fleshy, branching, and, when recent, bright scarlet covering; in the process of drying it changes to yellow, orange-yellow, or what is considered best, golden-yellow, and becomes transparent and horny.

It is prepared by drying in the sun for some days. The *aril* is sometimes flattened out, and dried in a single layer, but frequently it is pressed together, in which case it forms two layers. The Dutch sprinkle mace with salt water prior to packing it in sacks.

As there are two kinds of nutmeg, so are there two kinds of mace, the produce of the same plants: thus, there is true, or cultivated mace; and false, or wild mace.

"The London dealers distinguish three sorts of *true* mace: —

"1. *Penang Mace.* — This fetches the highest price. It is flaky and spread. The annual quantity produced in Penang is about 130 piculs (of 133½ lbs. each).

"2. *Dutch, or Batavian Mace.* — This is a fleshy sort. It scarcely fetches so high a price as the Penang sort.

"3. *Singapore Mace.* — This is a somewhat inferior kind." *

Wild or false mace is of a dark-red colour, and deficient in flavour and aroma.

Viewed under the microscope, mace presents a structure very distinct from that of the nutmeg itself.

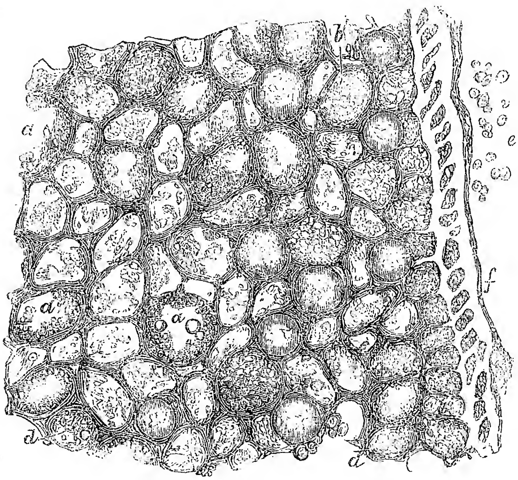
Covering the surface of the blades is a delicate membrane consisting of a single layer of cells; they are tubular, much elongated, taper at either end to a point, and resemble in size and form, although not in delicacy of texture, ordinary woody fibre. The long diameters of the cells are disposed vertically on the surface of the mace.

But the chief substance is made up of other cells differing in size and form from those already noticed; these contain fixed oil, and much starch.

Fig. 126.

Transverse Section of Mace.

(Magnified 220 diameters.)



a a. Receptacles for the essential oil; many of them appear in the section as apertures, and are represented in the figure as such. *b b.* The same, exhibiting the appearance of closed cells, from the circumstance of their not being cut into; the colouring matter of mace is located chiefly in these cells or receptacles. *c c.* Large air-bubbles usually observed in sections immersed in water. *d d.* Cells filled with starch-corpuscles. *e.* The starch-corpuscles loose, magnified 420 diameters. *f.* The cells forming the delicate coat or cuticle, investing mace.

Imbedded in the midst of these cells are larger cells, spaces, or *receptacles*, which, in thin sections, whether made crosswise or lengthwise, appear as apertures. These contain the essential oil of mace.

Scattered here and there may be seen, both in transverse and longitudinal sections, small bundles of woody fibre, of a brownish colour, enclosing one or two small spiral vessels. In transverse sections, the ordinary starch cells are perceived to be arranged round the bundles in a radiate manner.

The structure of mace is exhibited in the annexed wood-cut: —

Like the nutmeg, mace may be deprived, by distillation, of its essential oil.

In some cases, wild or false mace is sold for, or admixed with, cultivated or true mace.

Results of the Examination of Twelve Samples of MACE,

Purchased at the Establishments of various Grocers and Oilmen resident in the Metropolis.

1*st Sample.* — Purchased of Messrs. Harvey and French, 227. Oxford-street.
Examination. — Genuine.

2*nd Sample.* — Purchased of Messrs. Houle and Co., 282. Oxford-street.
Examination. — Genuine.

3*rd Sample.* — Purchased of Messrs. Strugnell and Co., 221. Oxford-street.
Examination. — Genuine.

4*th Sample.* — Purchased of R. Hall, 70. Wardour-street.
Examination. — Genuine.

* Pereira's Materia Medica, 2nd edit., vol. ii. part i. p. 1336.

5th Sample. — Purchased of C. Legg, 18. Wardour-street.
Examination. — Genuine.
6th Sample. — Purchased of C. Cream, 31. Lisle-street.
Examination. — Genuine.
7th Sample. — Purchased of Smith and Co., Grafton-street, Soho.
Examination. — Genuine.
8th Sample. — Purchased of J. Harris, King-street, Soho.
Examination. — Genuine.
9th Sample. — Purchased of C. Wilson, 44. Carnaby-street.
Examination. — Genuine.
10th Sample. — Purchased of J. Huddert, 15. Tyler-street.
Examination. — Genuine.
11th Sample. — Purchased of W. Gilbert, 20. Silver-street, Golden-square.
Examination. — Genuine.
12th Sample. — Purchased of Messrs. Phillipps and Co., 3. Foubert's-place.
Examination. — Genuine.

It thus appears that the whole of the twelve samples of mace examined were genuine. Much difference was observed in the quality of several of the samples; but, in accordance with our usual practice, we refrain from instituting comparisons respecting quality, our purpose being to detect and expose adulteration.

The duty on genuine mace was nearly the same as that on nutmegs—namely, 2*s.* 6*d.* per pound, and five per cent. It is now 1*s.* per lb. Wholesale price, 2*s.* to 2*s.* 6*d.* ex. duty. Entered for home consumption in 1852, 21,485 lbs.; in 1853, 23,558 lbs.

CLOVES, AND THEIR ADULTERATIONS.

Cloves are the unexpanded flower-buds of *Caryophyllus aromaticus*, a tree from fifteen to thirty feet in height, one of the Myrtaceæ or myrtle tribe. The word *clove* is derived from *clou*—French for nail, from a fancied resemblance to a nail in the form of the clove.

The flower-buds are arranged on terminal flower-stalks; they are either gathered by hand or obtained by beating with bundles of reeds, in which case cloths are spread beneath the trees to catch them; they are afterwards dried either by the fire, or, what is better, in the sun; they are imported in casks or bags.

The native habitat of the clove-tree is the *Molucca Islands*, to which the Dutch, following their usual policy, endeavoured unsuccessfully to limit its cultivation; it is now, however, grown in *Sumatra*, the *Mauritius*, *Cayenne*, *Bourbon*, *Martinique*, and *St. Vincent*.

Cloves of good quality should be dark-coloured, heavy, aromatic, pungent, and when strongly pressed upon with the nail, the oil should freely exude. Moreover, the rounded heads or flower-buds should not be absent.

Several varieties of clove are distinguished in commerce, according to the name of the place in which they are produced. Those from *Amboyna* and *Bencoolen*, two of the Spice Islands, are the best, the *Bencoolen* clove being most esteemed. They are large, heavy, and contain the greatest quantity of oil.

Bourbon and *Cayenne* cloves are smaller, somewhat shrivelled, and yield less oil. *Cayenne* cloves are the least valuable.

The following varieties of clove are described in the "Dictionnaire des Altérations et Falsifications des Substances Alimentaires," tome i. p. 395.: —

"*The English Clove* is most esteemed; it is plump, short, and of a brown colour, sometimes slightly greyish; the odour is powerful, and of a flavour sharp and very aromatic.

"*The Cayenne Clove* is long, somewhat large, of a brown colour, and of an odour less powerful than the preceding.

"*The Clove of Bourbon*, and of the *Island of France*, is small, short, of a less deep colour, and of a less strong odour, than the clove of Cayenne. Like this last, it is often mixed with the broken foot-stalks of clove, known under the name of *griffes de girofle*, in the form of small, broken, and greyish-brown branches, of a flavour and odour well marked, but they contain much less volatile oil than the cloves themselves.

" *The Clove of Holland* is of a deep brown colour, with an oily appearance, of a strong odour, and an acrid and aromatic flavour.

" *The Clove of Batavia* is very dry, of a grey colour, and appears to have been covered with plaster or lime (perhaps with *talc ?*).

" *The Clove of St. Lucia* is of a whitish-yellow colour, and resembles the Cayenne clove, with which it is frequently mixed."

Cloves contain, according to the Analysis of Trommsdorf,* *volatile oil*, 18 ; *almost tasteless resin*, 6 ; *tannin*, 13 ; *difficultly-soluble extractive with tannin*, 4 ; *gum*, 13 ; *woody fibre*, 28 ; and *water*, 18.

The volatile oil is obtained from cloves by repeated distillation. The yield on an average is said to be from seventeen to twenty-two per cent.

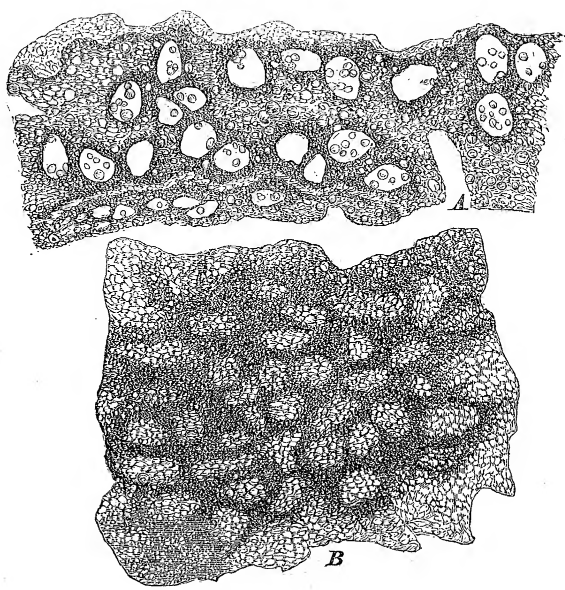
It has been ascertained that the oil which was formerly regarded as a simple oil, is really composed of two volatile oils, possessing different qualities, one of which is lighter, and the other heavier than water.

The characters and composition of these oils are thus given in Pereira's " Materia Medica," ed. 1. part ii. p. 1093. :—

" *α. Light Oil of Cloves (Clove-Hydro-Carbon)*. — Colourless sp. gr. 0·918. Incapable of combining with bases, but absorbing hydrochloric acid gas without yielding a crystalline compound. It consists of C_{10} H_8 ; hence it is isomeric with oil of turpentine.

" *β. Heavy Oil of Cloves* (Clove Acid ; Engenic Acid).—It is colourless when recently prepared, but becomes coloured by age. Its specific gravity, according to Bonastre, is 1·079. It combines with alkalies to form crystalline salts (*alkaline eugenates, clove-oil alkalies*). If a salt of iron be added to one of these, it yields a blue, violet, or reddish compound (*a ferruginous eugenate*), varying somewhat according to the nature of the ferruginous salt used ; thus the protosulphate of iron yields a lilac, the persulphate a red, which becomes violet

Fig. 127.
PETAL OF CLOVE-BUD.
(Magnified 60 diameters.)



A. Transverse section of the petal of flower-bud of clove, showing the receptacles in which the essential oil is contained. *B*. Surface of petal ; the receptacles for the oil in this view are indistinct.

* Gmelin, Handb. d. Chem., ii. 1272.

and afterwards blue; while the sesquichloride gives a vinous, which turns to red (Bonastre). Nitric acid reddens clove acid."

The unexpanded flower-buds are not the only parts of the tree which are aromatic, as the footstalks and fruit or seed vessels are likewise so to some extent.

The peduncles, or *footstalks*, according to Guibourt, are sometimes substituted for cloves by distillers of the oil.

The fruit, *mother-cloves* as they have been called, are occasionally met with in commerce; they have the shape of the olive, but are smaller, and possess the odour and taste of the clove in a mild degree.

The minute structure of cloves is extremely characteristic. The rounded head or *bud* consists of the unexpanded petals; if a transverse section of one of these be made, it will be seen to be composed of cellular tissue, in the midst of which are numerous receptacles for the essential oil; these extend through the whole thickness of the leaf, being usually three or four deep.

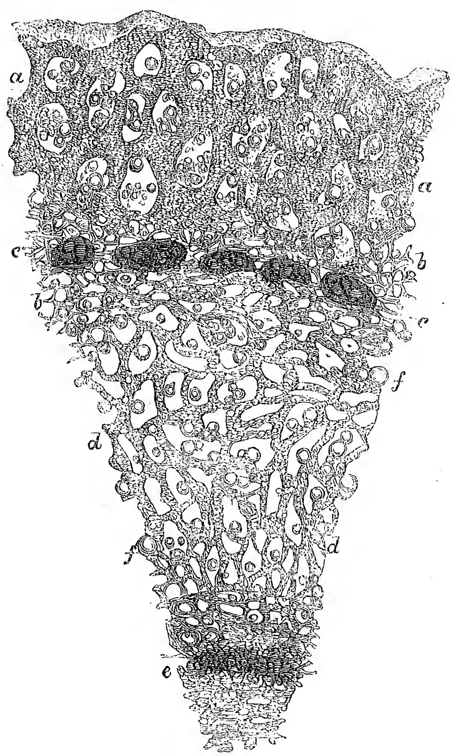
When the petal is viewed on the surface, the receptacles are seen but indistinctly, being obscured by the cellular tissue of which the surface of the petal is formed. *Fig.* 127.

In a transverse section of the *flower-stalk*, viewed with an object-glass of one-inch focus, the following appearances present themselves:—

Fig. 128.

TRANSVERSE SECTION OF FLOWER-STALK OF THE CLOVE.

(Magnified 60 diameters.)



a. Receptacles for the essential oil; the section being a thin one, they present the appearance of apertures, in consequence of being opened into. *b b*. Cellular tissue surrounding the woody-fibre. *c c*. Bundles of woody-fibre. *d*. The tubular structure and interspaces, of which the internal portion of the stalk is formed. *e*. The centre of the stalk; it appears dark under the microscope, the structure being obscure. *f f*. Droplets of oil.

In the outer third of the section, numerous large holes are observed; these are the divided receptacles; next to these, passing inwards, are bundles of woody fibre, forming a narrow circle in the interior of the stalk; extending from these to near the centre of the stalk is a tissue formed of numerous tubular cells, with large spaces between them. The receptacles, as well as the tubular cells and interspaces, contain essential oil, visible in sections immersed in water, in the form of innumerable droplets. *Fig.* 128.

Longitudinal sections exhibit a nearly similar structural arrangement. *Fig.* 129.

Cloves contain scarcely any starch.

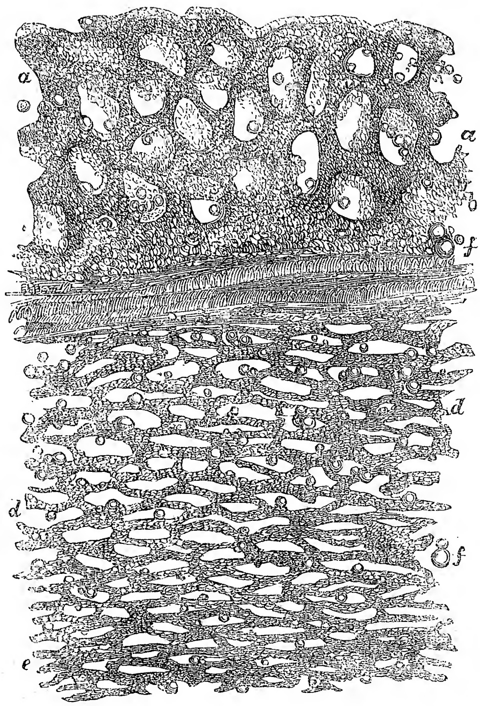
The quality and value of cloves are not unfrequently impaired, like some other spices, by the abstraction of the essential oil. Cloves which have been thus deprived of their active properties, are distinguished by being light, shrivelled, not yielding oil when pressed upon, possessing but little aroma or taste, and by the frequent absence of the flower-bud.

This fraud used to be extensively practised in Holland, the *drawn* cloves, for more effectual concealment, being mixed with others of good quality; and even, in some instances, the trouble being taken to restore as nearly as possible to the exhausted cloves their original appearance, by rubbing them over with some common oil.

Fig. 129.

LONGITUDINAL SECTION OF FLOWER-STALK OF THE CLOVE.

(Magnified 60 diameters.)



a a. Receptacles for the essential oil, appearing as apertures from having been cut into in making the section. *b.* Cellular tissue. *c.* Woody-fibre. *d.* The tubular structure and interspaces which form the internal portion of the stalk. *e.* The dark central part of the flower-stalk. *f f.* Droplets of oil.

The volatile oil itself, as imported into this country from India, has been found to be adulterated.

Mr. M'Culloch, on the authority of Milburn, states that the oil imported from India contains nearly half its weight of an insipid expressed oil, which is discovered by dropping a little into spirits of wine, and on shaking it the genuine oil mixes with the spirit, and, the insipid separating, the fraud is detected.

Cloves readily imbibe moisture, whereby their weight becomes greatly increased, a fact of which dishonest dealers have not failed to avail themselves.

Cloves are but seldom sold in powder, and hence the liability to adulteration is greatly lessened: they are, however, occasionally met with in that state.

Clove-stalks, although very inferior, contain some of the active properties of cloves, and, as already noticed, are occasionally used by distillers for procuring the essential oil of cloves. We have reason to believe that in some cases the stalks are ground up, and mixed with the powder of genuine cloves: this sophistication can be readily detected in a most satisfactory manner.

The clove-stalks present a structure somewhat similar to that of cloves themselves; that is, they consist of cellular tissue, hollowed out here and there into receptacles for the essential oil; but, in addition, the stalks are provided with an epidermis, or coating of the stellate cells, which are of such frequent occurrence in different kinds of bark.

When these cells, therefore, are found to occur in considerable abundance in any sample of powdered cloves, the other tissues met with being those of clove, there is no doubt but that a proportion of ground stalks has been introduced.

RESULTS OF THE MICROSCOPIC EXAMINATION OF TWENTY-NINE SAMPLES OF CLOVES,

PURCHASED AT THE ESTABLISHMENTS OF VARIOUS GROCERS AND OILMEN RESIDENT IN THE METROPOLIS.

WHOLE CLOVES.

1*st Sample.* —Purchased of J. Button, 76. Wardour-street.
Examination.— Essential oil not extracted.

2nd Sample. — Purchased of G. James, 72. Wardour-street.
Examination. — Oil not extracted.
3rd Sample. — Purchased of W. Sykes, 34. Old Compton-street.
Examination. — Oil not extracted.
4th Sample. — Purchased of S. Austin, 3 Old Compton-street.
Examination. — Oil not extracted.
5th Sample. — Purchased of Smith & Co., 1. Coventry-street.
Examination. — Oil not extracted.
6th Sample. — Purchased of J. Waltham, 6. Edward-street, Soho.
Examination. — Oil not extracted.
7th Sample. — Purchased of W. Oulds, 28. Peter-street, Soho.
Examination. — Oil not extracted.
8th Sample. — Purchased of Palmer & Co., 29. Grafton-street, Soho.
Examination. — Oil not extracted.
9th Sample. — Purchased of Alexander Braden, 13. High-street, Islington.
Examination. — Oil not extracted.
10th Sample. — Purchased of J. Hanks, 27. Little Newport-street.
Examination. — Oil not extracted.
11th Sample. — Purchased of G. Mills, 35. Little Earl-street.
Examination. — Oil not extracted.
12th Sample. — of J. Taylor, 10. Jermyn-street.
Examination. — Oil not extracted.
13th Sample. — Purchased of J. W. Stalman, 4. Jermyn-street.
Examination. — Oil not extracted.
14th Sample. — Purchased of Jones & Co., 166. Oxford-street.
Examination. — Oil not extracted.
15th Sample. — Purchased of Russell & Co., 22. King-street, Covent-garden.
Examination. — Oil not extracted.
16th Sample. — Purchased of E. Folkard, 40. Drury-lane.
Examination. — Oil not extracted.
17th Sample. — Purchased of James Appleton, 174. Drury-lane.
Examination. — Oil not extracted.
18th Sample. — Purchased of J. Way & Co., 272. Oxford-street.
Examination. — Oil not extracted.

Cloves in Powder.

19th Sample. — Purchased of Field & Co., 9. Walworth-road.
Examination. — Genuine.
20th Sample. — Purchased of R. Jones, 16. Borough.
Examination. — Genuine.
21st Sample. — Purchased of Harrington & Lucas, 11. High-street, Borough.
Examination. — Genuine.
22nd Sample. — Purchased of Beckett & Young, 3. High-street, Islington.
Examination. — Genuine.
23rd Sample. — Purchased of Roberts & Arnold, 1. Rosomon-buildings, Islington.
Examination. — Powder presenting the appearance of mixed snuff, being of a dark, dull-brown colour, possessing but little aromatic smell, but pungent to the taste. Examined with the microscope, numerous *stellate cells* are discoverable in it, showing that some of the stalks or "*griffes*" of clove have been ground up with it. It is evident, on a careful examination, that the article consists of a mixture of two powders of different colours, the one having the reddish hue characteristic of genuine powdered cloves, the other being of a dark-brown colour.

24th Sample. — Purchased of C. Young, 8. High-street, Islington.
Examination. — Genuine. Examined under the microscope, numerous cells of pepper were detected in this sample; the presence of these is probably to be explained by the circumstance of the cloves having been ground in a pepper-mill.

25th Sample. — Purchased of Messrs. Smith & Co., 2. Grafton-street.
Examination. — Genuine.

26th Sample.—Purchased of C. Collins, 66. Dean-street.
Examination.—Genuine.
27th Sample.—Purchased of J. Stalman, 4. Jermyn-street.
Examination.—Genuine.
28th Sample.—Purchased of Waller & Co., 5. Berwick-street, Oxford-street.
Examination.—Genuine.
29th Sample.—Purchased of W. Cox, 3. Rose-street, Long-acre.
Examination.—Genuine, but containing some rice and numerous pepper cells, both derived probably from the mill in which the spice was ground.

From the foregoing analyses it thus appears:—

1st. That whole cloves, as ordinarily met with, are not deprived of any portion of their essential oil. There is little doubt, however, that this fraud is practised in some cases; but it is satisfactory to find that it does not prevail to any considerable extent. As in the case of some of the other spices, many of the samples examined presented a great variation in condition and quality.

2nd. That the whole of the powdered cloves were free from adulteration. One of the samples contained, however, a proportion of ground clove-stalks.

The following remarks on the policy pursued by the Dutch with regard to this spice are extracted from the "Dictionary of Commerce:"—

"From the expulsion of the English from Amboyna, in 1623, the Dutch have—a few short intervals only excepted—enjoyed the exclusive possession of the Molucca or Clove Islands. In their conduct as to the clove trade, they have exhibited a degree of short-sighted rapacity which has been, we believe, seldom equalled, even in the annals of monopoly. Their object has not been to encourage the growth and trade of cloves, but to confine both within the narrowest limits. They have preferred deriving a large profit from a stunted and petty trade, to a moderate profit from a trade that might have afforded employment for a very large amount of capital; and to prevent their narrow and selfish projects from being counteracted by the operations of the natives, they have subjected them to the most revolting tyranny. 'That they might,' says Mr. Crawfurd, 'regulate and control production and price just as they thought proper, the clove trees were extirpated everywhere but in Amboyna, the seat of their power, and the surrounding princes were bribed, by annual stipends, to league with them for the destruction of their subjects' property and birthright. This plan was begun about the year 1551. The contracts are still in force, and an annual fleet visits the surrounding islands to suppress the growth of cloves, which, in their native country, spring up with a luxuriance which these measures of Satanic rigour, and of sacrilege towards bountiful nature, can scarce repress. By the plan on which the clove trade is now conducted,—a plan carried into effect through so much iniquity and bloodshed,—the country of spices is rendered a petty farm, of which the natural owners are reduced to the worst condition of predial slavery; and the great monopoliser and oppressor is that government whose duty it should have been to insure freedom and afford protection. Human ingenuity could hardly devise a plan more destructive of industry, more hostile to the growth of public wealth or injurious to morals, than this system, framed in a barbarous age; and it reflects disgrace upon the character of a civilised people to persevere in it.

"It is curious to remark how the monopolisers, in carrying the details of this system into effect, at once impose upon the natives, and deceive themselves. The *nominal price* paid to the natives is actually above the natural price of the commodity, but they are cheated in the details. The cultivator brings his produce to the public stores, where it is subjected at once to a deduction of one-fifth for payment of the salaries of the civil and military officers. The price of the remainder is fixed at the rate of 9·6 Spanish dollars the picul; but before payment is made, another deduction of one-fifth is made; one-half of which is for the chiefs or *Rajahs*, and the other for the native *elders*, who are overseers of the forced culture. The real price, therefore, paid to the grower is 8 Spanish dollars per picul, or $3\frac{1}{4}d.$ per lb. avoirdupoise, instead of $11\frac{52}{100}$ Spanish dollars per picul, or $4\frac{2}{3}d.$ per lb., which is pretended to be given.

"When cloves have been sold on the spot, the price usually exacted has been about 64 Spanish dollars the picul, or eight times the price paid to the cultivator. The average price in Holland, previous to the war of the French Revolution, may be taken at 6*s.* per lb., or $177\frac{78}{100}$ Spanish dollars per picul; being 2122 per cent. advance on the real cost of the commodity in the place of its growth. When brought direct to England, they have cost, at an average, 3*s.* 8*d.* per lb., making $108\frac{64}{100}$ Spanish dollars per picul, an advance on the natural export price of 1258 per cent." ("Eastern Archipelago," vol. ii. pp. 388—390).

"*The duty on cloves* was considerably reduced in 1819, and there has been, in consequence, a considerable increase in the consumption of the article, though not nearly so great as it would have been, had it been supplied under a more liberal system. At an average of the three years ending with 1842, the entries of cloves for home consumption amounted to 85,015 lbs. a year, producing annually 2219*l.* 4*s.* 1*d.* of revenue. The cultivation of cloves is carried on to some extent in Cayenne, but its culture there depends entirely on the existence of the present system in the Moluccas. The superiority which the latter enjoy over every other place in the production of cloves is so very great, that were anything like freedom given to those engaged in their culture, they would very speedily exclude every other from the market. It is not to be imagined that so liberal and intelligent a government as that of Holland can much longer continue insensible to the disgrace of supporting a system like the present, and to the many advantages which would result from its abolition."

In 1842 the duty on cloves was further reduced from three shillings per pound to sixpence, and five per cent. It is now 2*d.* per lb., being again reduced in 1853. Entered for home consumption in 1852, 175,287 lbs.; in 1853, 228,837 lbs. The prices of cloves in the market in bond, in 1851, were as follows:— Amboyna cloves, 7*d.* to 8*d.* per lb.; Penang, $10\frac{1}{2}d.$ to 1*s.* 1*d.*; Zanzibar, $5\frac{3}{4}d.$ to $6\frac{3}{4}d.$

PIMENTO OR ALLSPICE, AND ITS ADULTERATIONS.

Pimento, Jamaica Pepper, or Allspice, is the berry or fruit of the *Eugenia Pimento*, one of the *Myrtaceæ*. It grows in the West Indies, and principally in Jamaica, especially on the hills on the north side of that island. It forms a beautiful tree, which attains some thirty feet in height, and is planted in regular walks, which are named *Pimento walks*.

"The returns," says Mr. Bryan Edwards, "from a pimento walk in a favourable season are prodigious. A single tree has been known to yield 150 lbs. of the raw fruit, or 100 lbs. of the dried spice, there being commonly a loss in weight of one-third in curing; but this, like many other of the minor productions, is exceedingly uncertain, and perhaps a very plenteous crop occurs but once in five years." *

The name of allspice is derived from its flavour, which is considered to be a combination of that of several of the other spices; it differs, however, from them all in its great astringency.

The fruit is gathered after it has attained its full size, but while still green; it is usually sun-dried, but sometimes kiln-dried on sheets: in drying, the colour of the fruit changes from green to reddish-brown; when ripe, the berry becomes black or dark purple in colour, and is glutinous, and consequently in that state unfit for preservation.

Pimento is imported principally from Jamaica, in bags or hogsheads.

There is a second kind of pimento not ordinarily met with in commerce, which is also a native of the West Indies; it is distinguished from the common pimento by the form of the berries, which are ovate: the properties of the two kinds are nearly identical.

* Vol. ii. p. 372, edit. 1819. See M'Culloch's Dictionary.

Bonastre*, in 1825, published the following analysis of the composition of pimento berries: —

	Husks.	Kernels.
Volatile oil	10·0	5·0
Green oil	8·4	2·5
Solid fat oil	0·9	1·2
Astringent extact	11·4	39 8
Gummy extract	3·0	7·2
Colouring matter	4·0	
Resinous matter	1·2	
Uncrystallisable sugar	3·0	8 0
Mallic or gallic acid	0·6	1·6
Lignin	50·0	
Saline ashes	2·8	1·9
Water	3·5	3·0
Loss	1·6	1·8
Red matter insoluble in water	- -	8·8
Pellicular residue	- -	16·0
Brown flocculi	- -	3·2
Total	100·0	100·0

Complicated and complete as the above analysis would appear to be, it yet does embrace the starch which is contained in the seeds in large quantity. Braconnet, however, detected the presence of starch, and estimates it as forming nine per cent. of the seeds.†

As in the case of cloves, the essential oil of pimento is a mixture of two oils — a light and a heavy oil. The properties of these are thus described in Pereira's "Materia Medica:"‡

"By distillation with water, allspice, like cloves, yields two volatile oils — the one lighter, the other heavier than water. The oil of pimento of the shops is a mixture of these; except in odour, its properties are almost identical with those of oil of cloves. By distillation with caustic potash, the *light oil* is separated; the residue, mixed with sulphuric acid, and submitted to distillation, gives out the heavy oil."

"*α. Light Oil of Pimento* (*Pimento-Hydro-Carbon*) has not, to my knowledge, been previously examined. Its properties appear to be similar to those of the light oil of cloves. It floats on water and on liquor potassæ, and is slightly reddened by nitric acid. Potassium sinks in, and is scarcely, if at all, acted on by it.

"*β. Heavy Oil of Pimento* (*Pimentic Acid*). — Very similar to clove-acid. It forms with the alkalies crystalline compounds (*alkaline pimentates*), which become blue or greenish on the addition of the tincture of the chloride of iron (owing to the formation of a *ferruginous pimentate*). Nitric acid acts violently on and reddens it."

Mr. Whipple estimates the yield of pimento oil to be about 4·37 per cent. of the weight of the seeds.

As in the case of other seeds, the pimento berry is divisible into husk and seed, or seeds proper.

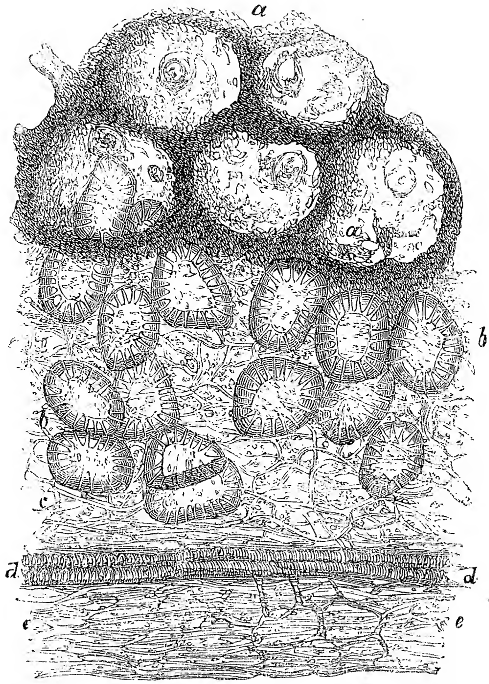
The husk is thick, and, when dried, soft and brittle; it sends off from its inner surface a prolongation which forms a septum, and divides the interior into two parts or cells.

Vertical sections of the husk, viewed under the microscope, present the following structures.

On the outer part of the section are seen several large cells or *receptacles* for the essential oil, sometimes two or three deep; more internally, numerous stellate cells, attached to and imbedded in cellular tissue, occur; next to these are bundles of woody fibre, and delicate spiral vessels; while the deepest or innermost part of the section consists of cellular tissue only.

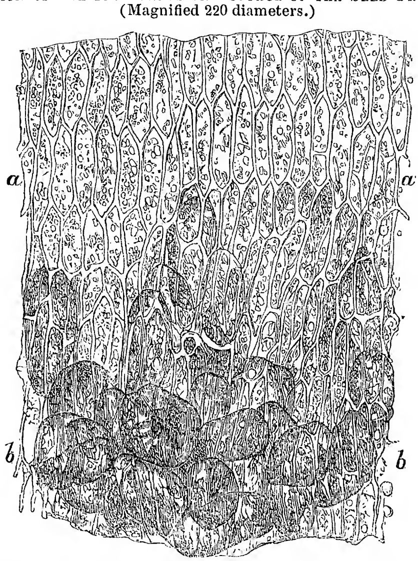
* Journ. de Chin. Méd. i. 210.
† Duncan, Edinb. Dispens.
‡ Part ii. p. 1096, edit. 1.

Fig. 130.
VERTICAL SECTION OF HUSK OF PIMENTO BERRY.
(Magnified 220 diameters.)



a. Cells or receptacles for the essential oil. *b.* Stellate cells. *c.* Cellular tissue surrounding the stellate cells. *d.* Bundles of woody fibre and spiral vessels. *e.* Cellular tissue forming the innermost part of the section.

Fig. 131.
PORTION OF THE MEMBRANES ON SURFACE OF THE SEED PROPER.
(Magnified 220 diameters.)

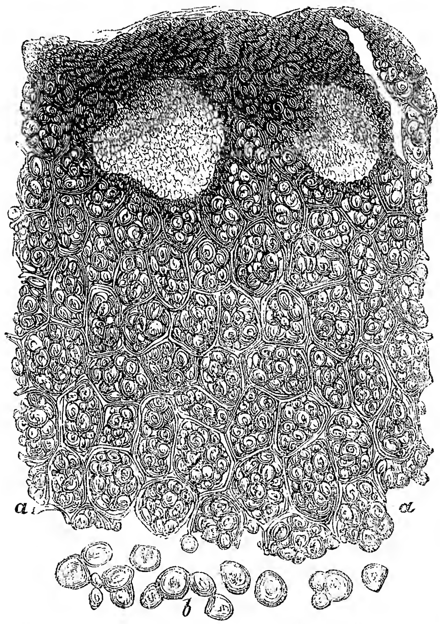


a. External membrane, consisting of a single layer of elongated and angular cells.
b. Internal membrane, made up of several layers of large port-wine-coloured cells.

Fig. 132.

VERTICAL SECTION OF THE SEED PROPER, OF PIMENTO BERRY.

(Magnified 220 diameters.)



In the upper part of the figure, two of the *receptacles* for the oil are exhibited; and in the lower part, *a a*, the cells containing the small rounded starch-corpuscles; *b*, loose starch-corpuscles, magnified 420 diameters.

Occupying each of the cells formed by the husk, is a small flattish seed of a dark brown or chocolate colour. After maceration, two membranes may be separated, although with some difficulty, from the surface of the seed. The most external of these is thin and delicate, and consists of a single layer of elongated and angular cells. The internal tunic is composed of several layers of large corrugated and coloured cells; it is to these that the dark colour of the surface of the seed is due; when viewed under the microscope, they exhibit a characteristic port-wine tint.

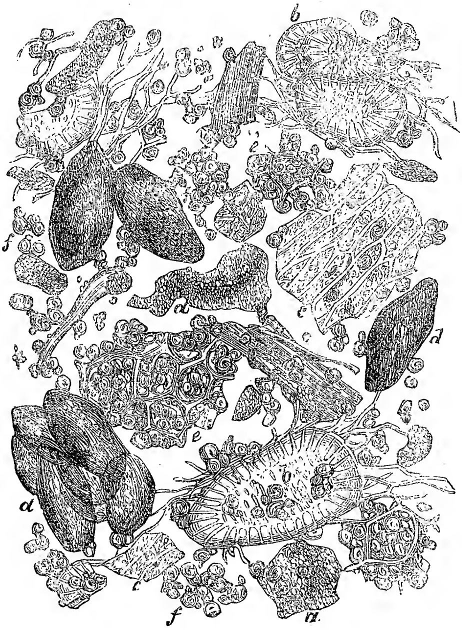
The structure of the seed proper, as displayed in vertical sectons, is as follows: —

Running round the outer part of the section is a single layer of large receptacles, the remaining thickness being made up of angular and transparent cells, the cavities of which are filled with numerous well-defined starch-granules.

When pimento berries are reduced to powder, the whole of the foregoing structures become disunited, broken up, and variously intermixed. The port-wine-coloured cells are particularly conspicuous, and afford a character by which the nature of the powder may be at once determined.

The several structures above mentioned, as they appear in genuine ground pimento-powder or allspice, are represented in *fig.* 133. on the next page.

Fig. 133.
GROUND PIMENTO, OR ALLSPICE.
(Magnified 220 diameters.)



a. Fragments of husk. *b*. Stellate cells. *c*. External coat or membrane of seed proper. *d*. Port-wine-coloured cells, which form the second membrane of seed. *e*. Cells of the seed, which contain the starch-granules. *f*. Loose starch-corpuscles.

RESULTS OF THE MICROSCOPIC EXAMINATION OF TWENTY-ONE SAMPLES OF ALLSPICE,

OBTAINED AN THE ESTABLISHMENTS OF VARIOUS GROCERS AND OILMEN IN THE METROPOLIS.

1*st Sample.*—Purchased of Dannan and Co., 2. Walworth-road.
Examination.—Genuine.

2*nd Sample.*—Purchased of Field and Co., 9. Walworth-road.
Examination.—Genuine.

3*rd Sample.*—Purchased of W. P. Moore, 4. Crown-row, Walworth-road.
Examination.—Genuine.

4*th Sample.*—Purchased of T. F. Probyn, 17. Cross-street, Walworth.
Examination.—Genuine.

5*th Sample.*—Purchased of C. Roads, 11. Black-Prince-row, Walworth.
Examination.—Genuine.

6*th Sample.*—Purchased of Mitchell and Co., 17. Blackman-street, Borough.
Examination.—Genuine.

7*th Sample.*—Purchased of J. Pringle, 35. Blackman-street, Borough.
Examination.—Genuine.

8*th Sample.*—Purchased of W. Bourne, 109. Blackman-street, Borough.
Examination. — Genuine.

9*th Sample.*—Purchased of Newsome and Williams, 50. High-street, Borough.
Examination. — Genuine.

10*th Sample.*—Purchased of White and Co., 107. Borough.
Examination. —Genuine.

11*th Sample.* — Purchased of Harrington and Lucas, 113. High-street, Borough.
Examination.—Genuine.

12*th Sample.*—Purchased of Roberts and Arnold, 11. High-street, Islington.
Examination.—Genuine.

13*th Sample.*—W. Young and Son, 27. High-street, Islington.
Examination.—Genuine.

14*th Sample.*—Purchased of Alexander Braden, 13. High-street, Islington.
Examination.—Genuine.

15*th Sample.*—Purchased of H. Davis and Co., 23. High-street, Islington.
Examination.—Genuine.

16*th Sample.*—Purchased of W. Turner, 215. Whitecross-street.
Examination —Containing a small quantity of *ground ginger.*

17*th Sample.*—Purchased of Mr. Hopkinson, Barbican.
Examination.—Genuine.

18*th Sample.*—Purchased of W. Clarke, 216. Whitecross-street.
Adulterated.—Containing a small quantity of *mustard,* the husk resembling that of *black.*

19*th Sample.*—Purchased of C. Cullingham, 84. Snow-hill.
Examination.—Genuine.

20*th Sample.*—Purchased of N. Yarrow, 42. King-street, Snow-hill.
Examination. —Genuine.

21*st Sample.*—Purchased of H. Sparrow, 216. Oxford-street.
Examination.—Genuine.

It thus appears, that of the *Twenty-one* samples of ground Allspice submitted to examination, *one only was adulterated;* a result probably mainly attributable to the great cheapness of this spice.

The duty on *Pimento* is 5*s.* per cwt. Present wholesale price is $5\frac{3}{4}$*d.* to 6*d.* per lb. Entered for home consumption in 1852, 3785 cwt.; in 1853, 3746 cwt.

MIXED SPICE, AND ITS ADULTERATIONS.

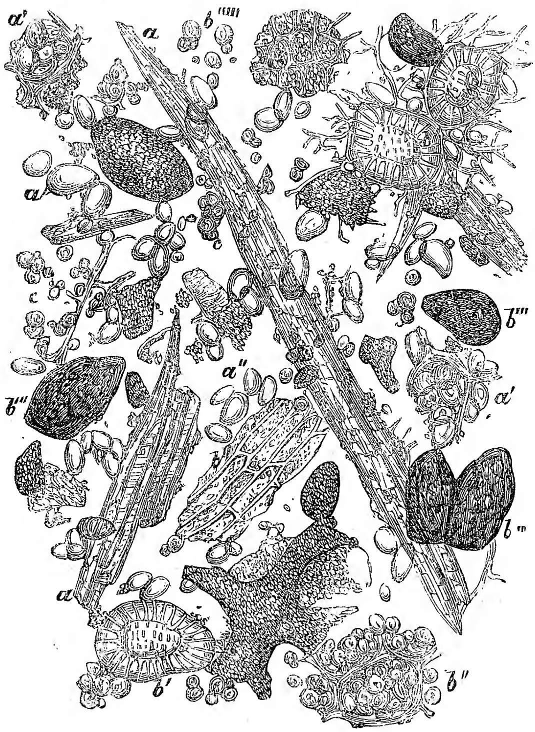
Mixed Spice, as the name implies, is a mixture in different proportions of several spices; those of which it is usually composed are ground ginger, pimento or allspice, with cassia or cinnamon, and sometimes a small quantity of powdered cloves. Such are the usual ingredients which enter into its composition. In some rare cases, however, it may contain other spices, as mace or nutmeg; but whatever the constituents, and in whatever proportions they are employed, mixed spice, when genuine, should consist entirely of a combination of spices, and should not contain a particle of farinaceous matter other than that proper to the articles composing it. Thus it should never contain *wheat-flour, potato-farina,* or *sago-meal,* and whenever any of these are present, the article is to be considered and treated as adulterated.

The following engraving represents the structure of the several ingredients of which genuine mixed spice is usually formed:—

Fig. 134.

GENUINE MIXED SPICE.

(Magnified 220 diameters.)



a. Woody fibre of ginger. *a'*. Cells of ginger which contain the starch. *a''*. Starch granules of ginger. *b*. Outer husk of pimento or allspice. *b'*. Stellate cells of same. *b''*. Husk of the seed proper of ditto. *b'''*. Port-wine coloured cells of ditto. *b''''*. Starch cells; and *b'''''*. Starch granules of same. *c*. Starch granules and fragments of powdered cinnamon.

RESULTS OF THE MICROSCOPIC EXAMINATION OF TWENTY-SIX SAMPLES OF MIXED SPICE,

PURCHASED AT THE ESTABLISHMENTS OF VARIOUS GROCERS AND OILMEN IN THE METROPOLIS.

1*st Sample.*—Purchased of Dannan and Co., Grocers, 2. Walworth-road.
Adulterated.—Containing a large quantity of *sago-meal.*

2*nd Sample.*—Purchased of Field and Co., 9. Walworth-road.
Adulterated.—Containing a considerable quantity of *ground rice.*

3*rd Sample.*—Purchased of Mitchell and Co., Grocers, 17. Blackman-street, Borough.
Genuine.

4*th Sample.*—Purchased of J. Pringle, Grocer, 35. Blackman-street, Borough.
Adulterated with a proportion of *wheat-flour.*

5*th Sample.*—Purchased of S. Jackson, 75. Blackman-street, Borough.
Adulterated.—Containing a *vegetable substance* of a yellowish colour, formed of numerous minute angular cells enclosing oil, but not starch; also a *second vegetable substance* made up of narrow fibres, disposed in two layers, and crossing each other in a waved manner. These substances

resemble very closely the structures of which *linseed* is composed, and doubtless belong to some analogous oily seed.

6*th Sample.*—Purchased of W. P. Moore, 4. Crown-row, Walworth-road.
Adulterated.—Containing a small quantity of *rice*, and a very large quantity of the first of the two vegetable substances noticed and described under 5th Sample. In this case the substance was remarkable for its decided yellow colour.

7*th Sample.*—Purchased of W. Bourne, 109. Blackman-street, Borough.
Genuine.

8*th Sample.*—Purchased of R. Jones, Grocer, 16. Borough.
Adulterated.—Containing the same vegetable substances as were detected in 5th Sample.

9*th Sample.*—Purchased of White and Fairchild, Grocers, 63. High-street, Borough.
Genuine.

10*th Sample.*—Purchased of Russell and Co., Grocers, 72. Borough.
Adulterated.—Containing a considerable quantity of *sago-meal.*

11*th Sample.*—Purchased of White and Co., Grocers, 107. Borough.
Genuine.

12*th Sample.*—Purchased of J. Rose and Co., Grocers, 213. Borough.
Genuine.

13*th Sample.*—Purchased of Brocksopp, Sons, and Co., Grocers, 234. High-street, Borough.
Genuine.

14*th Sample.*—Purchased of G. Pike, Oilman, 77. High-street, Borough.
Adulterated—containing a large quantity of *coarsely-powdered sago*, many particles of which are visible even to the naked eye.

15*th Sample.*—Purchased of W. T. Brown, 12. High-street, Islington.
Adulterated—contains a large quantity of *wheat-flour.*

16*th Sample.*—Purchased of Roberts and Arnold, Grocers, 1. Rosomon-buildings, Islington-green.
Adulterated—containing much *wheat-flour.*

17*th Sample.*—Purchased of G. Budd, Grocer, 86. Goswell-road.
Genuine.—This sample does not contain *ginger.*

18*th Sample.*—Purchased of Burrows and Co., 42. Skinner-street, New-road.
Adulterated—containing a proportion of *potato-flour;* the form of many of the granules is altered, as though the farina had been subjected to heat, in order to darken its colour.

19*th Sample.*—Purchased of J. Roberts and Co., 31. Barbican.
Adulterated—containing a large quantity of *sago-meal.*

20*th Sample.*—Purchased of Stevenson and Co., 159. Whitecross-street.
Genuine.

21*st Sample.*—Purchased of W. Turner, 215. Whitecross-street.
Adulterated—containing a large quantity of the vegetable substances noticed in 5th Sample.

22*nd Sample.*—Purchased of T. Taylor, 89. Whitecross-street.
Genuine.

23*rd Sample.*—Purchased of S. Hiram, 176. Whitecross-street.
Adulterated—containing *wheat-flour.*

24*th Sample.*—Purchased of W. Clarke, 216. Whitecross-street.
Adulterated—containing *potato-farina*, the form of many of the granules being changed by heat.

25*th Sample.*—Purchased of N. Yarrow, grocer, 42. King-street, Snow-hill.
Genuine.

26*th Sample.*—Purchased of G. Mills, 35. Little Earl-street, Soho; in tin-foil package.
Adulterated—containing a large quantity of *wheat-flour.*

It thus appears from the foregoing table, that of the *Twenty-six* samples of Mixed Spice subjected to microscopic examination, no less than *sixteen*, or considerably more than one-half, were adulterated; and hence it is seen that of all the spices, Mixed Spice is the most liable to adulteration.

The present affords an additional instance of what we have so frequently before observed — namely, that the higher the price of any article, the more it becomes subject to adulteration.

It thus again appears that the public and the revenue are extensively defrauded through the adulteration of the majority of the spices sold.

ON PRESERVED PROVISIONS.

The subject of Preserved Provisions is one which possesses at all times much importance, but this has recently become greatly enhanced, in consequence of the late exposures and the doubts thus thrown over the efficiency of the methods hitherto adopted for the preservation of animal and vegetable productions.

We propose, therefore, to enter at some length — first, into the consideration of the nature of the processes employed; and second, to determine to what extent these processes may be relied upon in effecting the object in view.

The following considerations render apparent the immense importance of the subject.

It is notorious that a supply of fresh meat and vegetables is essential, not only to the comfort but even the health of our navy. Until recently this object could only be obtained by taking on board a large quantity of live stock, the maintenance of which at sea for weeks and months was not only very expensive, but the supply thus procured was constantly lamentably short of the demand. The result of this deficiency of fresh provisions frequently displayed itself in the prevalence of scurvy and other disorders, now, happily, nearly eradicated, but which have been computed to have slain more seamen than ever fell in action.

But it is not to our navy only that such a supply is so indispensable; it is equally so to our mercantile marine, and, indeed, in every case where a ship with its crew is destined to pass any length of time upon the ocean; to the adventurous voyager and the gentleman in his yacht it is equally necessary.

Again, a supply of preserved provisions is nearly as necessary to the landsman as the seafarer — to the epicure, the house-keeper, and the invalid.

Through the art by which perishable culinary productions are preserved for lengthened periods, the epicure is enabled to defy seasons and climates; he has only to express the wish, and in the depth of winter he may have at command the productions of summer, and of other and distant countries. Thus, supposing him to be an inhabitant of the East Indies, he may indulge his appetite with the salmon of Scotland, the sardines of France, the truffles of the South of Europe, and a variety of other esteemed delicacies.

In a lecture on the subject of Preserved Provisions, delivered some years since before the Royal Dublin Society, Dr. Meyler thus graphically portrayed some of the chief effects which would result from the adoption of an efficient method of preservation: —

"When the earth is covered with snow, and when vegetation seems extinct, — locked up, as it were, in the icy grasp of death, — our tables may be loaded with the choicest vegetable productions of the spring, of the summer, and of the autumn. When the salmon, the turbot, the mackerel, the lobster, and other dainties of the ocean have become unfit for food, or have left our rivers and our shores, a sufficient supply would remain ready for use in the canisters in which they are cooked, and which will preserve them for us in full flavour. The free denizens of the air and of the forest will be also at our command at all seasons, and at periods when the sportsman could not reach them, or when otherwise they would be unfit for our consumption. Both the animal and vegetable kingdom would thus be at our command in all periods and seasons, to administer to the wants and caprices of the stomach, and to render our kitchens not alone independent of the winds and of the waves, and of the mutations of the seasons, but even of the laws which regulate the economy of organised nature."

By this art the housekeeper may add to his usually limited bill of fare many dainties and indulgences not otherwise attainable.

The invalid also may command at a moment's notice those articles of diet either best suited to his disorder, or such as alone are acceptable to his capricious appetite.

Having thus very briefly dwelt upon the importance of the subject, we will next proceed to consider the nature of the processes employed for the preservation of alimentary substances.

Although in the living organism, both of plants and animals, the chemical force is in operation in a variety of ways, yet its action is so far controlled by the vital force, as to be subservient to health and the maintenance of structure; but when vitality departs the ordinary play of affinities is permitted, and the various elements composing the tissues of the body rearrange themselves into new and simpler forms, giving rise to the phenomena which are known as those of putrefaction, fermentation, decay, and eremacausis.

Now, the object of the different preservative processes adopted is to prevent those chemical changes which occur in dead organic matter, and which constitute decomposition.

The agents which exert a greater or less influence either in retarding or in facilitating decomposition are of two kinds: the first may be termed *natural*, and are temperature, moisture, and air; the second may be denominated *artificial*, as the various preservative substances and fluids employed. We will first refer to the influence of *temperature*.

That heat accelerates, and cold, or a diminished temperature, retards putrefaction, is known to all; but the power of a greatly-reduced temperature in effecting the preservation of dead organic matter may not be so well understood or so generally appreciated.

Although a moderate degree of heat — as, for example, that of summer — facilitates decomposition, yet when the temperature is carried to the boiling-point, heat, as is well known, exerts a contrary effect, and retards putrefaction in all fluids and solids containing albumen; this it does by coagulating and rendering solid that constituent of organic substances, and which, when not thus operated upon, is exceedingly apt to undergo putrefactive changes, and to excite the same in other organic matters with which it is in contact.

The full effect of a diminished temperature or cold in these temperate latitudes we have seldom the opportunity of witnessing; fishmongers, indeed, constantly use ice to preserve their fish, and on all the eastern rivers and coasts of Scotland the salmon is packed in pounded ice, in troughs, and is sent in this state to London, being thus preserved for a long period.

In very cold countries, however, as in Russia, snow and ice are employed on a large scale for the preservation of a variety of animal substances.

"About the end of October, the Russians (according to Dr. King) kill their poultry, and pack them in tubs with layers of snow between them, using them afterwards as occasion requires. Veal frozen at Archangel and brought to Petersburgh is esteemed the finest they have; nor, when properly thawed, can it be distinguished from that which is recently killed, being equally juicy. It is in this manner that the markets are supplied, vast stacks of whole hogs, sheep, and fish being in this state exposed for sale." *

The period during which animal substances, when thus frozen, may be preserved, seems to be indefinite.

"Thus Pallas mentions the fact of a rhinoceros that was found on the banks of a river that falls into the Lena below Jacutsk. The carcase was at first almost entire, and was covered with the hide; and some of the muscles and tendons were actually adhering to the head when Pallas removed it. The preservation of this natural mummy, says Professor Playfair, was no doubt brought about by its being buried in earth that was in a state of perpetual congelation, for the place is in the parallel of 64°, where the ground is never thawed but to a very small depth below the surface.

"A still more remarkable discovery of this kind was made in 1799, on the

* Observations on the Preservation of Animal and Vegetable Food, page 6.

shores of the Frozen Sea, near the mouth of the same river Lena, which is one of the largest in Siberia. An animal of uncommon size was found imbedded in a mass of ice, which, as it melted, gradually disclosed him to view; his hair, skin, and flesh were in good preservation, so that dogs and many wild animals preyed upon it. The block of ice in which he was found was upwards of 200 feet high; and when first discovered, he appears to have been about forty feet beneath its surface. According to the celebrated Cuvier, this animal differs from every species of elephant, as well as from the large animals whose bones have been found on the banks of some of the great rivers in America. He bears, indeed, no resemblance to any species of animal at present known on the surface of the earth; and is therefore considered by Cuvier as *antediluvian*, and to have been preserved from the remote period of the deluge in the mass of ice that enveloped him."

It appears that *vegetable substances* may likewise be preserved for lengthened periods in the frozen state, and, provided they be properly thawed, without injury to their qualities.

Great care, however, is necessary in the thawing of all frozen substances, whether animal or vegetable; this should be effected very slowy, and the best means is by immersion in cold water.

A freezing temperature acts in the preservation of organised substances, by reducing the water by which they are permeated in every direction, and which is so essential to chemical action, to the solid state, a condition in which such action is rendered impossible.

Now water or *moisture* may be not merely frozen in, but entirely removed from organic bodies.

Thus it may be removed by means of currents of dry air; the marked effects of which are witnessed in sandy deserts, where but little rain falls, and where the winds which frequently prevail, being exceedingly dry, readily abstract moisture from any dead organic substance with which they happen to come in contact.

"I have been credibly informed," writes Dr. Shaw, "that at Saibah, which lieth about the half-way between Ras Sem and Egypt, there are a number of men, asses, and camels, which have been preserved from time immemorial in this manner. They are supposed to have belonged to some caravan or other, which in passing over these sandy deserts was suffocated by the hot, burning winds that now and then infest these sandy countries."

But organic substances may also be very completely deprived of moisture by means of heat alone, or by this in conjunction with free exposure to air.

Indeed, this means of preservation has long been resorted to in the case of grapes, which are preserved in the forms of raisins and currants; of plums, in that of prunes; and of apples, as Normandy pippins; in the animal kingdom we have dried gelatine and various kinds of dried fish, the preservation of which, however, is not entirely due to the drying from simple exposure, but in part to the salt used, to the mode of operation of which substance we shall hereafter have occasion to refer.

In the little work from which we have already quoted*, the following observations occur relating to the preservation of vegetables by the abstraction of their water:—

"Some vegetables, however, as potatoes and turnips, may be preserved a long time without change, though containing a large portion of water; but could they be deprived of this water, their preservation would be more easily and certainly accomplished, and their transportation greatly facilitated. A process for effecting this purpose was proposed some years ago by Mr. Forsyth, advocate. It consisted in first cutting or breaking the potatoes into small pieces, and then dissipating their water by exposing them on a metallic plate, heated by the steam of boiling water; in this manner they may be rendered dry without risk of scorching or burning; and the flour or meal they yield is said to have no disposition to attract moisture, and if closely packed may be preserved for any length of time. This process seems to be simple and efficacious, and might be advantageously used for the desiccation of any other vegetable sub-

* Loc. cit., pages 6, 7.

stances; but it is probable that the labour and expense attending it will prevent its employment to any great extent in ordinary life. It seems, however, worthy the attention of mariners, who may desire to possess vegetable substances in a state adapted to keep through long voyages."

The process proposed by Mr. Forsyth appears recently to have been put into execution with very considerable success under the patent of M. Masson, Head Gardener to the Horticultural Society of Paris. This gentleman has succeeded in preserving in a very perfect manner various descriptions of vegetables and fruits: the substances thus preserved are dry and shrivelled, contain but little water, and it is evident from their appearance that a very essential part of the process of preservation consists in the abstraction of the water, which forms so very considerable a portion of the weight and bulk of nearly all vegetables and fruits. When vegetables thus prepared are immersed in water for some time, they swell up, become soft and tender, and resume to a very great extent the appearance, colour, and flavour proper to them in the fresh state. M. Masson has managed to preserve completely, spinach, Brussels sprouts, cabbage, beans, peas, sliced carrots, parsnips, potatoes, apples, &c. Having ourselves submitted samples of each of these fruits and vegetables to examination, we are in a position to speak from personal knowledge and observation, and are enabled to state that the results obtained apparently in so simple a manner are really surprising.

It is obvious that the importance to navies of these dried vegetables is very great; and from the following extract of a Report, it appears that the naval authorities of France are not only well satisfied with the success of the process, but also fully alive to its advantages.

" *Extract of Report from the Committee appointed by the Minister of Marine, respecting the advantages of* M. MASSON'S *Dried and Compressed Vegetables, for the use of the French Navy.*

" Paris, 24th November, 1851.

" By a resolution of the 27th August last, the Minister of Marine appointed a committee to examine whether it would be advantageous to the navy to adopt the use of M. Masson's dried and compressed vegetables, and the result fully confirmed the favourable reports unanimously made to the Minister of Marine, from the five military ports where the experiments were tried.

" The experiments were made with cabbage, potatoes, julienne, French beans, haricots, Brussels sprouts, spinach, endive, cauliflower, bulb-rooted celery, apples, chervil, parsley, and taragon.

" The good state, appearance, and flavour of the different vegetables, have been unanimously approved; consequently, there is no doubt that the useful invention of M. Masson will be a benefit to the navy.

" Cabbage, which has been four years on board a man-of-war, was tested by the committee, with the most complete success.

" The committee entirely agree with the opinion of one of its members, that julienne is a vegetable most suitable for the sick.

" Trials were made, at various times, to ascertain by comparison the difference between the preserved ready-dressed julienne, in tin boxes, and the samples presented by Mons. Chollet, which last met with the decided preference of the committee, on account of its superiority, and, above all, its cost being but one-third that of the preserved ready-dressed julienne in tin boxes, as it is now supplied to the navy.

" The committee has also made experiments with Mons. Chellet's vegetables, to ascertain whether they are suited to the hospitals of the colonies — Senegal, for instance — where they are absolutely without vegetables for nine months in the year, and the committee is of opinion that in such case they would be of the greatest advantage.

" The committee proposes to order immediately the necessary quantity of cabbage and julienne to provision

1st. For one month, *six ships of the line.*
2nd. For six months, *the frigate in command of the West African station.*
3rd. For six months, *the flag-ship stationed in the China Seas.*
4th. For one year, *the " Armida " transport frigate.*

"The cabbage should be given three times a week with the salt meat, in the proportion of fifteen grammes to each man.

(Signed) JURIEN,
The Director of the Administrative Service.

"Paris, 10th December, 1851."

At the late Great Exhibition, the invention of M. Masson, if it may be termed such, was rewarded by a Council Medal.

It is stated that a cubic yard of these dried and compressed vegetables contains as much as 16,000 rations; and that they are of better flavour, and much cheaper, than the vegetables preserved in the moist way in canisters.

We have been given to understand that the attention of our own naval authorities has been directed recently to the vegetables prepared under the patent of M. Masson, and that a supply of them has been ordered for our navy.*

But by far the most certain and manageable of the natural means of insuring the preservation of animal substances, is by excluding the *atmosphere*.

Thus eggs, the shells of which have been covered over with a coating of varnish or grease, whereby the air is prevented from passing through the pores of the shell, and so promoting decomposition, have been preserved in a perfectly fresh state for several years, and so as to be capable, when set upon, of producing chickens. Again, instances have repeatedly occurred in which toads, serpents, and other animals have been found, in perfect preservation, immured in the hearts of trees or in the solid rock.

Few attempts appear, however, to have been made to preserve vegetable substances by the simple exclusion of the atmosphere; it has been suggested that many fruits might be kept for a long time, as oranges, lemons, apples, pears, &c., by coating them over with a layer of varnish in the same manner as the shell of the egg.

Currants, gooseberries, cherries, and other soft fruits, have been preserved for use in winter by gathering them when not too ripe, and, when very dry, putting them unbruised into dry bottles, which are afterwards well corked, and then buried in the earth. This method acts partly by the exclusion of the air, and partly by the low and uniform temperature which prevails beneath the surface of the earth.

The efficiency of this method of preservation is increased by immersing the bottles containing the fruit, for a few minutes, and previous to corking, in hot water. By this proceeding the vegetable albumen, which is so prone to pass into a state of decomposition, is solidified, and rendered less disposed to undergo putrefactive changes.

A further improvement on this method was suggested so far back as the year 1807 by Mr. Saddington, who received from the Society of Arts a premium for "A Method of Preserving Fruits without Sugar for House or Sea Stores."

The fruit is to be gathered before it is too ripe; the bottles are to be well filled with it, and loosely corked; they are next to be placed in a vessel containing cold water, which should reach as high as the necks of the bottles; heat is then to be applied, and the temperature raised to from 160° to 170°, and maintained at this for half an hour; but the heat must not be raised higher nor continued longer, as the fruit would be liable to burst. Lastly, the bottles are to be filled to within an inch of the corks with boiling water; they are to be well corked immediately, and laid upon their sides, so that the water may swell the corks, whereby the entrance of the air will be more effectually prevented.

We have next to inquire, upon what principle does the exclusion of the air assist in the preservation of organic matter? The atmosphere is a mixture of oxygen and nitrogen in certain proportions; the former of these has a great affinity for the elements of organised bodies, and so it is ever striving to combine with them and effect new combinations. It thus facilitates chemical changes, and consequently promotes decay. By excluding the atmosphere, we, therefore, shut out a powerful agent of decomposition.

It has been suggested, that in place of driving the air out of the vessel, and then taking means to preserve a vacuum, it might be desirable in some cases to surround the substance with an artificial atmosphere, not containing oxygen, as of nitrogen or hydrogen gases.

* The agents in London are C. Devaux and Co., 62. King William-street, City.

We now come to the consideration of an important division of our subject—viz., the means employed by the manufacturers of preserved foods of different kinds to insure their preservation.

The following is a brief and general description of the method of preservation now commonly practised:—

The article to be preserved is placed, sometimes in the raw state, but generally cooked, in a tin canister, the lid of which is soldered down, but is perforated with a small aperture or pin-hole. It is then subjected to the action of either steam, boiling water, or a muriate-of-lime bath, until the contents of the canister, if not previously dressed, have become about two-thirds cooked. The aperture in the cover is then closed, and the canister and its contents are once more submitted, for a shorter period,—that is, until the article is completely dressed—to the operation of heat. As soon as it has become cold the canister is covered over with a coating of paint; its preparation is then complete, and it is removed to the proving room. The proving room is simply an apartment the temperature of which has been raised to the degree most favourable to decomposition. If the operation of preservation has been well performed, the top and bottom of the canister, as also, in some cases, the sides, will have fallen in, or have collapsed to some extent; this indicates the exhaustion of the air within, and is regarded by the manufacturer as a tolerably correct proof that the process has been properly conducted. If, however, after some days' exposure in the proving room, the top and bottom of the canister first become flat, and subsequently even convex, it is a certain sign that the contents have not been well cured, and that they are not in a condition to keep for any length of time. Such canisters have therefore to be either rejected, or else subjected to the same process over again.

On a consideration of the above details, it appears that the preservation of articles cured in this manner is due to two causes—viz., first to the coagulation, by the heat employed, of the albumen, which, we have stated, is so prone to decomposition; and second, to the expulsion of the air by the formation of steam. The subjection of the canister to the action of heat a second time, and after the aperture has been closed, might appear at first sight to be unnecessary;—it is not so, however, as it is required to expel the last portions of air in the case, and which escape through the pores present in the tin. As even after the second application of heat, air would in time enter the canister by these pores, it is found advisable that each should receive a thick coat of paint.

The operation of closing the pin-hole is one of considerable nicety; the heat employed drives out not only the air contained in the canister, but also a jet of steam, and this with considerable force. The solderer, therefore, squeezes a few drops of cold water from a sponge, and allowing these to fall on the tin, around the aperture, produces a momentary condensation and arrest of the steam, during which the pin-hole is dexterously closed. The nicety of the operation consists in carrying the condensation only so far as barely to arrest the jet of steam, and in closing the aperture at the instant. If carried too far, or if the soldering be delayed, the air re-enters and endangers the success of the process.

A visit to the establishment of a manufacturer of preserved provisions will well repay the curiosity of the inquirer. If well regulated it should consist of several compartments, a butcher's shop, kitchen, proving-room, store-house, and canister factory.

It should be known that it is not only *boiled* provisions which may be preserved by the above process, but *roasted* also, with but a little extra care.

The application of heat for the preservation of animal and vegetable substances, so as to effect at the same time the coagulation of the albumen and the exclusion of the atmosphere, was first put into general practice on a large scale by M. Appert.

This practice originated at the period of the French Revolution, when, from the destruction of commerce in consequence of the long wars that prevailed, the want of a process of preserving perishable alimentary substances was very much felt—a want which caused the nation, in 1809, to offer a reward of 12,000 francs for the discovery of this great desideratum. This reward was bestowed, in 1810, on M. Appert, for his inventions.

The process of M. Appert differed in some respects from that employed in the present day, many improvements having been effected since his time.

One great difference was, that M. Appert made use only of glass vessels, the disadvantages of which were, their liability to burst, and the extreme difficulty experienced in completely excluding the air.

In order to preserve boiled meat, M. Appert adopted the following proceedings:—The bones were first removed from the meat; this was boiled in the ordinary way until it was about three-fourths done. It was then taken out, and put into jars, which were completely filled with strong broth made from other portions of the meat. The jars were then corked, coated with cheese and powdered lime, put into bags in order that the fragments might be caught, should any of the jars burst, and placed in a boiler of cold water. Heat was then applied until the water boiled, and the boiling temperature was maintained for about an hour, when the fire was extinguished, the water drawn off, and the jars gradually cooled.

Soups, gravies, broths, and the juices of fruits, were preserved in the same manner; but with these the boiling should be continued for an hour longer.

To preserve milk, M. Appert evaporated it in a water-bath to about one-half, removing from time to time the albuminous scum which rose to its surface; the milk was strained, allowed to cool, and after having been secured in the bottles, was again submitted to the action of the water-bath for two hours. Milk prepared in this way kept fresh for two years; after which, the butter or cream separated from it. This separation was subsequently prevented by the addition to the evaporated milk of a small portion of yolk of egg, which succeeded perfectly. Cream was evaporated to the extent of one-fifth, and afterwards preserved in the same manner.

Peas, Windsor beans, either with or without their skins, were packed in the bottles in the raw state, and afterwards subjected to the action of the water-bath for from an hour and a half to two hours.

Carrots, potatoes, turnips, require to be half dressed before being put into the bottles.

Fruits and their juices should be put up as soon as possible after gathering; they should be gathered when not too ripe, lest they should suffer in the packing, and as they would be apt to dissolve from the action of heat.

In the preservation of white and red currants, cherries, raspberries, and other small fruits, the water is just allowed to boil only; the fire is then extinguished, and the bottles permitted to remain in the water for a quarter of an hour more, when it is drawn off.

The larger soft fruits, as apricots and peaches, are first to be stoned, and cut into pieces, in order that they may pack closer in the bottles.

The expressed juices of fruits must be strained before being bottled.

When required for use, nothing more is necessary, in the case of all those articles which, previous to being placed in the jars or bottles, have undergone either partial or complete dressing, than that they should be warmed.

For the above details respecting the process of M. Appert we are indebted to the little work before quoted.

In addition to the articles above referred to, a great variety of dainties and luxuries are now preserved on the principles of M. Appert, modified and still further improved; to some of these articles we shall have occasion to refer hereafter.

We have now to consider very briefly the *modus operandi* of those preservative substances which, in contra-distinction to the natural, may be termed *artificial*.

The chief articles employed for the preservation of organised substances are salt, sugar, oil, charcoal, acetic acid, or pyroligneous acid, and alcohol.

Salt is used in the curing of fish of different kinds, bacon, hams, &c., in the pickling of pork, and in the corning of beef. It possesses great affinity for water, which it abstracts largely from the substance to which it is applied, and to which affinity its power as a preservative agent is mainly due. Its effect in abstracting water from meat is well seen, in the pickling of pork, in the large amount of fluid termed brine, which escapes from the meat.

Unfortunately, the effect of salt in its application to the preservation of meat is not confined to the removal of water; it hardens the fibre so as to render it tough and indigestible; and at the same time the water, the discharge of which it occasions, dissolves out of the meat several of its most important constituents, as the albumen, kreatine, kreatinine, lactic acid, and soluble phosphates: again, this salted meat, by the subsequent boiling to which it is subjected, has its nutritive properties still further impaired, for this extracts much of the gelatine and osmazome; thus at length little else of the meat is left besides the fibre, which is so insoluble and comparatively destitute of nourishment.

After this explanation of the operation of salt on meat, the reason why the continued use of salted provisions for any length of time gives rise to scurvy and other disorders is evident.

The following important remarks, taken from Liebig's "Researches on the Chemistry of Food," will be read with interest: —

"It is obvious that if flesh employed as food is again to become flesh in the body, — if it is to retain the power of reproducing itself in its original condition, — none of the constituents of raw flesh ought to be withdrawn from it during its preparation for food. If its composition be altered in any way, — if one of the constituents which belong essentially to its constitution be removed, — a corresponding variation must take place in the power of that piece of flesh to re-assume in the living body the original form and quality on which its properties in the living organism depend. It follows from this, that boiled flesh, when eaten *without* the soup formed in boiling it, is so much the *less* adapted for nutrition the greater the quantity of the water in which it has been boiled, and the longer the duration of the boiling."

Salt exerts the same effect on vegetable substances as on animal; this is seen in its application to sliced cucumbers and other vegetables. Salt-and-water, termed "brine," is largely employed by pickle-makers for keeping a reserved stock ready for use at all times and in all seasons, of the different kinds of vegetables used by them for pickling. The larger makers have some hundreds of hogsheads filled with various vegetables — in some, beans, in others, gerkins, and so on — thus preserved in salt-and-water. We have been given to understand that they keep well for months in this way. The salt-and-water is selected in preference to vinegar on the score of economy.

Sugar is principally employed for preserving fruits, either entire or in the state of jam or marmalade. In the condition of syrup it is semi-solid, and operates partly by the barrier which it interposes to the free access of the atmosphere to the surface of the fruit, and partly in consequence of its being a non-nitrogenous substance.

The use of *oil* as a preservative medium is extremely limited; sardines and anchovies are nearly the only articles commonly put up in oil. It appears to operate in the same manner as sugar.

The powerful effect of *charcoal* in retarding putrescence in meat, and even in restoring tainted meat to a state of sweetness, is well known. Its action is due to its property of absorbing gases, and effecting their oxydation as rapidly as they are developed from the decomposing meat, and which is thus made to preserve at least the appearance of freshness.

The use of dilute *acetic acid* or *vinegar* is confined to the preservation of vegetable substances, and is employed principally by pickle-makers. We are not aware that its mode of operation is well understood; it probably acts chiefly by the coagulation of the vegetable albumen which it occasions.

Pyroligneous acid, which is an impure kind of acetic acid, possessing a smoky flavour, is applied in two ways to the preservation and curing of such articles as hams and red herrings, either in the fluid state, or in that of vapour; in the latter case it proceeds from the wood or turf employed in the drying, and which, being sontinually formed and evolved during the imperfect combustion of the wood or turf, gradually penetrates into every part of the meat, imparting the flavour which is so much esteemed. Its action is, no doubt, the same as that of acetic acid.

Alcohol is but little used in the preservation of alimentary substances, although some fruits, as cherries, are often preserved in brandy. For the preservation of anatomical preparations it is the best liquid known. Its action is in part due to its affinity for water.

It now only remains to ascertain how far certain of the processes of preservation above described do really accomplish the object in view.

Table showing the Results of the Examination of numerous Samples of Preserved Provisions, both Vegetable and Animal.

PRESERVED VEGETABLE SUBSTANCES.

PRESERVED VEGETABLES.

In Canisters.

1*st Sample.*—Purchased of Ritchie & M'Call, 137. Houndsditch, one pound canister of *turnips*. Price 1*s*. 1*d*.

Examination.—When brought to table, the slices of turnip were of a decided brown colour, but tender and soft, possessing nearly unimpaired the flavour of this vegetable in its recent condition.

2*nd Sample.*—Purchased of D. Hogarth & Co., 78. Cheapside, one pound canister of *carrots*. Price 6*d*.

Examination.—On opening the canister, the contents were found to be in perfect preservation, having all their natural colour and taste.

3*rd Sample.*—Purchased of Cooper & Aves, 134. Leadenhall-street, one pint canister of *green peas*. Price 1*s*.

Examination.—In this case the peas were found to have lost much of their original freshness, and to have become of a yellow colour; at the same time an odour faintly stale and disagreeable was perceptible; they were perfectly tender, but deficient in flavour. We are unable, therefore, to say that the preservation of this sample was altogether successful.

4*th Sample.*—*In bottle.*—Purchased of Westbrooke & Co., 21. Oxford-street, one quart bottle of *rhubarb*. Price 9*d*.

Examination.—The stems, which were cut into short pieces, presented the appearance and flavour of the recent vegetable, and their state of preservation might be pronounced good.

In Tinfoil Packages.

5*th Sample.*—*Cabbage*, preserved according to the process of M. Masson.

Examination.—On opening the package, the contents, which formed a solid cake, were seen to consist of fragments of leaves of a yellowish colour, interspersed here and there with some that were green. In this state it was difficult to determine what the nature of the vegetable was. Soaked in hot water for about half an hour, it gradually underwent a great expansion, so that it occupied several times its former bulk. When examined, it was evident at a moment's glance that the vegetable consisted of the sliced leaves of the white-hearted garden cabbage, the leaves presenting the appearance and colour, and possessing the taste and smell to a remarkable extent of the vegetable when in its recent state.

6*th Sample.*—*Brussels Sprouts*, preserved according to M. Masson's process.

Examination.—On removing the tinfoil, the contents of the package in the dried state were seen to be of a deep green colour, and to break up into separate masses, on the surface of many of which a perfect leaf could frequently be traced. On immersion in hot water for half an hour, the vegetable, as in the previous case, increased greatly in size, and it was then evident that it consisted of Brussels sprouts, the fresh and natural appearance presented by which was really marvellous.

7*th Sample.*—*Julienne*, preserved according to the process of M. Masson.

Examination.—The contents of this package presented, in the dried state, a variegated appearance, and consisted evidently of fragments of vegetables, some green or red, and others of a yellowish colour; soaked in hot water for the same length of time as in the other cases, they increased to several times their original size, and the following vegetables sliced into small pieces, but in perfect preservation, could be readily detected—viz., turnip, carrot, and cabbage.

These mixed vegetables are intended to be used in the preparation of "Julienne Soup."

8*th Sample.*—*Potatoes*, preserved according to the process of M. Masson.

Examination.—The potatoes were reduced to thin slices, which were about as thick as a shilling, twisted or curled, and somewhat transparent; on immersion in hot water, the slices increased greatly in size, became opaque, and presented the appearance of the potato in its recent and raw state.

9*th Sample.*—*Carrots*, preserved according to the process of M. Masson.

Examination.—This vegetable, also in slices, when soaked in hot water, recovered most completely its natural appearances and qualities.

The packages in which the different kinds of vegetables prepared under the patent of M. Masson are enclosed are about four inches square, and five-eighths of an inch thick. Each package bears the name of the vegetable contained in it, is furnished with directions for dressing, and specifies the number of rations which it will afford.

It is evident from the appearance of these vegetables that they have not only been thoroughly dried, but subjected also to very great pressure.

10*th Sample.*—*Potatoes*, preserved under the patent of Mr. Edwards.

Examination.—These potatoes are in the form of little granular fragments, very closely resembling tapioca; one would judge from their appearance that the article consisted of cooked and mashed potatoes, well dried and broken into small pieces. Treated according to the directions printed below, we obtained an excellent dish of mashed potatoes.

"By Royal Letters Patent.

EDWARDS' PRESERVED POTATO.

Proved to keep in all climates, and not occupying one-sixth the space of other Potatoes.

DIRECTIONS FOR USE.

"To about *Three Quarters of a Pound* of the Patent Preserved Potato, add One Quart of *Boiling Water*, stirring it at the same time; cover it closely, and to prevent chilling, the basin or vessel used should be kept hot; let it stand for ten minutes, then *Well Mash*, adding salt, butter, &c., at pleasure.

"Observe.—The Cooking of this concentrated Vegetable is effected by the above simple means, and a Dish of Mashed Potatoes, excellent in flavour, and highly nutritious, is produced at a cost not exceeding the Common Potato.

"N.B.—The Patent Preserved Potato is proved of great advantage in making Bread, Pastry, Soups, &c.; if flour be mixed with it, and well boiled in a cloth, it produces (without Suet or Eggs) a light and wholesome pudding.

D. & H. EDWARDS & Co., Sole Patentees, No. 1. Bishopsgate-street Within, London."

The excellence of Edwards' preserved potatoes are certified to by Professors Brande, Daniell, and A. Taylor, Dr. Paris, and Dr. Ure, and they have formed the subject of several favourable reports, made at the instigation of the army and navy authorities, one of which we republish.

"*Special Report on the Patent Preserved Potato, required by Dr. Gordon's Letter, May* 20. 1842, *for the Army Medical Department.*

"The Preserved Potato, of Edwards & Co., was this day treated according to the printed directions contained in each bag, and was then tasted by each of the undersigned, as well as by many other persons, (Medical Officers and patients in the hospitals,) and all were of opinion, that the preparation, as far as they could discover, retained all the virtues of fresh potatoes, and was not less palatable.

"The Board therefore consider the preparation as affording a most valuable article of diet, and are of opinion that it might be advantageously adopted as a portion of the ration of Soldiers proceeding on board ship to foreign stations.

"In the event of its not being considered necessary by the Authorities to adopt it generally, they would particularly recommend that a quantity of it should be regularly put on board ships conveying troops, in order to be issued to such sick as the Medical Officers in charge might consider it better adapted than the articles of diet which it has hitherto been customary to substitute for salt provisions.

(Signed)
ANDREW SMITH, M.D., P.M.O.
J. KINNIS, M.D., Staff Surgeon.
R. DOWSE, Staff Surgeon, 2nd Cl.

"General Hospital, Fort Pitt, 5th June, 1842."

The certificate given by Dr. Ure is as follows: —

"I hereby certify that Messrs. Edwards' Patent Preserved Potato contains, by chemical analysis, the whole nutritious principle of that root in a pure concentrated state; that it contains

60 parts in the hundred, at least, of starch; nearly
30 of a soluble fibrine of demulcent antiscorbutic quality;
5 of a vegetable albumine of the nature somewhat of the white of egg; and
5 of a lubricating gum.

"The fibrine and albumine render it more light of digestion, and the gum more demulcent to the stomach than wheat-flour, with which, also, it may be regarded as nearly equally nutritious, and more so than peas, beans, sago, or arrow-root.

ANDREW URE, M.D., F.R.S."

On the very peculiar style of the above document, as well as on some of the very questionable statements contained in it, we refrain from offering any comment.

Edwards' Patent Preserved Potatoes were used in the Arctic Expedition in search of Sir John Franklin, under Captains Austin and Sir John Ross, and gave great satisfaction, as appears from the annexed testimonial: —

"*Her Majesty's Ships Resolute and Assistance, Pioneer and Intrepid, Steam-Tenders, in Search of Sir John Franklin, &c.,* 1850 *and* 1851.

"We the Commanders and Officers employed in the Arctic Expedition under Captain Horatio Thomas Austin, C.B., feel bound to record our favourable testimony of the excellent properties of Edwards' Patent Preserved Potato. In fact, we can scarcely speak too highly of it as a vegetable: being able to use it in various ways, it retained all the virtue, and much of the flavour of fresh mashed potato, during the whole voyage out and home, a period of eighteen months; and that remaining is as good and serviceable as ever. The men having been perfectly free from scurvy, we are induced to entertain a high opinion of its antiscorbutic properties. The whole of the people appeared to relish the Preserved Potato more with their salt meat than with anything else, and infinitely to prefer it to *rice*, or the mixed vegetable or carrots, with which these ships were supplied.

Signed by the Officers and Surgeons of H.M.S.
Resolute, *Assistance*, *Pioneer*, *Intrepid*."

Preserved in Gravy; in Tin Canister.

11*th Sample.* — Purchased of J. H. Gamble, 137. Leadenhall-street, one pint canister of *vegetables and gravy*, price 10*d.*

Examination. — This article consists of beef-soup, containing a considerable quantity of sliced carrot and turnip. It constitutes a very agreeable article of diet, suitable for luncheon or supper. The contents of the canister opened by us were in a perfect state of preservation, and free from the slightest taint.

PRESERVED FRUITS.

In Bottle.

12*th Sample.* — Purchased of Crosse & Blackwell, 21. Soho-square, bottle of *cherries*, price 1*s.* 3*d.*

Examination. — The fruit had evidently been dressed, and consequently lost its form somewhat, as well as much of its colour, which had passed into the fluid in which the cherries were immersed, and which consisted of water only. The fruit itself retained much of its original flavour, but the water surrounding it possessed the flavour still more strongly.

In this and the three following cases the process of preservation adopted was the one which originated, many years since, with Mr. Sadlington. In this instance the result may be said to have been most satisfactory, the fruit being in excellent condition for use in tarts.

13*th Sample.* — Purchased of Crosse & Blackwell, 21. Soho-square, one quart bottle of *raspberries and red-currants*, price 1*s.* 9*d.*

Examination. — Fruit slightly altered in appearance only, from the action of the boiling water to which it had been subjected, but presenting very much the colour and taste proper to the fruit in its fresh state, and in good condition for pies and tarts.

14*th Sample.* — Purchased of Westbrooke & Co., 21. Oxford-street, one quart bottle of *gooseberries*, price 9*d.*

Examination. — The gooseberries had lost much of their green colour, but retained their form well, and were all entire. The taste was that of the fresh fruit, but less acid than freshly gathered gooseberries usually are.

15*th Sample.*—One quart bottle of *greengages*, manufactured by Bull and Ambler, price 1s.

Examination. — Fruit somewhat faded in colour and wrinkled, but possessing to a great extent the flavour of greengages when not quite ripe; the fluid in which the greengages were immersed was very acid, and covered with a thick coating of fungus.

In Tinfoil Packages.

16*th Sample.*— *Apples*, preserved according to the process of M. Masson.

Examination.—Fruit cut into slices, which in the dried state were about the thickness of a shilling, but become, when immersed in water for a short time, greatly increased in dimensions, and then resemble in a very perfect manner the appearance and taste of the recently-sliced fruit. Altogether, the preservation in this case was the most complete and satisfactory yet noticed.

PRESERVED ANIMAL SUBSTANCES.

17*th Sample.*— Purchased at the office of the agency, No. 2. St. Peter's-alley, Cornhill, one pound of

"Borden's Patent Meat Biscuit,
Manufactured at Galveston, United States, by
Gail Borden, Jun.
Jury III.—The Council Medal awarded.
Exhibition of the Industry of All Nations, 1851.

"This new and useful preparation of concentrated meat and bread can be prepared for use in the shortest time as a soup. Puddings, custards, sauces, &c. are made from it in the United States. One pound of this meat biscuit contains the nutriment of five pounds of the best beef, the extract of which is combined and baked with the finest flour, forming the most portable and convenient diet known. It is eminently adapted for the naval and commercial marine, whalers, and troops on frontier service; for emigrants, travellers, and for ordinary use in families, &c. Its easy digestibility and highly-nutritious properties render it very valuable for invalids and convalescents, and generally for use in hospitals. Its preservative qualities have been fully tested by its being carried to California across the Plains, and from New York to Canton and back, and other long voyages.

"No article purporting to be the meat biscuit will be guaranteed as genuine, except purchased of the patentee's authorized agents.

Directions for Cooking.

"The biscuit being ground or made fine, stir it into sufficient cold water to form a thin batter; let it remain in this state a few minutes, then pour it into boiling water, and boil it twenty to thirty minutes, stirring frequently during the process, to prevent burning.

"Add salt and pepper to suit the taste.

"Such condiments may also be added as are used in other soups; but if vegetables, they must be previously cooked. Without vegetables, a little milk may be added when boiling. This biscuit put into the liquid of well-boiled vegetables strained through a colander, will make an excellent soup.

"One ounce, or a little less than two tablespoonfuls of this biscuit, will make a pint of very rich, nutritious soup. After boiling, if found too thick, dilute with boiling water; or if diluted with cold water, let it boil again.

"In case of shipwreck or other emergency, the biscuit may be eaten without preparation.

"The *whole* biscuit can be ground in a common spice or pepper mill, made fine in a mortar, or crushed under the rolling-pin.

Price 2*s*. 6*d*. per pound.

WHOLESALE ORDERS EXECUTED.

Sample packages of one pound or more, whole or ground, the latter more convenient for immediate use."

Examination.— The biscuits are usually reduced to a coarse powder, and in this state are packed in tin canisters. The powder is of a brownish colour, has evidently been subjected to the action of heat, and has the taste and smell, to a considerable extent, of roasted beef. Prepared in the manner directed, it affords an article of diet of very agreeable flavour; and, if the statement made respecting it — viz., that one pound contains the virtues of five pounds of beef — be correct, an article possessing highly nutritive properties.

In reference to this preparation, it appears that the nutritive qualities of the meat are extracted by means of heat; whether the process is so conducted as to ensure the removal of the whole of the albumen, we cannot say. From amongst other testimony adduced in favour of "Borden's Meat Biscuit" we extract the following: —

(COPY.)

From Col. E. V. Sumner, 1st Regiment U. S. Dragoons.

"Fort Leavenworth, May 14, 1850,

"MAJOR,— I have tried the 'Meat Biscuit,' and find it all, and more than the inventor thinks it is. To satisfy myself, I have lived upon it *entirely* for several successive days, and I am convinced that I could live upon it for months, and retain my health and strength. I thought that, although it might sustain life, there would be a craving for more solid food; but it is not so — my appetite was perfectly satisfied. The inventor thinks that five ounces a day will support a man. * * * I could not use four ounces a day, made into soup, with nothing added but pepper and salt; and, moreover, I found I could entirely dispense with tea and coffee, which is a great advantage, and which has not been enumerated.

"In my judgment, this is a very great discovery, and must lead to important results.

"I have long thought the compression of wholesome food into a smaller compass was one of the most important things that remained to be discovered in this age of inventions. Think of a regiment of 500 men, cutting loose from all magazines for two months, with no other baggage-train than 50 or 60 packed mules. At five ounces a day for each man, the weight would be 9375 pounds, which forty-five mules would carry.

"In military operations fresh meat would generally be found and put into the soup, which would make it more substantial; but the men could subsist without it, and it would not be necessary for their health and vigour to transport *bread* or any other rations.

"I have no idea that it will be used to this extent for some time to come, as great changes must be gradually made; but I am decidedly of opinion, that we ought to commence using it in the army at once; and I believe, *for all active operations in the field*, the advantages of this food will be so apparent, that it will come into general use in a few years.

"I think it will be better to have it always pulverized, and kept in tin canisters to hold about 25 pounds.

"The inventor had better send me a dozen of these canisters before I march upon the plains this summer.

"I shall frequently send out detachments on long excursions, and it will be a good opportunity to put this discovery to a thorough test. Please send this letter to Gen. Gibson—and will you inform Mr. Borden of its purport?

"Very respectfully, your obedient servant,
E. V. Sumner,
Brevet-Col. 1st Dragoons."

"To A. B. Eaton, Com. Sub. U. S. Army."

(Extract.)

From J. J. B. Wright, M. D., &c., Chief Surgeon of the 8th Military Department.

"I have examined and tried the article (the meat biscuit) with considerable attention to particularity—have used it in the hospital and at our private table; and have no hesitation in bearing testimony to its excellence as an article of diet. I think it admirably adapted for the use of troops on long marches or campaigns, where it is important to combine a large quantity of nourishment in small bulk and little weight.

"A friend of mine has in his possession a remaining quantity of the article, that was manufactured a year ago last September; which, having been kept with only ordinary attention to its preservation, is now in as good condition apparently, as when it was first prepared.

(Signed) "J. J. B. Wright,
Surgeon U. S. Army."

"January 4, 1851.

"To Brig.-Gen. Thos. Lawson,
Surgeon-General of the Army."

18*th Sample.*—*Extract of beef*, preserved according to the process of Mr. Roberton, of Manchester.

Examination.—This article is in the state of fine powder of a light brown colour; it possesses all the taste and smell of freshly roasted beef; half a pint of boiling water poured upon two tea-spoonfuls of it furnishes in the course of two or three minutes, a large cup of beef-tea of excellent quality.

It will be remembered that, some short time since, we spoke in favourable terms of this really important preparation. It is prepared under a process which has been patented by Mr. Roberton, of Manchester, for the manufacture of pharmaceutical extracts generally, and by which a very high degree of concentration is obtained, in most cases without heat. It is estimated that one ounce of the dried extract of beef contains the whole of the nutritive properties of one pound of solid meat. In using it, it may be combined with flour or vegetables.

19*th Sample.*—Purchased of J. H. Gamble, 137. Leadenhall-street, half-a-pint canister of *preserved milk*, price 6*d.*

Examination.—On pouring out the contents of the canister, it was seen that a separation of the butter had taken place to a great extent; the milk also possessed a flavour which, although it could not be said to be the result of decomposition, was yet not agreeable, and was perceptible in the tea to which the milk had been added.

The process of preservation in this case can hardly be considered successful; it was evident, however, that the milk was rich in cream, of excellent quality, and certainly very different from the blue watery compound sold as milk in London.

It will be remembered that the separation of the cream from the milk was noticed to occur under the process adopted by M. Appert, but that gentlemen succeeded in preventing it by the addition of a small quantity of the yolk of egg.

SOUPS AND BROTHS.

20*th Sample.*—Purchased of D. Hogarth & Co., Aberdeen, and 78. Cheapside, half-pint canister of pure *essence of beef*, price 6*d.*

"Add one pint of water, bring to the boil, season with salt and pepper, when it will be found both excellent and nutritious. This case contains the essence of three pounds of beef without the bone."

Examination.— This preparation has the colour and taste of the concentrated gravy of roasted beef; with the addition of water, it forms a very agreeable article of diet.

The contents of the canister opened by us were perfectly fresh and sweet.

21*st Sample.*—Purchased of Ritchie & M'Call, 137. Houndsditch, half-pint canister of *chicken-broth*, price 1*s.*

Examination. — The contents of this canister were perfectly unchanged, and in as fresh a state as though the broth had been but recently prepared.

22*nd Sample.*—Purchased of D. Hogarth & Co., 78. Cheapside, half-pint canister of *mutton-broth*, price 7*d.*

"The contents of this case are perfectly fresh, and will retain their sweetness and flavour in any climate for several years. After removing them into a saucepan, if a rich soup be required, add half as much water as the case will contain, but if a more economical soup be wanted, add as much water as the case will hold."

Examination.— The broth contained pieces of mutton, and a considerable quantity of carrot and other vegetables. When diluted with water in the manner directed, and warmed, it furnished a bowl of strong broth, in which, however, a taste slightly unpleasant was detected.

23*rd Sample.*—Purchased of J. H. Gamble, 137. Leadenhall-street, one-pint case of *soup and bouilli*, price 9*d.*

"Empty the soup and bouilli into a saucepan and warm it. It can be eaten cold. Some prefer to warm it in the canister, and then opening. A small quantity of water may be added if the gravy be found too strong; or by adding a quart of '*Gamble's* Concentrated Gravy,' with a sufficient quantity of water, to the soup and bouilli, while warming, it will make a tureen of delicious soup, and the bouilli can be served on a dish, garnished with carrots and gherkins, if approved."

Examination.— This constitutes a capital article of diet, and the contents of the canister tried by us were found to be in excellent preservation.

24*th Sample.*—Purchased of J. H. Gamble, 137. Leadenhall-street, one-pint case of *soup julienne*, price 1*s.* 2*d.*

"The soup merely requires to be warmed. A small quantity of water may be added if the soup be found too strong and rich. Be careful to stir it gently while warming in the saucepan, to prevent it burning."

Examination.—The soup julienne of Mr. Gamble is a strong beef soup, containing a large quantity of maccaroni and sliced vegetables, cut into ornamental devices. We noticed in it carrot, turnip, and celery. The condition of the article was excellent.

25*th Sample.*—Purchased of Cooper & Aves, 134. Leadenhall-street, one-pint case of *mock turtle*, price 1*s.* 1*d.*

Examination.—This article was in the state of incipient decomposition, and the flavour of the meat contained in it was such as to render it scarcely eatable. It was the least successfully prepared of all the provisions preserved in canisters, and examined by us.

26*th Sample.*—Purchased of Ritchie & M'Call, 137. Houndsditch, one-pint case of *Mulligatawny soup*, price 1*s.* 7*d.*

Examination.— This article was in capital preservation, and furnished a delicious plate of soup.

FISH.

27*th Sample.*—Purchased of Cooper & Aves, 134. Leadenhall-street, half-pint case of *Milton oysters*, price 1*s.*

Examination. — The oysters, as well as the fluid in which they were immersed, were both perfectly fresh and sweet, and possessed the saltish and marine odour and flavour for which this delicacy is so esteemed.

28*th Sample.*— Purchased of J. H. Gamble, 137. Leadenhall-street, one pound canister of *mackerel*, price 10*d.*

Examination.— The mackerel in this case was in perfect preservation, the skin even retaining the mottled, bright, and silvery appearance peculiar to the fish when quite fresh.

29*th Sample.*— Purchased of D. Hogarth & Co., 78. Cheapside, two-pound canister of *fresh herrings*, price 1*s.* 2*d.*

"The herrings in this case are fresh as when caught, are sufficiently cooked, and may be eaten cold; but if required warm, boil the case before it is opened ten or twelve minutes, when they will be found fit for the table. The liquor contained in the case is a rich essence of the fish, and may be eaten with them when used, either in a warm or cold state."

Examination.—The herrings in this canister were in excellent preservation.

MEATS.

30*th Sample.*— Purchased of Cooper & Aves, 134. Leadenhall-street, one-pound case of *boiled beef*, price 1*s.*

Examination.— The contents of this canister were in good preservation.

31*st Sample.*— Purchased of Ritchie & M'Call, 137. Houndsditch, one-pound canister of *roast beef*, 1*s.* 1*d.*

"Open the canister carefully, so that the contents may be taken out whole, and eaten cold. When used in a hot climate, or warm weather, every possible method of cooling should be adopted previously to opening, so that the contents may come out in a gelatinous state."

Examination.— The piece of roast beef contained in this case was tender, and perfectly sweet.

PEMMICAN.

Pemmican consists of the muscular fibre of beef, baked, and reduced to a coarse powder. The preparation of the article has been described to us as follows:—

The beef, trimmed and deprived as far as possible of fat, is cut into slices, which are placed on metallic plates, and baked until it becomes dry, hard, and cooked; lastly, the slices are reduced to a coarse and fibrous powder. The article in this state constitutes what is known as common pemmican.

There are, however, other preparations of pemmican; thus, a proportion of fatty matter is commonly added, with the intention of restoring the fat of which the meat was necessarily deprived in order that it might be baked, and thus rendering it the better adapted to serve all the purposes of nutrition and respiration. Again, to this mixture of muscular fibre and fat, in some cases sugar is added, and in others, currants.

Pemmican is prepared at Gosport in large quantities for the use of the navy, and, we believe, is considered to form a valuable and nutritive article of diet. We have been informed that the *North Star*, which is about to proceed in search of Sir John Franklin, has a large supply on board. It is used, particularly that with sugar, mixed with the cocoa given for breakfast, and the other kinds with gruel, broth, or soup. Further information in regard to the preparation and use of pemmican will be found, we believe, in "Sir John Richardson's Arctic Boat Voyage."

For the samples of pemmican above noticed, as well as for information respecting its preparation, we are indebted to Mr. Stone, late librarian of the Royal College of Surgeons. We had repeatedly tried at different times to obtain samples of pemmican, but until Mr. Stone procured them for us, we had failed in our endeavours to meet with them.

32*nd Sample.* — Common pemmican.

Examination. — The article is of a light-brown colour, with a fibrous and woolly texture. In the dried state it has somewhat the taste of roasted beef.

33*rd Sample.* — Pemmican with fat and sugar.

Examination. — This form of pemmican possesses much the same character as the preceding, but it has a less woolly texture, and its sweet taste masks, to some extent, the flavour of the meat.

34*th Sample.* — Pemmican with fat and currants.

Examination. — This article is inferior to common pemmican, which retains more of the flavour of the meat.

The samples did not exhibit the slightest sign of change or decomposition, but were in a perfect state of preservation.

From a review of the table of examinations, the following general conclusions may be deduced: —

As regards the Preserved Vegetables —

1st. That of the three vegetables examined and enclosed in tin canisters, the *carrots* were in a perfectly fresh and sound state; the *turnips* were apparently sound, but when dressed and brought to table were seen to be very much discoloured; the *green peas* were not in a satisfactory state of preservation, being altered in colour, having but little flavour, and evincing signs of incipient decomposition.

2nd. That the vegetable *rhubarb*, contained in a bottle, and preserved according to the method devised by Mr. Sadlington, which has already been described, was in good condition.

3rd. That the several vegetables preserved under the process of M. Masson — viz., *cabbage*, *Brussels-sprouts*, *carrots*, *potatoes*, and *julienne*, were all sound and fresh, and in admirable condition in all respects.

4th. That the potatoes prepared under the patent of Mr. Edwards were likewise in a perfectly satisfactory state.

5th. That the fruits put up after the method of Mr. Sadlington were, with one exception, in a good state of preservation.

6th. That the apples prepared according to the patent of M. Masson, when soaked, as directed, in warm water, possessed the flavour unimpaired of the recent fruit.

With respect to the Preserved Animal Substances, the conclusions are: —

7th. That *Borden's Patent Meat Biscuit* was in a perfectly sound state, and that there is much reason to regard it as a valuable article of diet in the provisioning of ships, garrisons, &c.

8th. That the *extract of beef*, manufactured under the patent of Mr. Roberton, was free from the slightest taint, and possessed all the odour and flavour, to a remarkable extent, of beef recently roasted.

9th. That the *soups* were, with one exception, in which the article appeared to be in a state of incipient decomposition, of excellent quality, and in sound condition.

10th. That the preservation of the *milk* examined was not entirely successful.

11th That the three canisters of *fish* were all found to be in excellent condition, the fish being as fresh as on the day they were enclosed in the cases.

12th. That the cases of *boiled and roasted beef* were in good preservation.

13th. That the samples of *pemmican* exhibited no symptoms of change or decomposition.

It thus appears, that out of the *Thirty-four* samples of preserved provisions of all kinds submitted to examination, the condition of preservation of *Twenty-nine* was most satisfactory, the state of *Five* only out of the number being unsatisfactory, three of these being vegetables; and hence we deduce the further conclusion, that the several processes adopted for the preservation of vegetable and animal substances are, at least so far as regards home and domestic use, productive of satisfactory results. From the few cases, however, which have turned out unfavourably, it is evident that the greatest care is requisite in conducting the several steps of whatever process is adopted.

But it remains for us to inquire whether the processes employed for the preservation of meat in tin canisters are sufficiently certain and accurate to ensure its preservation for long periods, and under the trying circumstances to which it is exposed from continual motion on ship-board, and change of climate. For a solution of this point it is necessary that we consult other authorities.

In the little work on the Preservation of Food, quoted in our first Report, the following remarks occur bearing on this point: —

" A number of specimens of fish, vegetables, meat, gelatine, and particularly a case of real turtle, prepared by Mr. Morrison, twenty years ago, in the West Indies, were opened and exhibited in the course of the lecture, the quality and excellence of which may be collected from the reports given after an entertainment of which we are about to speak.

" Thomas Michael Gresham, Esq, of Roheny Park, who has taken a lively interest in promoting the views of the company about to be established in Dublin, for the preserving animal and vegetable food of every description, invited a number of distinguished individuals to partake of various specimens of provisions according to the new process, for the purpose of testing the system of preservation, and adding their testimony as to the great value and importance of the project proposed by Mr. F. Gamble. Mr. Gresham explained to the meeting a few of the many advantages which would result to the public by the introduction of so valuable and important an invention. By means of the preservative process, he stated that provisions could be kept for any length of time, and in any climate. The turtle of which they had just partaken, and which was opened eight days back at Dr. Meyler's lecture, had been preserved at the Bahama Islands, by Mr. Morrison, more than twenty years ago; and there was not a prepared specimen of meat, fish, or vegetable, brought to table, which had not been at least three years put into the canister, and yet the whole were found in a most perfect state of preservation."

In the different expeditions to the North Pole, the ships for many years past have been provided with large quantities of fresh preserved provisions, for the use of both the officers and crews. In Captain Parry's first voyage to the polar seas, from ten to twelve thousand pounds worth of these articles were supplied to him, and on his return Captain Parry reported on them to the following effect:—

"His Majesty's Ship *Hecla*, 9. December, 1820.

"Gentlemen,—In reply to your letter of the 28th ultimo, I beg leave to acquaint you that I feel it impossible to speak too highly of the preserved meats and soups supplied to his Majesty's ships *Hecla* and *Griper*, employed under my orders on the late expedition for the discovery of a north-west passage. Of the very large supply we obtained, not a single instance occurred of opening a bad canister of meat. Four or five bottles of vegetable soup and two or three of the concentrated gravy soup were unfit for use. With these few exceptions they were excellent, and proved a most invaluable acquisition to us in the absence of all other fresh supplies. I have the honour to enclose the opinions of the surgeons of the *Hecla* and *Griper*, and am, Gentlemen, your very humble servant,

W. E. Parry, Captain."

"To the Commissioners for Victualling
His Majesty's Navy, London."

Letters innumerable might be given, were it necessary, from commanders of vessels, and others, all testifying to the fact that meat preserved in tin cases may retain its freshness and flavour during periods extending over several years.

It thus appears that the principles upon which meat is preserved in tin cases are sound, and sufficient to answer every useful purpose, when carried into operation in a sufficiently careful manner; in those cases in which failures have occurred, they have been due almost constantly to the want of proper precaution.

Of all the processes used for the preservation of vegetable substances, there appears to be none so satisfactory as that of M. Masson.

That fruits preserved in bottles according to the method of Mr. Sadlington lose very considerably in flavour, is unquestionable, yet the process, on the whole, yields valuable results.

We believe that the most effectual means of preserving fruit, is by immersion in syrup; the expense of this, however, is too great to allow of its use in all cases.

Although it may appear perhaps somewhat invidious to institute comparisons between the results obtained by different manufacturers, yet, as we desire to make known all the facts which have come before us, we feel bound to state that the articles put up by Mr. J. H. Gamble, of Leadenhall-street, Mr. Dangar, of Billiter-street, City, and Messrs. Hogarth & Co., of Cheapside, and examined by us, have appeared to be in the soundest and best condition.

The business of a preserved provision merchant would seem to be one which is greatly extending, since there are now in London several manufacturers, in addition to those of whom we have made purchases, as the following:—H. W. Brande & Co., 11. Little Stanhope-street, May-fair; Da Costa & Tanqueray,

11. Great St. Helen's; Geddes & Yule, 78. Great Tower-street; D. Mackenzie 33. Chamber-street; and W. R. Mark, 1 & 2. Spitalfields-market.

It will be apparent that there are many articles preserved, not included in the list which we have given; but the majority of these are to be regarded rather as delicacies than as adapted for ordinary use, such as pâte de foies gras, truffes, perigord, anchois à l'huile, sardines à l'huile, Russia caviare, &c.

Some years ago a preparation, consisting of a combination of gelatine with arrow-root or wheat-flour, was sold by E. Lardner, of Piccadilly, under the names of *animo-vegetable powder*, or *anamalised arrow-root*. We are not aware whether these or any similar preparations are made now. They would form in many cases convenient and useful articles of diet, suited particularly for children and invalids.

We will now proceed to offer one or two suggestions which have occurred to us respecting the manner in which the canisters are filled. It appears that in many cases greater care is required in apportioning the relative quantities of the several ingredients. Thus, some canisters which we have opened have contained a great excess of fat; others have been almost destitute of it; in some there has been little or no gelatine, and in others the cases have been half filled with it. These objections apply, perhaps, mostly to the smaller canisters. As a general rule, we believe that the drier the condition of the article the more certain will be its preservation; and that where meat is packed up in gravy or soup, this should always be as concentrated as possible.

It is estimated that one pound of cooked and preserved meat, and deprived, as it always is, of bone, will go nearly as far as two pounds of raw meat, and in considering the price at which preserved provisions are sold this fact should be remembered. It is, nevertheless, necessary, before preserved provisions can come into general use in households, that a very great reduction in the prices should be effected; and in order to accomplish this reduction, no means so effective can be adopted as the preservation in large quantities of the different kinds of vegetable and animal substances, at those seasons and in those localities and countries in which they most abound, and where they are to be obtained at the cheapest rate.

Thus many years ago Mr. Morrison, perceiving how important it was to secure certain articles where they were to be obtained most readily, had the turtle, which is found in the Bahama islands in such quantities, killed, cut up, and packed in tin cases on the spot. He adopted a like practice with salmon.

Mr. Borden also obtains his supply of beef for the manufacture of his meat biscuits from the prairies of Texas.

Lastly, Mr. Dangar imports into this country largely, beef obtained in Australia. We have been at the trouble of paying Mr. Dangar a visit, and have examined the contents of some of the canisters put up in Australia four years ago, and are pleased to be able to state that they were in sound condition, the meat being tender, and its flavour excellent. As an illustration of the advantage of preserving provisions largely where they are to be obtained cheapest, we may mention that Mr. Dangar is able to sell his 6 lb. canisters of fresh beef from Australia, at $5\frac{1}{4}d.$ per pound — that is, he can supply the cooked beef at a cheaper rate than it can generally be procured in this country in the raw state.

There is this great advantage, and one which ought materially to affect the prices of preserved meats, that the manufacturer is enabled to make use of every part of the animals intended for preservation; thus, from the bones, even the gelatine should be extracted.

Hitherto we have said nothing on the adulteration of preserved provisions, and this for the reason that they, if practised in any cases, are for the most part of a nature to escape detection: thus they consist chiefly of the substitution of one kind of meat for another. The only instance with which we are acquainted of improper substances having been found in the canisters was that of Goldner, recently exposed, in which pieces of hearts, livers, intestines, kidneys, &c., were detected, mixed up with other meats.

Messrs. Ritchie and M'Call have addressed to us a communication, in which the following remarks occur relative to the process adopted by them: —

" We think it right to point out to you with reference to the article that appears in this week's paper, that the *modus operandi* described by you as that commonly practised is only made use of by ourselves, and forms the subject of a patent introduced into this country in 1840. It differs from all other modes in this respect, that it enables us to obtain a *perfect* vacuum in the canister, which we maintain is essential to insure success. This can only be done by finally closing the canister against the jet of steam issuing from the pin-hole, and, as you remark, success depends upon this being most dexterously performed. Now, the system of the other houses, which is that of Appert, relies entirely upon the coagulation of the albumen, and the decomposing or separation of the gases in the canister by continued boiling: they close the canister completely before commencing to preserve. In some cases, indeed, they open the canister for a few minutes, and reclose it during the operation; but this is a modification only introduced subsequently to Wertheimer's patent being taken out."

We may remark, on the above observations, that although the details as practised by different manufacturers vary, yet in the two great principles upon which meats are preserved, they all agree — viz. that the albumen should be solidified by heat, and the atmosphere excluded. In our first Report we stated that after the closure of the aperture in the lid, the case was submitted a *second time* to the action of heat, with the view, as we supposed, of expelling the last portions of air, and which, we suggested, escaped through pores in the tin. A doubt has been raised whether this explanation is correct; the practice, at all events, is as stated, and it is, moreover, one which experience has shown to be necessary.

EXTRACT OF MEAT.

To the Editor of THE LANCET.

SIR,—I have only just observed in THE LANCET of the 20th December, amongst replies to correspondents, "Mr. J. Roberton — The preparation having been mislaid," &c. I presume this refers to myself and the extract of meat, of which I sent you a sample. I therefore send you with much pleasure another portion, and shall feel obliged by your examination and report of it. As you will perceive, it consists entirely of the albuminous and saline portion of the juice of the flesh, extracted *cold*, and, by a peculiar arrangement in the evaporating process, obtained in the form of a dry powder, with a very limited application of heat. It appears to me a valuable preparation in the hands of the medical man, and useful and convenient to the patient. A cup of beef-tea, in every respect adapted for the purpose of nutrition, may be at once obtained by boiling three or four teaspoonfuls of the extract in about half a pint of water for three minutes. The extract, so long as it is preserved in a dry state, will of course remain unimpaired for any length of time. I believe it is the first time an extract of meat prepared on Liebig's principle has been offered for general use in this form.

I am, Sir, your obedient servant,

J. ROBERTON.

Oxford-street, Manchester, Jan. 1852.

*** The powder in question is of a light brown colour, and has exactly the agreeable smell of roast beef. We have had a cup of beef-tea made from it, and agree with Mr. Roberton that, prepared from good and wholesome meat, it forms to the invalid and medical man a useful and valuable article. Under the microscope, the powder is seen to consist of granules and masses of various size, which also exhibit a granular composition. (See p. 441.)

THE

BITTER BEER, PALE ALE,

OR

INDIA PALE ALE,

OF

MESSRS. ALLSOPP AND SONS, AND MESSRS. BASS AND CO.,

OF BURTON-UPON-TRENT.

In all those countries in which the vine tree is extensively cultivated, wine is the ordinary beverage of the population; while in England, the climate being unsuited to the growth of the vine, beer is the national beverage, and enters into the daily consumption of all classes of persons, from the richest to the poorest. It is therefore not extraordinary that any statement calculated to throw a suspicion on the genuine character of beer should be viewed with alarm by the public, and with the utmost concern by those engaged in its manufacture, whose pecuniary interests are of course very largely involved.

A statement of this kind has recently come before the public, in which it is asserted that strychnine, a deadly poison, is commonly employed by brewers in the manufacture of "bitter beer," or "pale ale."

Into the origin and foundation of this allegation, we propose fully to inquire in the following Report.

In the course of a lecture recently delivered at the "Conservatoire des Arts et Métiers," M. Payen is asserted to have stated that strychnine was prepared in large quantities in Paris, and that the French authorities had ascertained that it was destined for England, it being employed in the manufacture of the celebrated bitter beer of that country.

This statement, after having appeared in some of the French papers, and amongst others in the *Constitutionnel*, attracted the attention of some English journalists, who commented at some length upon it, incautiously treating the assertion as though its truth had been fully ascertained. At length the injurious statement made its way into the columns of the *Times* newspaper, and thus become universally disseminated.

It was impossible for the brewers of bitter beer, the preparation of which is confined to a small number of persons, to pass by without notice so grave a charge, and one so immediately affecting their interests. Accordingly the two chief firms, those of Messrs. ALLSOPP and SONS, and Messrs. BASS and CO., lost no time in publicly denying, in the most unequivocal terms, that strychnine, or any other deleterious substance was ever employed by them in the manufacture of their beer.

These celebrated brewers suggested that their bitter beer should be subjected to a rigorous chemical and microscopical examination, and expressed their willingness to place the inquiry in the hands of the "Analytical Sanitary Commission." They offered to throw open their breweries, stores, &c., in the most complete and unreserved manner, and afford every facility for the fullest investigation.

Feeling that the subject was one of great importance; that it involved the public health to a great degree, and also the pecuniary interests of a trade, which, from its magnitude, had almost assumed a national character; that it also affected the judgment of the medical profession by whom the bitter beers had been so strongly recommended—we ultimately agreed to undertake the inquiry upon the distinctly-declared condition that the results of the investigation and analyses, whether favourable or unfavourable to the reputation and quality of the beer, should be unreservedly and faithfully communicated to the public.

The importance of the subject will be duly appreciated when it is recollected that strychnia is the active principle of *nux vomica*, that it is remarkable for its intense bitterness, and highly poisonous nature, *one-sixth of a grain* having been known to prove *fatal*.

Composition and Peculiarities of the Burton Water.

Burton brewers have long been celebrated for the quality of their beer, and many conjectures have been made, to account for the excellence and superiority of the article brewed in that locality.

It is the general opinion, in which, we believe, the brewers themselves concur, that their success depends to a great extent upon the quality of the well-water used.

This water, repeated analyses have shown, contains a very large quantity of sulphate of lime, a good deal of the sulphates of potash and magnesia, and a considerable amount of carbonate of lime; the lime and magnesia in the state of carbonate, being held in solution by carbonic acid, the excess of which is so great as to redden blue litmus paper.

The Burton well-water, therefore, is evidently a very *hard* water, remarkable for the quantity of earthy sulphates and carbonates contained in it, and, *à priori*, it would be considered from its chemical constitution but ill adapted for the purpose of brewing. That it is not so, however, has been shown by long experience. A rational and scientific explanation of the cause of the superiority of the Burton well-water can now be afforded.

In the course of boiling, the excess of carbonic acid in the water, by which the carbonates of lime and magnesia are dissolved, is expelled, and these salts are precipitated: again, the alkaline phosphates present in malt have the power of decomposing and precipitating sulphate of lime, phosphate of lime and a soluble alkaline sulphate being formed; the greater part of the phosphate of lime so formed is re-dissolved in the acid generated during fermentation. The water from being at first hard thus becomes comparatively soft, and in this state is well suited for the extraction of the active properties of the malt and hops used in the manufacture of bitter beer.

The correctness of this explanation is clearly shown in the following analyses: —

Analysis of the Water used in the Brewery of Messrs. Allsopp & Co., *by* Dr. Henry Bottinger.

(Contents of Imperial Gallon.)

	Grs.
Chloride of sodium	10·12
Sulphate of potash	7·65
,, lime	18·96
,, magnesia	9·95
Carbonate of lime	15·51
,, magnesia	1·70
,, iron protoxide	0·60
Silica	0·79
Total solid contents	65·28

Besides a varying quantity of free carbonic acid, which keeps the carbonates in solution.

The water is remarkable for its complete freedom from organic matter.

Analysis of Water used in the Brewery of Messrs. Bass & Co., *by* Mr. Cooper.

(Contents of Imperial Gallon.)

Uncombined carbonic acid, cubic inches		7·5
Carbonate of lime	grains	9·93
Sulphate of lime	,,	54·40
Muriate of lime	,,	13·28
Sulphate of magnesia	,,	·83
Total solid contents		78·44

Analysis, showing the Saline and Mineral Ingredients contained in Sample of Beer brewed by Messrs. Allsopp & Sons. *Taken from the Stores at Blackwall.*

(Contents of Imperial Gallon.)

	Grains.
Alkaline sulphates, chiefly of potash - -	78
Alkaline chlorides - - - -	28
Alkaline carbonates and phosphates - -	14
Phosphate of lime and magnesia, very fusible before the blowpipe - - -	102
Total saline and mineral ingredients - -	222

Analysis, showing the Saline and Mineral Constituents contained in Sample of Beer brewed by Messrs. Bass & Co. *Taken from the Stores at Blackwall.*

(Contents of Imperial Gallon.)

	Grains.
Alkaline sulphates, chiefly of potash - -	62
Alkaline chlorides - - - -	25
Alkaline carbonates and phosphates - -	19
Phosphate of lime and magnesia - - -	91
Total saline and mineral ingredients - -	197

The two last analyses include, of course, not merely the saline constituents of the water used in making the beers, but also those of the malt and hops employed, consisting principally of phosphates.

It will be observed that the earthy salts, the carbonates and sulphates of lime and magnesia, which impart the quality of hardness to water, have disappeared, and that the Burton water, though hard at first, really becomes a soft water, as contained in the beer.

But the chemical constitution of the Burton water explains also another circumstance connected with Burton ales. It is known that these ales speedily become bright and clear, that they never require "finings" to be employed, and are fit for use almost as soon as brewed.

Now the depurating power of lime is well known, insomuch so, that it has long been employed in the clarification of cane and other vegetable juices, and it is no doubt to the presence and precipitation of this substance that the action of the Burton water in rendering the beer transparent and bright is attributable.

Having thus determined the chemical composition and peculiarities of the water used by Messrs. Allsopp & Sons, and by Messrs. Bass & Co., we will next proceed to treat of the general qualities and strength of the bitter beers manufactured by these brewers.

Analyses showing the Composition and Strength of Messrs. Allsopp & Sons', and Messrs. Bass & Co.'s Bitter Beers.

No. 1.

Analysis of Beer brewed March, 1851, by Messrs. Allsopp & Sons, for Exportation to India. Selected from the Stores at Blackwall of Messrs. Friend & Co.

(Contents of Imperial Gallon.)

	Grains.
Sugar - - - - -	200
Gum - - - - -	2,080
Bitter extract - - - -	810
Total solid extract - - -	3,090
Alcohol, of spec. grav. ·794 - - -	3,540
Water - - - - -	63,370
	70,000

Per-centage of alcohol, 5·05.

No. 2.

Analysis of Beer brewed March 20th, 1851, by Messrs. Allsopp & Sons, for Exportation. Selected from the Stores at Blackwall of Messrs. Byass & Co.

(Contents of Imperial Gallon.)

	Grains.
Sugar	320
Gum	2,110
Bitter extract	750
Total solid extract	3,180
Alcohol, of spec. grav. ·794	3,820
Water	63,000
	70,000

Per-centage of alcohol, 5·46.

No. 3.

Analysis of Beer brewed March 3rd, 1852, by Messrs. Bass & Co., for home consumption. From the Stores at Blackwall.

(Contents of Imperial Gallon.)

	Grains.
Sugar	390
Gum	3,930
Bitter extract	760
Total solid extract	5,080
Alcohol, of spec. grav. ·794	3,983
Water	60,937
	70,000

Per-centage or alcohol, 5·69

No. 4.

Analysis of Beer brewed November 25th, 1851, by Messrs. Bass & Co., for home consumption. From the Stores at Blackwall.

(Contents of Imperial Gallon.)

	Grains.
Sugar	420
Gum	2,660
Bitter extract	800
Total solid extract	3,880
Alcohol, of spec. grav. ·794	3,744
Water	62,376
	70,000

Per-centage of alcohol, 5·34.

The different ages of the beers sufficiently explain the slight variations in the results of the preceding analyses.

The above general analyses are important. They show—

1st. That the bitter beers of Messrs. Allsopp & Sons, and of Messrs. Bass & Co., contain only a moderate amount of alcohol; and

2nd. That they contain an unusually large quantity of bitter extract, consisting of the extract of hops.

In estimating the quality and condition of beer, it is of great importance to ascertain its specific gravity, since this indicates to a considerable extent the amount of solid contents or extractive matter in the beer, which, as a rule, is greatest in the newest and strongest beers.

It should be remembered, however, that alcohol, being lighter than water, conceals in some measure the amount of extract as estimated by the hydrometer, rendering the beer by so much the less dense as the proportion of alcohol is greatest.

It should also be borne in mind that the sugar, as the beer ages, gradually becomes converted into alcohol, and this again into acetic acid, and hence old beers usually possess a low specific gravity.

The effect of age in diminishing the density of beer is clearly shown in the following tables of specific gravities: —

Table showing the Specific Gravities of different Samples of Beer of various Ages brewed by Messrs. Allsopp & Sons.

		Specific grav.
1.	From the stores at Blackwall, for home trade, brewed March 23rd, 1852	1020
2.	From the stores at Blackwall, for home trade, brewed Dec. 1851	1017
3.	From the stores at Blackwall, for exportation, brewed February 27th, 1852	1019
4.	From the stores at Blackwall, for exportation, brewed March, 1852	1019
5.	From the stock of Messrs. Wallis & Co., agents for home trade, brewed October, 1851	1019
6.	From the stock of Messrs. Child & Co., agents for home trade	1015
7.	From the stock of Messrs. Findlater, Mackie, & Co., agents for home trade	1016
8.	From the stock of Messrs. Daukes & Rodick, agents for home trade	1015
9.	From the stock of Messrs. Foster & Sons, agents for home trade	1014
10.	From the stock of Mr. Bovill, agent, brewed Nov. 1851	1015
11.	From the stock of Mr. Bovill, agent, brewed Jan. 1851	1009
12.	From the stock of Mr. Bovill, agent, brewed Dec. 23, 1850	1006
13.	From the stock of Messrs. Hibbert, agents for exportation	1007
14.	From the stock of Messrs. Friend & Co., at Blackwall, agents for exportation, brewed March, 1851	1008
15.	From the stores of Messrs. Byass & Co., at Blackwall, agents for exportation, brewed March, 1851	1009

Table showing the Specific Gravities of different Samples of Beer of various Ages brewed by Messrs. Bass & Co.

1.	From the stores at Blackwall, for home trade, brewed April 27th, 1852	1024
2.	From the stores at Blackwall, for home trade, brewed April 28th, 1852	1024
3.	From the stores at Blackwall, for home trade, brewed March 3rd, 1852	1019
4.	From the stores at Blackwall, for home trade, brewed November 25th, 1851	1013
5.	From the stores at Blackwall, for exportation, brewed February 18th, 1852	1021
6.	From the stores at Blackwall, for exportation, brewed February 19th, 1852	1021
7.	From the stores at Blackwall, for exportation, brewed March 25th, 1852	1022
8.	From the stock of Messrs. Saunders & Cameron, agents for home trade	1015
9.	From the stock of Messrs. Daukes & Rodick, agents for home trade	1016
10.	From the stock of Mr. Fevenc, agent for home trade	1015
11.	From the stock of Messrs. Kinahan, agents for home trade	1012
12.	From the stock of Messrs. Crimp & Ward, export agents, brewed January, 1852	1015
13.	From the stock of Messrs. Crimp & Ward, agents for exportation, brewed December, 1851	1009
14.	From the stock of Mr. Halston, agent, brewed 1850	1008

The above tables prove that the density of beers differs remarkably with age. The nature of certain of the changes which take place in *old beer* is shown in the following analysis: —

Analysis of Beer brewed by Messrs. Allsopp & Sons, *Jan.* 1851. *Selected from the stock of* Mr. Bovill, *agent.*

(Contents of Imperial Gallon.)

			Grs.
Alcohol			1,160
Acetic Acid			200
Solid extract, consisting of	Sugar	100	3,320
	Bitter extractive,	710	
	Gum	2,510	
Water			65,320
			70,000

Per-centage of alcohol	1·65
Specific gravity of the beer	1009

It may be well, in the next place, to consider how far the statement made, that strychnia is employed in the preparation of bitter beer, is consistent with probability. In order to form an opinion on this point, it is necessary to obtain clear ideas of the quantity of this substance necessary to impart bitterness to a given bulk of fluid, to determine the chemical condition in which it exists in beer, and to ascertain the amount of strychnia which may be introduced into the system, with safety to health and life. With respect to its bitterness, we find that one grain only of strychnia imparts a decided and persistent bitterness to at least 40,000 grains of water, or upwards of half a gallon; but the taste of the same quantity of strychnia is perceptible when diluted with 420,000 grains, or six gallons of water.

But it must be remembered that most beers contain free acetic acid in variable amount, and that, therefore, strychnia added to beer usually becomes converted into acetate of strychnia. Now this salt, although very bitter, is less so than strychnia itself; consequently, a larger amount of the combined alkaloid is necessary to impart the same degree of bitterness.

We have ascertained that not less than three grains of acetate of strychnia are needed to give a persistent and suitable bitterness to half a gallon of water; it is therefore evident that not less than one grain and a half of strychnia in combination with acetic acid would be required to impart such a degree of bitterness to the same quantity of beer as to render its use in the preparation of bitter beer a matter of any moment. Now a quantity of strychnia so considerable as this could not be taken in beer consistently with safety, or even without danger to life. Were the quantity present in beer much below this, its use would still be attended with the greatest danger, since there is much reason to believe that this poison, like digitalis, colchicum, and certain other active vegetable products, is liable to be retained in the system, and to accumulate in it to such an extent, as at length to give rise to the tetanic spasms and other consequences symptomatic of poisoning by strychnia.

From all these considerations, therefore, we conclude that the statement made concerning the use of strychnia in beer, under any circumstances, is scarcely consistent with probability.

Analyses and Tests for Strychnia.

We now come to treat of the means by which the presence of strychnia in beer may be determined.

While chemical science, in its present condition, fails to detect many compounds derived from the organic kingdom, it is fortunate that this is not the case with the majority of the more deadly vegetable substances, as prussic acid, morphia, nicotina, brucia, and also strychnia.

Strychnine, or strychnia, is met with in two states—the one impure, the other pure.

In its impure condition, it is in combination with another vegetable principle, termed brucia, and for which there exists a very characteristic chemical test.

Commercial strychnia is very commonly impure, being admixed with a greater or less amount of brucia; much, however, of the strychnia manufactured contains very little of this principle, and is even frequently entirely destitute of it, so that no reliance, for the detection of strychnia, can be placed upon this contamination, since it is not constant. The principal test for brucia, and indirectly for strychnia, when the two occur together, is nitric acid, with which reagent a blood-red colour is developed.

For the alkaloid in its pure state there are likewise appropriate and most satisfactory tests.

The first and chief of these was proposed in 1843 by Marchand*, who showed that if a small quantity of strychnia be rubbed with a few drops of concentrated sulphuric acid, or oil of vitriol, containing a very minute proportion of nitric acid, no change of colour would ensue; but that on the addition of a small quantity of the puce-coloured oxide of lead, or even of litharge, a beautiful violet colour is immediately developed, which quickly changes, first to red, and then to an orange tint.

A modification of this test was subsequently proposed by Mack†, who suggested the substitution of peroxide of manganese for the oxide of lead. In this case precisely the same changes take place, and the same development and play of colours is produced.

Again, Otto‡ has suggested a further modification and improvement of the test by the employment of chromate of potash.

Lastly, Mr. Thompson recommended, in 1849, the use of bichromate of potash.§

One or two drops of strong sulphuric acid are to be allowed to fall on a minute quantity of strychnia, and in this a small fragment of bichromate of potash should be placed, around which a beautiful violet colour will be rapidly and continuously formed, so long as any of the strychnia or bichromate of potash remains undissolved and unacted upon.

The whole of these tests are exceedingly delicate and satisfactory—the last one particularly so; and by it so minute a quantity as the one-thousandth of a grain of pure strychnia may be detected. The colours developed are the same whichever reagent be employed, but the tints are seen to the greatest advantage when the chromate or bichromate of potash is used, on account of the solubility of these salts.

The reagents noticed all act in the same way—namely, by parting with oxygen, which passes to and oxidates the strychnia.

The advantage of the bichromate of potash over the chromate, is attributable to the much greater quantity of oxygen contained in it.

The identification of strychnia, when obtained in a separate and crystallised state, is therefore perfectly conclusive.

When, however, we come to operate upon a dense and complex liquid, such as beer, the difficulties are somewhat enhanced, since it is necessary to obtain, in a separate form, the strychnia dissolved in it. This object may be effected in at least two ways. The first method of separation is as follows:—

Half a gallon of the beer is to be evaporated to dryness in a water-bath; the extract is then to be treated with about ten or twelve ounces of alcohol, the mixture being occasionally stirred with a glass rod. The alcohol dissolves out the strychnia, and takes up scarcely anything else except some colouring matter. The alcoholic solution is then to be filtered, treated with a sufficient quantity of liquor plumbi diacetatis, filtered, treated with a few drops of dilute sulphuric acid, again filtered, evaporated to dryness, and the residue then tested with any of the reagents above described.

The employment of acetate of lead is rendered necessary to effect the separation of the small quantity of organic matter taken up by the alcohol, and the sulphuric acid is required in order to get rid of any excess of lead. The same object may be better attained in the following manner:—

* Journal de Pharmacie et de Chimie, 3me Series, tom. iv., p. 200, 1843.
† Buchner's Repertorium, second series, vol. xliii.
‡ Pharmaceutisches Central Blatt, Dec. 30. 1846.
§ Pharmaceutical Journal, vol. ix. p. 24.

In place of using alcohol, boil the extract with spirits of wine, filter, distil off the spirit, add a small quantity of solution of potash to the aqueous residue, and shake up with about an ounce of ether; this will take up the strychnia, and being lighter than water, will float on the surface, leaving the impurities in the water beneath. Lastly, the ethereal solution is to be evaporated, and the residue tested.

Another method of extraction is by means of animal charcoal. The extraordinary power possessed by this substance for absorbing gases and various other bodies, especially those active principles of vegetables termed alkaloids, is well known; and of this property advantage may be taken in the present instance.

From two to three ounces of animal charcoal are to be diffused through half a gallon of beer, and allowed to digest in it with frequent agitation from eight to twelve hours. The beer is to be filtered, when it will be observed that it has lost much of its colour and a portion of its bitterness; the charcoal, the whole of which should be collected on the filter, is then to be boiled with ten ounces of spirit of wine; and either of the plans described above may be adopted for obtaining the strychnia in a state of purity.

As the process of evaporation is one of considerable time and trouble, and as it is difficult to obtain a perfectly colourless residue in this way, the last method proposed for isolating the strychnia will be found the most convenient, as well as expeditious.

If the method of purification by ether and potash be followed, the spirit of wine, after filtration, is to be distilled off, the aqueous residue treated with about forty drops of solution of potash; and, then, after the lapse of a few minutes, an ounce or so of ether is to be added. This floats and holds the strychnia in solution.

In the second method of purification, the spirits of wine, after filtration, is to be treated with solution of diacetate of lead, about two drachms being usually sufficient; this, in combination with the organic matter which it throws down, is to be got rid of by a second filtration; lastly, a few drops of dilute sulphuric acid are to be added, the liquid again filtered, evaporated, and tested.

The two methods may even be combined, and the potash and ether may be added to the aqueous residue after the employment of the solution of lead and sulphuric acid, and in this way a very pure ethereal solution may be obtained. Of the two plans, the necessary precautions being observed, the first is perhaps the best.

Whichever proceeding for the extraction and purification of the strychnia be followed, several precautions are required.

If charcoal be employed for the extraction of the strychnia, it is not simply sufficient to add the charcoal to the beer, but both before and during filtration the beer must be well shaken several times.

If the method of purification by means of ether and potash be adopted, the spirit of the spirits of wine used to separate the strychnia from the charcoal should be entirely distilled or evaporated off, which may be known to be the case when the vapour evolved ceases to smell spirituous, and to be pungent. If this precaution be not observed, the ether, in place of floating, will combine with the water and spirit.

The ether employed should be strong sulphuric ether, and it should not only be well shaken, with the aqueous residue, more than once, but should be allowed to remain in contact with it for about half an hour, so that it may have time to dissolve out the strychnia.

In adding the potash care must be taken lest too little or too much be employed; if too little be used, some of the organic matter will remain in suspension; and if too much the aqueous solution will become darkened.

If the plan of purification with acetate of lead and sulphuric acid be practised, the lead must be added until it occasions no further precipitate, and the sulphuric acid also, until the insoluble sulphate of lead ceases to fall.

When it is remembered that concentrated sulphuric acid darkens, and even chars organic substances of all kinds, the necessity for a complete separation of the organic impurities will become apparent.

A green colour in the course of a minute or two almost constantly forms around the fragments of bichromate of potash, even when strychnia is not present, and this takes place very quickly indeed if any ether, sugar, or organic matter remains on the glass. It is possible that this colour, formed by the green oxide of chrome which becomes liberated, might be erroneously regarded as an evidence of the presence of strychnia.

We refer to all these particulars because unless pointed out they are calculated to lead, as they have more than once done with ourselves, to embarrassment and disappointment.

Before proceeding to analyse the samples, preliminary experiments were made with beer to which we had purposely added from half a grain to a grain of strychnia to the gallon of beer, and we found that we could invariably succeed in detecting, by the methods indicated, the presence of the poison in these minute quantities.

We thus perceive how conclusive are the tests employed for the detection of strychnia.

But we need not confine ourselves to chemistry in order to obtain evidence of the presence of strychnia in organic fluids, as physiology will disclose the fact almost equally well.

One gallon of beer, to which a grain of strychnia had been purposely added, was evaporated to an extract; this was boiled for nearly an hour in a mixture of ether and alcohol; the solution, after filtration, was evaporated, and the residue, of a soft consistence, was administered as a pill to a small rabbit. In the course of two minutes the animal became affected with convulsive twitchings; these were almost immediately succeeded by a paroxysm of convulsions, in which the animal threw himself on his side, the head and neck being thrown back, the hind and fore legs extended and drawn backwards. The first paroxysm was rapidly followed by others, and in less than five minutes after the administration of the pill the rabbit was dead, it having exhibited the peculiar symptoms which characterise poisoning by strychnia.

In the course of our examination of the samples of beer, the results of the analyses of which are given in the following tables, we have not confined ourselves to chemical methods of research, but have also employed the microscope when that powerful instrument was calculated to throw any light upon the subject; and, in the progress of our experiments, in addition to resorting to the aids furnished by chemistry and the microscope, we have appealed even to the evidence afforded by physiology and pathology.

ANALYSES OF THE BITTER BEER, PALE ALE, OR INDIAN PALE ALE, BREWED BY MESSRS. ALLSOPP AND SONS.

Twenty samples, procured as follows:—

1*st Sample.* — Selected from the stores at King William-street, London-bridge; from cask.

Analysis. — The products of *malt* and *hops*, and the constituents of *pure spring water. Not any other ingredient found, either organic or inorganic.*

2*nd Sample.* — Selected from the stores at Blackwall; from butt; brewed Jan. 9th, 1852.

Analysis. — *Results the same as in the first examination.*

3*rd Sample.* — Selected from the stores of Pale India Ale for exportation, at Blackwall, belonging to Messrs. Byass & Co.; from butt; brewed March 20th, 1851.

Analysis. — *Results the same as in the first examination.*

4*th Sample.* — Selected from the stock of India Pale Ale, for exportation, at Blackwall, of Messrs. Friend & Co., export agents, 2. Abchurch-lane; from butt, brewed March, 1851.

Analysis. — *Results the same as in the first examination.*

5*th Sample.* — Selected from the stock of E. and G. Hibbert, 7. Jewry-street; bottled expressly for exportation.

Analysis. — *Results the same as in the first examination.*

6th Sample.— Selected from stock of Messrs. White and Price, agents, 45. and 54. Mark-lane; in bottle.

Analysis. — Results the same as in the first examination.

7th Sample.—Selected from stock of Messrs. Moline, Harper, & Moline, agents, 5. Adelaide-place, London-bridge; in bottle.

Analysis. — Results the same as in the first examination.

8th Sample. — Selected from stock of Mr. N. Eastty, agent, 132. Upper Thames-street; in bottle.

Analysis. — Results the same as in the first examination.

9th Sample. — Selected from stock of Messrs. Crimp & Ward, agents, 7. Old Broad-street; in bottle.

Analysis. — Results the same as in the first examination.

10th Sample. — Selected from the stock of Mr. W. Bovill, export agent, 63. Cannon-street, City; represents thirty butts, brewed 23d December, 1850.

Analysis. — Results the same as in the first examination.

11th Sample. — Selected from the stock of Mr. W. Bovill, export agent, 63. Cannon-street, City; represents sixty butts, brewed November, 1851.

Analysis. — Results the same as in the first examination.

12th Sample. — Selected from stock of Mr. W. Mabey, agent, 64. Cornhill; and Lloyd's Coffee House, Royal Exchange; in bottle.

Analysis. — Results the same as in the first examination.

13th Sample. — Selected from stock of Mr. Leonard Clow, agent, 19. Princes-street, Fitzroy-square; in bottle.

Analysis. — Results the same as in the first examination.

14th Sample. — Selected from stock of Messrs. Findlater, Mackie, & Co., agents, 1. Upper Wellington-street, Covent-garden; from butt.

Analysis. — Results the same as in the first examination.

15th Sample. — Selected from stock of Messrs. Daukes & Rodick, agents, Exeter-hall Vaults, Strand; from butt.

Analysis. — Results the same as in the first examination.

16th Sample. — Selected from stock of Messrs. Childs & Co., agents, 43. Leicester-square; in bottle.

Analysis. — Results the same as in the first examination.

17th Sample.—Selected from the stock of Messrs. M. B. Foster & Sons, agents, 56. Brook-street, Bond-street; in bottle.

Analysis. — Results the same as in the first examination.

18th Sample. — Selected from the stock of Messrs. G. and J. H. Blockey, agents, 80. Jermyn Street; in bottle.

Analysis. — Results the same as in the first examination.

19th Sample. — Selected from the stock of Mr. G. R. Nisbett, 11. Jermyn-street, St. James's; in bottle.

Analysis. — Results the same as in the first examination.

20th Sample. — Selected from the stock of Messrs. Wallis & Co., agents, Millbank-street, Westminster; in bottle; brewed October, 1851.

Analysis. — Results the same as in the first examination.

ANALYSES OF THE BITTER BEER, PALE ALE, OR INDIAN PALE ALE BREWED BY MESSRS. BASS AND CO.

Twenty samples, procured as follows: —

1st Sample. — Selected from the stores at Blackwall; in butt; brewed 25th November, 1851; intended for home consumption.

Analysis. — The product of *malt* and *hops*, and the constituents of *pure spring water. Not any other ingredient found, either organic or inorganic.*

2nd Sample. — Selected from the stores at Blackwall; in butt; brewed 3rd March, 1852; intended for home consumption.

Analysis. — Results as in the first examination.

3rd Sample.—Selected from the stores at Blackwall; in hogshead; brewed 5th March, 1852; intended for exportation.

Analysis.—*Results as in the first examination.*

4th Sample.—Selected from the stock of Messrs Saunders & Cameron, export agents, 7. Hart-street, Crutched-Friars; in bottle.

Analysis.—*Results as in the first examination.*

5th Sample.—Selected from stock of Messrs. J. Hobson & Son, export agents, 45. Leadenhall-street; in bottle; brewed March, 1851.

Analysis.—*Results as in the first examination.*

6th Sample.—Selected from stock of Messrs. Crimp & Ward, import agents, 1. Cushion-court, Old Broad-street; in butt, brewed January, 1852.

Analysis.—*Results as in the first examination.*

7th Sample.—Selected from stock of Mr. E. Favenc, 41. Threadneedle-street, City.

Analysis.—*Results as in the first examination.*

8th Sample.—Selected from stock of Messrs. Crimp & Ward, import agents, 1. Cushion-court, Old Broad-street; brewed December, 1851; bottled in March.

Analysis.—*Results as in the first examination.*

9th Sample.—Selected from stock of Mr. Leonard Clow, import agent, 19. Princes-street, Fitzroy-square; in bottle.

Analysis.—*Results as in the first examination.*

10th Sample.—Selected from stock of Messrs. Findlater, Mackie, & Co., agents, Upper Wellington-street, Covent-garden; in bottle.

Analysis.—*Results as in the first examination.*

11th Sample.—Selected from stock of Messrs. Field, Wardell, & Co., import agents, 22. Henrietta-street, Covent-garden; brewed March 6, 1851; bottled June 7, 1851.

Analysis.—*Results as in the first examination.*

12th Sample—Selected from stock of Messrs. Daukes & Rodick, agents, 3. Exeter-street, Strand; in bottle.

Analysis.—*Results as in the first examination.*

13th Sample.—Selected from stock of Messrs. Childs & Co., Agents, 43. Leicester-square; in bottle.

Analysis.—*Results as in the first examination.*

14th Sample.—Selected from stock of Messrs. M. B. Foster & Sons, agents, 56, Brook-street; in bottle.

Analysis.—*Results as in the first examination.*

15th Sample.—Selected from stock of Mr. C. Halson, agent, 40. Cross-street, Finsbury; bottled in 1850.

Analysis.—*Results as in the first examination.*

16th Sample.—Selected from stock of Mr. C. Halson, agent, 40. Cross-street, Finsbury; in bottle; bottled March, 1850.

Analysis.—*Results as in the first examination.*

17th Sample.—Selected from stock of Mr. R. Miller, agent, 6. Cross-street, Finsbury; in bottle; part of 30 hhds.; brewed 15th Nov., 1851.

Analysis.—*Results as in the first examination.*

18th Sample.—Selected from stock of Messrs. G. Pay & Son, agents, 8. Rodney-buildings, New Kent-road; in bottle.

Analysis.—*Results as in the first examination.*

19th Sample.—Selected from stock of Mr. Blockey, agent, 104. Ebury-street, Pimlico; in bottle.

Analysis.—*Results as in the first examination.*

20th Sample.—Selected from stock of Messrs. Kinahan, Sons, & Smyth, agents, 8. Great Windmill-street, Haymarket.

Analysis.—*Results as in the first examination.*

We have now reported the results of the chemical and microscopical examination of FORTY SAMPLES of bitter beer, pale ale, or India pale ale, brewed by Messrs. Bass & Co. and by Messrs. Allsopp & Sons, and obtained under circumstances which precluded the possibility of error, fallacy, or of preparation for the selection.

Many of the samples were taken from the stores of Messrs. Allsopp & Sons, and of Messrs. Bass & Co., at Blackwall and in the City, while others were procured from the principal agents and bottlers in the metropolis. In all cases, the utmost facility for investigation was afforded.

Some of the Ales were destined for exportation, others for the home trade; whilst the dates at which they were brewed extended over a period of nearly two years. Not any sample of beer analysed was brewed *after* the promulgation of the statement concerning the employment of strychnia.

The stores at Blackwall belonging to Messrs. Bass & Co., and Messrs. Allsopp & Sons, each comprise many thousand butts, hogsheads, and barrels of bitter beer, which, arranged in tiers, and piled one above the other, extend over a space of several acres. The whole of these stores were thrown open to us, and liberty given to tap whichever casks we chose to select. In the case of the agents and bottlers the same liberty of choice was permitted, and in this manner butt after butt was opened and samples taken.

It should be observed that the casks are all branded with the names of the brewers, and that in most cases a register is kept, not only at the breweries and stores, but also at the agents and bottlers, of the dates at which the different lots were brewed, all chance of mistake in the selection of the samples being thus obviated by reference to the marks and registries.

Under the above circumstances, and after the most scrutinising examination, microscopical, chemical, and physiological, we have failed to detect the smallest atom of strychnia, or, indeed, of any other ingredients than the products of malt and hops, and the constituents of pure spring water.

Unknown to, and wholly independent of ourselves, those distinguished chemists, Messrs. Graham & Hoffman, at the request of Messrs. Allsopp & Sons, subjected several samples of their bitter beer to analysis. In a published report, it is stated that they failed to discover the slightest trace of strychnia.

Those gentlemen likewise placed themselves in communication with M. Payen, with whom the report was stated to have originated, in order to ascertain from himself the exact nature of the statement made by him.

It appears that the charge made by M. Payen was founded on information obtained by M. Pelletier, the celebrated preparer of quinia and other alkaloids, in France, who at one time received an order for a large quantity of strychnia, the destination of which was at first unknown to him, but which he afterwards found was exported to England, and used, so he informed M. Payen, to complete the bitterness of certain kinds of beer.

"We have reason to know," write Messrs. Graham & Hoffman, "although it is not stated by M. Payen, that these remarks of Pelletier refer to a period of ten or twelve years past; and further, although not informed of the amount of the order, we have good authority to state that fifty or a hundred ounces would have been considered a large order for strychnia at that time. The calculation already given shows how utterly insignificant such a supply of strychnia would be for its imagined application in the pale ale breweries. It is likewise known that the manufacture of strychnia has not been on the increase in France of late years."

Finally, M. Payen expressed his regret that he had ever said the fraud *appeared* to have been practised; although, at the time, he accompanied this observation with the further remark that *the falsification had no doubt ceased.*

M. Payen excused the statement made by him, on the ground that he did not originate it, and that the charge had been made public in the year 1850, in a French work treating of the Adulterations and Falsifications of Food. We have procured the publication in question, and find that it refers to the matter rather as a vague and uncertain report, than as a distinct allegation of the use of strychnia by English brewers; the author, concluding his remarks on the subject in the following words:—"We hasten to say that this sophistication, like the preceding, is far from being based upon ascertained facts." *

* Dictionnaire des Altérations et Falsifications des Substances Alimentaires, &c. p. 118.

From the pure and wholesome nature of the ingredients employed, the moderate proportion of alcohol present, and the very considerable quantity of aromatic anodyne bitter, derived from hops, contained in these beers, they tend to preserve the tone and vigour of the stomach, and conduce to the restoration of the health of that organ when in a state of weakness or debility.

These bitter beers differ from all other preparations of malt in containing a smaller amount of extractive matter, thus being less viscid and saccharine, and consequently more easy of digestion: they resemble, indeed, from their lightness, *a wine of malt* rather than an ordinary fermented infusion; and it is very satisfactory to find that a beverage of such general consumption is entirely free from every kind of impurity.

The admirers, therefore, of the bitter beer, manufactured by the celebrated brewers we have mentioned, may enjoy with advantage this, their favourite beverage. The report so commonly circulated, that it contained a deadly poison, was a severe reflection on the sagacity and judgment of the members of the medical profession, because it is perfectly well known that "bitter beer or pale ale" first acquired and afterwards maintained its general celebrity in consequence of the universal recommendation of our profession—a recommendation which is now found to have had the best possible foundation.

ON POISONOUS CAYENNE PEPPER.

Cayenne Pepper consists of the pods or seed-vessels, ground and reduced to powder, of different species of *Capsicum*, but principally of *C. annuum*, and *C. frutescens;* the latter species, being stronger and better flavoured, yields the best description of Cayenne pepper.

The genus capsicum belongs to the *Solanaceæ* or night-shade family, which also includes the potato-plant.

Capsicum annuum is a native of America, but is cultivated in the West and East Indies, and to some extent in green-houses, in England and other European countries.

It is an annual, herbaceous plant, and, according to M'Culloch, "one of the hardiest and most productive plants found in tropical climates, growing luxuriantly in almost all dry soils, however indifferent." In this country it flowers in July, and ripens its pods in October; when immature, the berries are green, and only gradually become red as they grow ripe; they are used both in the green and red states, and in the undried and dried conditions: in the recent state they are employed for pickling; when dried they are used in medicine; and, reduced to powder, they constitute Cayenne pepper.

The dried berries ordinarily sold as *chillies* are of this species; in this condition they are more or less shrivelled, oblong, broad at the base, pointed at the distal extremity, the calyx and stalk being usually adherent to the broad end. They vary much in size and form; the largest are two or three inches long, and at the base are an inch or more wide; they are distinguished, according to their size and shape, into long-podded, short-podded, and heart-shaped.

The pods of this capsicum are hot and pungent, but they have *no aroma.*

The pods of *Capsicum frutescens* constitute what is known as *guinea or bird-pepper*, and when ground they furnish the best description of Cayenne pepper. They are small, scarcely an inch in length, a line or two broad, and of a deep orange-red colour. Each berry encloses usually about a dozen flattened, reniform seeds.

The pods are hotter and more fiery than those of *C. annuum;* they are likewise to some extent *aromatic.*

Two other species of Capsicum have been denominated, from the form of the fruit, *Cherry chilly* or *Cherry pepper*— *Capsicum cerasiforme,* and *Bell pepper* or *Capsicum grossum.*

The composition of capsicum berries is shown in the following analyses made in the years 1816 and 1817.

BUCHOLT'S ANALYSIS.*

(1816.)

Acrid soft resin (*capsicin*)	4·0
Wax	7·6
Bitter aromatic extractive	8·6
Extractive with some gum	21·0
Gum	9·2
Albuminous matter	3·2
Woody fibre	28·0
Water	12·0
Loss	6·4
Fruit of *Capsicum annuum,* without seeds	100·0

BRACONNOT'S ANALYSIS.†

(1817.)

Acrid oil	1·9
Wax with red colouring matter	0·9
Brownish starchy matter	9·0
Peculiar gum	6·0
Animalised matter	5·0
Woody fibre	67·8
Salts: citrate of potash, 6·0 Phosphate of potash, and Chloride of potassium, 3·4	9·4
Fruit of *Capsicum annuum*	100·0

Of *capsicin,* the active principle of cayenne, Pereira gives the following account: —

" Obtained by digesting the alcoholic extract in ether, and evaporating the ethereal solution. It is a thick liquid, of a yellowish-red or reddish-brown colour, which becomes very fluid when heated, and at a higher temperature is dissipated in fumes. Half a grain of it volatilised in a large room causes all who inspire the air of the room to cough and sneeze. By exposure to air and light it solidifies; it is decolorised by chlorine; it is slightly soluble in water and in vinegar, but very much so in alcohol, ether, oil of turpentine, and the caustic alkalies; with baryta it forms a solid acrid combination."

Each capsicum berry is made up of three parts — an outer skin or epidermis, parenchyma, and seeds.

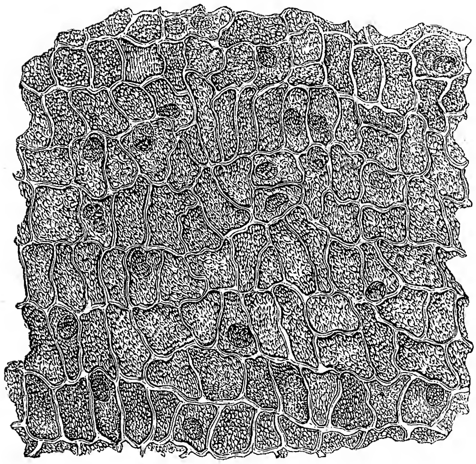
The *epidermis* consists of a single layer of flattened cells, tortuous and angular in form; viewed on the outer or upper surface, the borders of the cells are seen to be well defined. *Fig.* 135.

On the inner surface the cells are less angular, but more tortuous, the margins broader, and the lines of junction of contiguous cells indicated by rows of minute dots.

When fragments of the epidermis are seen immersed in water, numerous oil-globules of a globular form, and of a deep and beautiful orange-red colour, are visible; some of these are imbedded in the cavities of the cells, but the majority float freely in the surrounding water. *Fig.* 136.

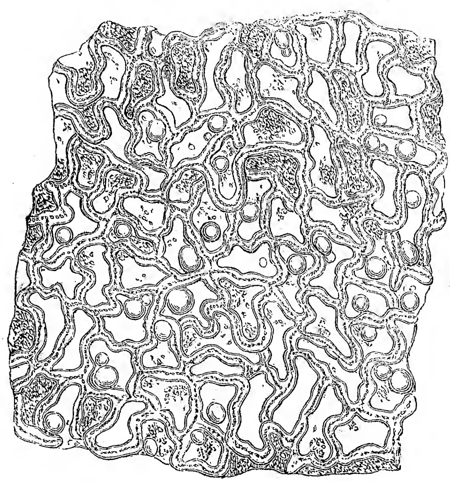
* Gmelin, Handb. d. Chem. ii. 1310. † Ann. de Chim. Phys. vi. 122.

Fig. 135.
EPIDERMIS OF CAPSICUM BERRY.



A fragment of the *epidermis* of the capsicum berry, viewed on its outer surface.

Fig. 136.
EPIDERMIS OF CAPSICUM BERRY.

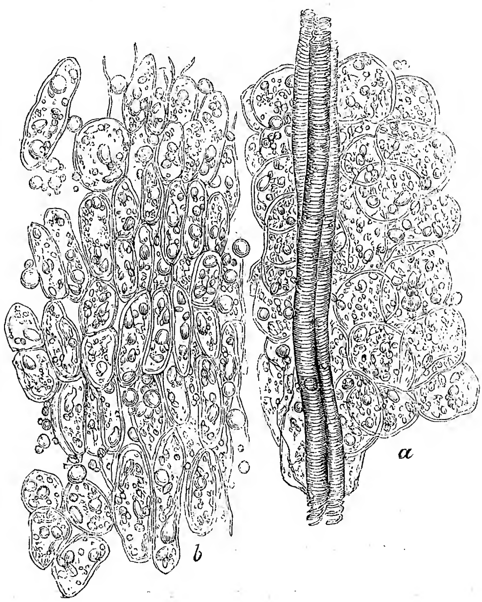


A fragment of the *epidermis* of the capsicum berry viewed on its inner surface.

The *parenchyma*, which unites the seeds with each other, and the whole with the peduncle, is likewise composed of cells, but these are smaller than those of which the epidermis is formed; they are of a rounded or oval form, their parietes are thin, and their cavities contain a very large quantity of oil, in the form of innumerable droplets, many of considerable size, and which impart to this object, viewed under the microscope, a very beautiful appearance. *Fig.* 137.

Fig. 137.

PARENCHYMA OF CAPSICUM BERRY.



a. Parenchyma situated immediately beneath the epidermis; the cells in this situation are of a more rounded form, and are traversed by spiral vessels and woody fibre. *b.* The *parenchyma* surrounding the seeds.

In the *seed*, two parts — the covering of the seed and the seed itself — require to be described.

The covering of the seed possesses a very peculiar structure, which it is difficult fully to understand, and therefore not easy to describe accurately. It is of a bright yellow colour, and of considerable thickness. Viewed under the microscope, its outer surface presents a cellular texture, the margins of what appear to be the cells being thick, tortuous, and indented, and the cavities dark and depressed, as though they were rather apertures than the hollow interiors of the cells.

Vertical sections of this covering present a very singular appearance; in this view it appears as though composed of a number of tooth-like processes, having a somewhat radiate disposition, with intervals between each process, the points or summits of the teeth being surmounted by a layer of the tortuous cells with thick walls, referred to in the previous paragraph.

The seed proper consists of minute angular cells, having thick and colourless parietes, and the cavities of which are filled with molecules and globules of oil of a yellowish or reddish-yellow colour, but do not contain starch. *Fig.* 138.

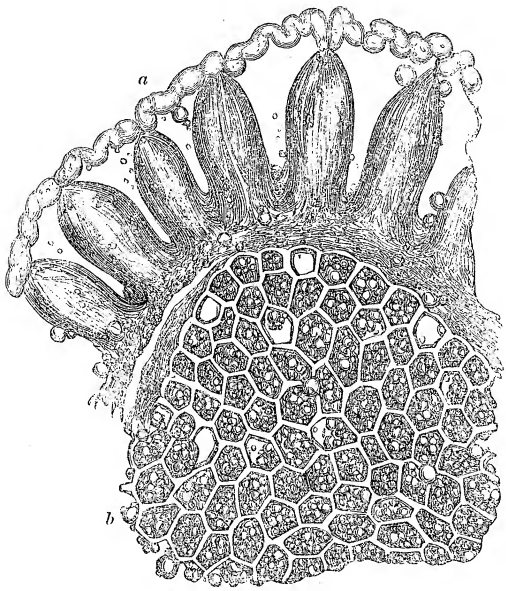
We will now proceed to cite the remarks of the principal writers on the subject of the sophistication of food, in relation to cayenne pepper and its adulterations.

"It is sometimes adulterated," writes Accum*, "with red lead, to prevent its becoming bleached on exposure to light. This fraud may be readily detected by shaking up part of it in a stopped vial containing water impregnated with

* Loc. cit. p. 293.

Fig. 138.

VERTICAL SECTION OF SEED OF CAPSICUM.



a. The *covering of the seed*. *b*. The *seed proper*.

sulphuretted hydrogen gas, which will cause it speedily to assume a dark muddy-black colour; or the vegetable matter of the pepper may be destroyed by throwing a mixture of one part of the suspected pepper and three of nitrate of potash (or two of chlorate of potash) into a red-hot crucible, in small quantities at a time. The mass left behind may then be digested in weak nitric acid, and the solution assayed for lead by water impregnated with sulphuretted hydrogen."

According to Brande*, "many varieties of capsicum probably enter into the composition of *cayenne pepper*, which consists of their powder mixed with a very variable proportion, but often about half of its weight, of common salt. Other adulterations are practised upon it, such as the addition of coloured saw-dust, and, according to some, of red lead; this latter fraud is very easily detected by the rapidity with which it sinks in water through which the pepper is diffused; or by digesting it in dilute nitric or in acetic acid, and then applying to the filtered solution the usual tests for the detection of lead, such as sulphuretted hydrogen and sulphate of soda — the former giving a black and the latter a white precipitate."

We find M'Culloch† stating that "cayenne is sometimes adulterated with muriate of soda, and sometimes with a very deleterious substance — the red oxide of lead; but this fraud may be detected by its weight and by chemical tests."

"Cayenne pepper," writes Mr. Mitchell‡, "is often subject to a very deleterious fraud. It, when exposed to the light for any length of time, always loses the fine bright red colour it at first possesses, and therefore becomes deteriorated in the eyes of the purchaser; in order to prevent this, a quantity of red lead is added, which not only causes it to keep its colour for a greater length of time, but also adds to its weight, and consequently to the profit of the vendor."

* Manual of Pharmacy and Materia Medica, 1839, p. 149.
† Dictionary, p. 943.
‡ Treatise on the Falsifications of Food, p. 272.

"Cayenne pepper," according to Normandy*, "is often adulterated with *common salt*, finely pulverised *brick-dust*, and, it is said, even with *red lead!*

"These frauds may be readily detected by treating a portion of the sample with pure water, filtering, and testing the filtrate with solution of nitrate of silver. If a white, curdy precipitate, or only a white turbidness, appears, completely and immediately soluble in ammonia, and re-precipitated by an excess of nitric acid, it is chloride of silver, and it indicates that chloride of sodium, common salt, is present. The precipitated chloride of silver is washed, dried, fused, and weighed; 144 of chloride of silver represent 60 grains of common salt.

"The portion of cayenne pepper which remained in an insoluble state, after treatment with water, should now be treated by acetic or by nitric acid, and the whole thrown on a filter. A current of sulphuretted hydrogen must now be passed through the filtrate; and if this produces a black precipitate, it is sulphuret of lead, and of course red lead was present.

"The presence of *brick-dust*, *ochre*, &c. may be ascertained by incinerating the portion which could not be dissolved by the acid; the above inorganic impurities will of course be left behind."

We will now proceed to describe the methods of investigation adopted in the researches the results of which will shortly be detailed.

Each sample of cayenne was first subjected to microscopic examination, with the view of discovering whether any mineral colouring matter had been employed to heighten the colour of the article; for it is not only vegetable structures that the microscope is capable of detecting and discriminating, but by it also the presence in cayenne of even a *very minute quantity* of any coloured mineral ingredient may generally be discovered.

It having been determined in this way which of the samples were admixed with mineral colouring matters, the whole of the samples were next submitted to a second microscopic scrutiny, in order to ascertain whether any of them contained rice, wheat-flour, turmeric, or any other description of foreign vegetable admixture.

The microscopic examination of the samples being thus concluded, they were next examined chemically, for the purpose of determining the nature of the mineral ingredients employed.

With this view, about half a drachm of each of the samples was burned to an ash in a crucible. The ash was treated with about one scruple of strong nitric acid, and, after the lapse of three or four hours, two or three drachms of distilled water were added, and the mixture filtered: one part of the clear solution was tested for lead, and the other for iron.

The tests used for *lead* were hydrosulphuret of ammonium and iodide of potassium: the first gives a black precipitate of sulphuret of lead, and the second a bright-yellow one of iodide of lead.

As iron gives a greenish-black precipitate, both with hydrosulphuret of ammonium and sulphuretted hydrogen, and as this might lead to the erroneous inference that lead was present when it was not, it is proper in all cases to employ the iodide-of-potassium test.

When the quantity of lead present is considerable, a drop or two of hydrosulphuret of ammonium allowed to fall into a test-tube containing a few grains of cayenne, suspended in distilled water, will afford tolerably certain indications of the presence of that metal: the mixture will lose its bright colour, and gradually, especially after the lapse of some hours, become dark and muddy.

As will be perceived by the quotations given, some writers advise that the mineral substance should be dissolved by means of dilute nitric acid added to unincinerated cayenne. But when the solvent is applied in this manner, it seldom acts satisfactorily, and the tests fail to give their characteristic reactions. The hydrosulphuret of ammonium may, indeed, give a black precipitate, but then it gives a somewhat similar one with iron, while iodide of potassium rarely acts on the lead contained in such a solution at all; and if the sample be adulterated with starch, as it frequently is, we get a blue in place of

* Handbook of Chemical Analysis, p. 155.

a yellow precipitate. It is therefore necessary, in testing for lead, to incinerate in all cases.

As *iron* is frequently contained in small quantity in capsicum berries, it is necessary, in order to determine the presence of this metal in unusual amount, to perform, not merely a qualitative, but a quantitative, analysis, in every case in which lead was not ascertained to be present.

The tests employed for iron are either a solution of ferrocyanide of potassium or ammonia; by the first re-agent the iron is converted into Prussian blue, and by the second it is precipated in the state of hydrated oxide.

Having tested for both lead and iron, we shall have determined the nature of the mineral colouring agents employed in the majority of cases, whether it be *red lead* or some red earth containing iron, as *red ochre*, *Venetian red*, or *brick-dust*. But it will happen that in some few cases neither lead nor an excess of iron can be discovered; it will then be necessary to test for another substance occasionally employed — viz., cinnabar, vermilion, or sulphuret of mercury.

As *mercury* sublimes at a red heat, we cannot proceed in the analysis by incineration; the solvent must be added to the cayenne direct, and this solvent must consist of aqua regia, which is a mixture of nitric and hydrochloric acids, in the proportions of one part of the former to two of the latter acid.

About a scruple of aqua regia should be added to half a drachm of cayenne, and after an hour or two, a small quantity of distilled water; the mixture must next be filtered, and the excess of acid got rid of by evaporation, which must be conducted nearly, but not quite, to dryness; a little water must then again be added, and the solution tested.

The tests employed were liquor potassæ and iodide of potassium. The former gives a yellow precipitate, and the latter either a yellow or more commonly a beautiful scarlet-coloured precipitate of biniodide of mercury. The colour produced on the addition of iodide of potassium would always be bright scarlet, were it not that the presence of organic matter in the solution modifies the action of the test. The solution of iodide of potassium should be added in very minute quantity, as the iodide or biniodide is readily and almost instantly dissolved in an excess of this re-agent; and it should be known that very often, when the colour of the precipitate is rather yellow than red, after standing an hour or two it will frequently change to the characteristic scarlet hue.

But there is still another adulteration to which cayenne pepper is liable, which remains to be treated of — viz., that with *chloride of sodium*, or *common salt*.

Whenever the colour of any sample of cayenne is particularly deep and bright, and yet in which the microscope does not detect any mineral substance, this adulteration is to be suspected.

If, after exposure to the air, the colour of the suspected cayenne becomes deeper, and the paper stained and wetted, there can no longer be any doubt of the adulteration, and a chemical analysis is thus rendered, in the majority of cases, unnecessary. The saturation of the paper is due to the absorption of moisture from the air by the chloride of calcium or magnesium, with which salt is ordinarily contaminated.

In some doubtful cases, however, recourse must be had to chemical means of investigation.

There are two methods of proceeding which may be followed: either a portion of cayenne may be diffused through a large quantity of distilled water, which after filtration may be tested with nitrate of silver; or the cayenne may be incinerated, and the ash tested for the salt. Of the two methods, the latter is the best; for the salt is so incorporated with the oil or acrid substance of the cayenne, that it does not readily become disengaged by mere diffusion in water.

Much of the colour of cayenne is located in the acrid substance, which has many of the properties of oil, and on the presence of which the active properties depend. Now it is on this substance that salt acts, heightening its colour, extracting it from the cells, and rendering it more soluble; thereby not only deepening the colour, but increasing the pungency. In developing the colour, salt has the same effect as the alkalies, which are known to heighten greatly all vegetable colours.

To some it may appear as a somewhat harsh conclusion to regard the presence of salt in cayenne as an adulteration. That it is not so, however, will be evident, when it is known that it frequently constitutes a very considerable portion of the article, and also that it is often used to cover and hide other adulterations.

It might be thought that the presence of salt would be revealed plainly enough by the taste; but this is not the case, — for the acrid sensation produced almost as soon as cayenne comes in contact with the tongue immediately overpowers the flavour of the salt.

A consideration of the foregoing details will show that the satisfactory analysis of cayenne pepper is a task of no slight labour.

Results of the Microscopical and Chemical Examination of Twenty-eight Samples of Cayenne Pepper purchased at the Establishments of Grocers and Oilmen resident in the Metropolis.

1st *Sample.* — Purchased of A. Forsyth, 78. Ossulston-street, Somers-town.
Adulterated — consisting of a mixture of *ground rice, turmeric*, and *cayenne*, vividly coloured with a large quantity of RED LEAD.

2nd *Sample.* — Purchased of S. Rain, 8. Chapel-street, Somers-town.
Genuine.

3rd *Sample.* — Purchased of J. R. Dean, 52. Chapel-street, Somers-town.
Adulterated — consisting of a mixture of *turmeric, rice*, and *cayenne*, highly coloured with VERMILION, CINNABAR, or SULPHURET OF MERCURY.

4th *Sample.* — Purchased of J. Warwick, 22. Chapel-street, Somers-town.
Adulterated — consisting of large quantities of *rice, turmeric*, and *cayenne*, the whole being highly coloured with RED LEAD.

5th *Sample.* — Purchased of Mrs. J. Crouch, 57. Chapel-street, Somers-town.
Adulterated — containing a small quantity of *rice*, some *deal saw-dust*, and a very large quantity of a *ferruginous earth*, resembling *brick-dust.*

6th *Sample.* — Purchased of F. Ibbetson, 12. Skinner-street, Somers-town.
Adulterated — containing a very large quantity of *salt*, together with much *ferruginous earth.*

7th *Sample.* — Purchased of Mr. Reeves, Skinner-street, Somers-town.
Adulterated — containing RED LEAD.

8th *Sample.* — Purchased of A. Gain & Co., 44. Judd-street, Somers-town.
Adulterated — consisting of a mixture of *rice, turmeric*, and *cayenne*, vividly coloured with a large quantity of RED LEAD.

9th *Sample.* — Purchased of R. A. Hollis, 78. Judd-street, Somers-town.
Adulterated — consisting of a mixture of *salt, white mustard-husk*, and *cayenne*, the whole being highly coloured with a large quantity of a *red earth.*

10th *Sample.* — Purchased of Mrs. Hannah Hartley, 14. Brewer-street, Somers-town.
Adulterated — being coloured with RED LEAD.

11th *Sample.* — Purchased of F. Ibbetson, 10. Brewer-street, Somers-town.
Adulterated — containing a large quantity of *salt*, together with much *ferruginous earth.*

12th *Sample.* — Purchased of Edmondson & Co., 29. Tottenham-court-road, in bottle.
Adulterated — containing a very small quantity of RED LEAD.

13th *Sample.* — Purchased of J. Oulds, Tottenham-court-road, in bottle.
Genuine.

14th *Sample.* — Purchased of W. Bowley, Oil and Colourman, 110. Tottenham-court-road.
Adulterated — consisting of a mixture of *ground rice, turmeric*, and *cayenne*, the whole being highly coloured with a *ferruginous earth*, remarkable for its brilliancy and its difficult solution even in *aqua regia.*

15th *Sample.* — Purchased of Salmon & Co., 69. Tottenham-court-road.
Adulterated — containing a large quantity of *rice*, and much RED LEAD.

16th *Sample.* — Purchased of J. Revell, Oil and Colourman, Oxford-street, in bottle. Labelled thus:

"CLARKE'S
ECONOMICAL PEPPER-CASTOR."

Adulterated — containing *rice*, and a *red ferruginous earth.*

17*th Sample.* — Purchased of Westbrooke & Co., 21. Oxford-street, in bottle.
Adulterated — consisting of a mixture of *ground rice*, *turmeric*, and *cayenne*, highly coloured with a very large quantity of RED LEAD.
18*th Sample.* — Purchased of Messrs. Hedges & Butler, Regent-street.
Adulterated — containing *salt*.
19*th Sample.* — Purchased of Messrs. Fortnum & Mason, Piccadilly.
Adulterated — containing a small quantity of *salt*.
20*th Sample.* — Purchased of Russell & Co., King-street, Covent-garden.
Adulterated — containing *salt*, perceptible to the taste, and coloured with a *ferruginous earth*.
21*st Sample.* — Purchased of Brocksopp & Co., 234. Borough.
Adulterated — containing a large quantity of salt, together with a small quantity of RED LEAD.
22*nd Sample.* — Purchased of G. Pike, 77. High-street, Borough. 4*d.* per oz.
Genuine.
23*rd Sample.* — Purchased of White & Fairchild, 63. Borough.
Adulterated — being vividly coloured with RED LEAD.
24*th Sample.* — Purchased of R. Jones, 16. Borough.
Adulterated. — Containing a considerable quantity of *rice* and much RED LEAD.
25*th Sample.* — Purchased of W. Young & Sons, 27. High-street, Islington.
Adulterated. — Being coloured with RED LEAD.
26*th Sample.* — Purchased of C. Young, 8. High-street, Islington.
Genuine.
27*th Sample.* — Purchased of A. Braden, 13. High-street, Islington.
Adulterated. — Highly coloured with a considerable quantity of RED LEAD.
28*th Sample.* — Purchased of H. Davis & Co., 23. High-street, Islington.
Adulterated. — Containing a very large quantity of *salt*, and coloured with a *ferruginous earth*.

Reviewing the results contained in the preceding table of analyses, it appears—

1st. That out of the twenty-eight samples of cayenne pepper subjected to analysis, *twenty-four were adulterated.*

2nd. That out of the above number, *four* only *were genuine.*

3rd. That out of the twenty-four adulterated samples, *twenty-two* contained *mineral colouring matter.*

4th. That RED LEAD, often in large and poisonous quantities, was present in *thirteen* samples.

5th. That *Venetian red*, *red ochre*, *brick-dust*, or some other analogous ferruginous earths were contained in *seven* samples.

6th. That CINNABAR, VERMILION, or SULPHURET OF MERCURY, was detected in one sample.

7th. That *six* of the samples consisted of a mixture of *ground rice, turmeric* and *cayenne*, coloured with either *red lead*, or a *red ferruginous earth.*

8th. That *six* samples contained large quantities of *salt*, sometimes alone, but more frequently combined with *rice* and a *red ferruginous earth* or with *red lead.*

9th. That *one* of the samples was adulterated with a large quantity of the *husk of white mustard seed.*

10th. That *two* contained *rice* only, coloured with *red lead* or a *ferruginous earth.*

As is well known, RED LEAD, and VERMILION or SULPHURET OF MERCURY, are highly deleterious substances, both being characterised by a disposition to accumulate in the system, and finally to produce symptoms of a very serious nature. Thus it is that, however small the dose taken from day to day, the constitution is sure to be at last brought under the influence of the poison, and to become seriously affected.

But the quantity of red lead and mercury introduced into the system in adulterated cayenne pepper is by no means inconsiderable, since it commonly forms a large portion of the article. Some idea of the amount of these substances frequently present may be formed from the fact, that in a pinch of cayenne, moistened and diffused over a white plate, or a piece of glass, they may be distinctly seen by the eye alone.

It is scarcely possible to conceive the amount of mischief that may be committed in this way, and we think that for the sake of the public health the interposition of the Legislature is strongly demanded. The man who steals one's purse commits a less crime than he who, by tricking our food, robs us of health.

We think it right to state, that, since the above Report was in type, we have been informed that cayenne pepper is frequently imported in the ground state; it is therefore probable that *some* of the adulterations discovered, and particularly that with salt, may have been practised in the localities whence the article is imported, and, therefore, before it reaches this country.

CURRY-POWDER, AND ITS ADULTERATIONS.

Several ingredients enter into the composition of curry-powder. The articles of which genuine curry-powder of good quality ordinarily consists are, turmeric, black pepper, coriander seeds, cayenne, fœnugreck, cardamoms, cummin, ginger, allspice, and cloves. Of these, turmeric forms the largest proportion; next to this in amount are coriander seeds and black pepper; cayenne, cardamoms, cummin, and fœnugreck, form but a small portion of the article; while the ginger, cloves, and allspice are in many cases omitted.

The properties and structure of several of the above ingredients have been already fully described and illustrated; as turmeric, black pepper, cayenne, ginger, cloves, and allspice; it thus only remains to give a description of the other ingredients which enter into the composition of curry-powder — namely, coriander seeds, cardamoms, fœnugreck, and cummin seeds.

Coriander Seeds.

Coriander (*Coriandrum sativum*) belongs to the natural family Umbelliferæ; it is an annual plant of a foot or a foot and a half in height; it is cultivated in Essex, and, although not really indigenous, is frequently met with growing wild in the neighbourhood of Ipswich and some parts of Essex.

The fruit or seed-vessels are globular, about twice the size of white mustard-seeds, and of a light brown colour. Each fruit consists of two hemispherical portions, termed *mericarps*, each of which is a seed; each mericarp exhibits on its outer surface five *primary* ridges, which are depressed and wavy, and four *secondary* ridges, which are more prominent and straight. The channels are without receptacles for the essential oil, or, as they are technically termed, *vittæ;* but near the commissures in each mericarp there is a small vitta, so that each fruit is provided with four of these receptacles.

The epidermis or husk is thick and brittle; when examined with the microscope, it is observed to consist of narrow fibres, which cross each other, and are disposed in a waved manner. It is united to the seed by means of loose cellular tissue, the cavities of the cells being empty. On the removal of the husk, these cells are torn through, some remaining attached to it, and the rest to the surface of the seed. After the separation of the husk, the seed is still of a brown colour. Beneath the cells above described succeeds a delicate fibrous membrane; and next to this is a layer of deeply coloured cells, which merge into the cells which form the substance of the seed; these are angular, with well-defined parietes, their cavities enclosing oil in a molecular condition. The mature seed does not contain starch. *Fig.* 139.

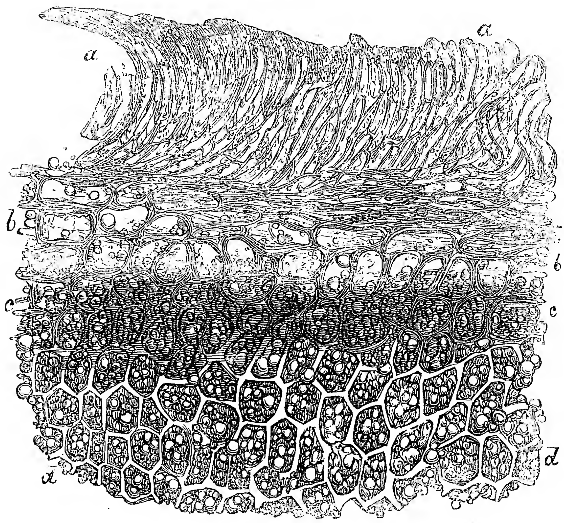
The peculiar structure of the husk of coriander seeds affords a means by which their presence in curry-powder may be readily determined.

Coriander seeds, like those of most plants belonging to the family Umbelliferæ, are mildly carminative, aromatic, and stimulant; they yield, upon distillation, a volatile oil, upon which their properties depend.

Fig. 139.

TRANSVERSE SECTION OF MERICARP OF CORIANDER.

(Magnified 220 diameters.)



a a. Fibres forming the husk. *b.* The loose cells which unite the husk to the seed. *e.* The layer of deeply-coloured cells, in contact with the seed. *d d.* Cells composing the seed itself.

CARDAMOM SEEDS.

There are several species of cardamom; but the true or officinal species is the *Elettaria Cardamomum*, one of the natural order Zingiberaceæ.

It is a native of the mountainous parts of the coast of Malabar; in some localities the plant in its wild state yields cardamoms fit for use, but those which are cultivated are the best.

According to Mr. White*, the spots chosen for the cardamom farms are called *Ela-Kandy*, and are either level or gently sloping surfaces on the highest ranges of the Ghaûts, after passing the first declivity from their base. "Before the commencement of the periodical rains, in June, the cultivators of the cardamom ascend the coldest and most shady sides of a woody mountain; a tree of uncommon size and weight is then sought after, the adjacent spot is cleared of weeds, and the tree felled close at its root. The earth, shaken and loosened by the force of the fallen tree, shoots forth young cardamom plants in about a month's time."†

There are three varieties of Malabar cardamoms distinguished in commerce, which are named from the size and form of the seed-pod, *shorts*, *short-longs*, and *long-longs*,—the shorts being the most esteemed variety; the two latter differ from each other in size only.

"The three sorts are brought from Bombay in chests. The shorts are usually the dearest, and fetch from 3*d.* to 6*d.* per pound more than the longs. The long-longs are seldom brought over. From Madras, only long cardamoms (usually short-longs, rarely long-longs) are brought; they are generally packed in bags, and are lighter by weight than the Bombay sort, and usually fetch 3*d.* per pound less than the latter."‡

Cardamom pods are of a triangular form, and consist of three valves, tapering

* Transactions of Linnæan Society, vol. x. p. 237.
† Captain Dickson, in Roxburgh's *Fl. Indica.*
‡ Pereira's Materia Medica, third edition, vol. ii. part i. p. 1144.

at either extremity to a blunt point; the seed-vessel is thick, tough, and fibrous, and is made up of cellular tissue and bundles of woody fibre, which spread out from the flower-stalk, and are visible on the surface to the naked eye, imparting the striated appearance characteristic of the seed-vessel of cardamom.

From its interior, the seed-vessel sends off three prolongations or septa, which divide it into as many compartments; each of these contains several hard seeds of a reddish-brown colour, and exhibiting upon the surface peculiar markings; the seeds are united together by a gelatinous parenchymatous substance, which, under the microscope, is seen to consist of numerous delicate tubules, filled with granular and oily matter.

The covering of the seed, examined with the microscope, and viewed on its outer surface, is observed to consist of a single layer of coloured cells, much elongated, and of uniform diameter, terminating in rounded extremities, the cells being accurately adapted to each other. Beneath these are other cells, which bear a general resemblance in form to those previously described, but differ in being more irregular, much more delicate, and in the absence of colour; they are disposed in an opposite direction to those of the outer layer. *Fig.* 140. *A.*

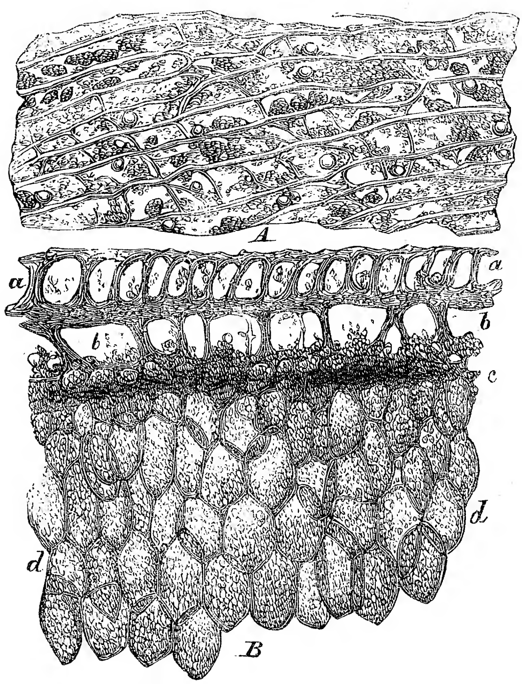
In transverse sections, the elongated coloured cells appear as small canals, of a rounded form.

Lying beneath the coating, and forming part of the seed, is a single row of

Fig. 140.

OUTER MEMBRANE AND TRANSVERSE SECTION OF A CARDAMOM SEED.

(Magnified 220 diameters.)



A. Portion of outer membrane, exhibiting the elongated cells of which it is composed. *B*. Transverse section of seed. *a a*. Cells forming outer membrane. *b b*. Receptacle-like cells. *c*. Layer of coloured cells. *d d*. Transparent and minutely-dotted cells, of which the substance of the seed itself is made up, and which are filled with starch-corpuscles.

large cells, resembling receptacles; next in order from without inwards is a layer of small cells, deeply coloured; next to these succeed the cells which constitute the principal part of the seed; these for the most part resemble closely the cells of pepper, being very angular, but they differ in their more delicate and transparent appearance, and in being minutely dotted. *Fig.* 140. *B.*

Dr. Pereira, in his "Materia Medica," quotes the statement made by Schleiden, that he has discovered in the cells of cardamom "amorphous, paste-like starch." We find the cells to be completely filled with minute, distinctly-formed starch-granules, resembling closely those of rice. Probably the statement of M. Schleiden arose from his having employed but a feeble magnifying power in the examination of the seeds.

The presence of cardamom seeds in curry-powder is most readily determined by means of the dotted and angular cells which form the substance of the seeds.

To the taste, cardamom seeds are sharp, warm, aromatic, and very like camphor. They contain both a fixed and volatile oil; but their chief properties are due to the presence of the latter.

Cummin Seeds.

The Cummin plant (*Cuminum Cyminum*) belongs, like Coriander, to the natural order Umbelliferæ; it is a native of Upper Egypt, but is extensively cultivated in Sicily and Malta.

Cummin seeds resemble somewhat caraway seeds, but they are larger, straighter, and of a lighter colour. The fruit is double, like that of coriander and all other umbelliferous plants, consisting of two seeds or mericarps; each mericarp has five *primary* ridges, which are filiform; and four *secondary* ridges, which are prominent; but both are furnished with very fine hairs or prickles, and under each secondary ridge is a receptacle or vitta.

Transverse sections of a cummin seed exhibit the following structure:—

The hairs or prickles are composed of cells, the long diameters of which are arranged in the long axes of the hairs. The husk or covering of the seed is made up of numerous rounded or angular cells, in the midst of which the large and triangular vittæ are situated; and between the husk and seed itself, there is usually a small space, which is formed by the contraction of the seed after it has arrived at maturity. The surface of the seed is of a pale brown colour, and its interior whitish and transparent. The exterior portion of the seed is constituted of elongated and flattened cells of a brownish colour, while the interior and chief substance of the seed itself is composed of numerous distinct, angular cells, the walls of which are thick and perfectly transparent; their contents consist principally of oil. The seeds do not contain starch. *Fig.* 141.

Cummin seeds possess a very peculiar, medicinal taste and smell, and it is to these that curry-powder owes the greater part of its characteristic flavour and odour.

Fœnugreck Seeds.

Fœnugreck seeds are the produce of *Trigonella Fœnum Græcum*, one of the family Leguminosæ, or pea-tribe.

It is an annual plant, bearing yellow flowers, and grows principally in India, Arabia, Sicily, and Montpelier.

The taste of the ground seeds is peculiar, but at the same time raw, and somewhat like that of beans; it is to these seeds that the characteristic flavour of curry-powder is in part due.

According to Mr. Gray, the seeds are used by the inhabitants of the East Indies in cases of dysentery, and by the Arabs as a poultice for wounds. In England they are employed in veterinary medicine, but chiefly as an ingredient in curry-powder.

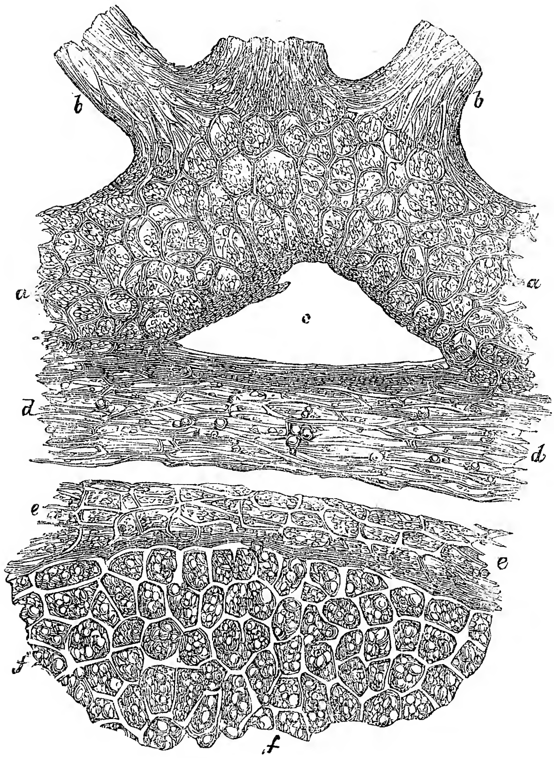
The seeds contain a large quantity of mucilage, and hence their infusion and decoction are demulcent.

The structure of Fœnugreck seeds is very characteristic. The husk of the seed consists of three membranes; the outer is formed of a single layer of cells, which bear a remarkable resemblance in shape to a short-necked bottle; the

Fig. 141.

TRANSVERSE SECTION OF MERICARP OF CUMMIN.

(Magnified 220 diameters.)



a a. Cells forming the husk. *b b.* Commencement of two hairs or prickles. *c.* Receptacle or vitta. *d d.* Elongated cells which compose the innermost layer of husk. *e e.* Cells and fibres of which the external surface of the seed is formed. *f f.* Cells of the seed itself, containing oil.

long diameter of these cells is disposed vertically, the narrow, neck-like part being most external, and forming the outer surface of the membrane. The second membrane consists of a single layer of cells, two or three times larger than the former, very much flattened, and having their margins regularly and beautifully crenate. The third and innermost membrane is made up of several layers of large transparent cells filled with mucilage; these cells expand greatly when immersed in water. *Fig.* 142.

The seed itself consists of two lobes, which are made up of numerous minute cells; those in the outer part of each lobe are of a rounded or angular form, while those situated near the innermost part become much elongated, the long axes of the cells being placed transversely in each lobe; the entire seed is covered by a single layer of small angular cells. *Fig.* 143.

In various works which we have consulted, we do not meet with a single remark relating to the adulteration of curry-powder. Like many of the other articles of which we have treated, this appears to have been neglected by writers on the adulteration of food.

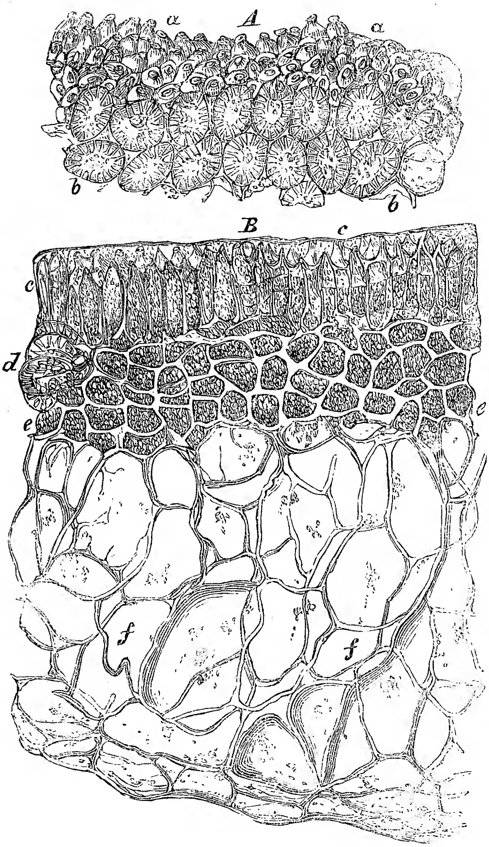
It is necessary that each sample of curry-powder should not only be examined microscopically, but also be tested chemically for lead, mercury, and iron.

Since genuine curry-powder ordinarily contains a very large and variable quantity of iron, it is requisite to determine the exact amount of that metal present. It is only when the quantity of iron detected is greatly above that ordinarily contained in genuine curry-powder, that we can safely pronounce the sample to be adulterated with that metal.

Fig. 142.

OUTER COAT OR TESTA OF A FŒNUGRECK SEED.

(Magnified 220 diameters.)



A. Portion of the outer and second membrane stripped off; *a a*, peculiar bottle-like cells; *b b*, crenated cells of second membrane. *B*. Transverse section of husk of seed; *c c*, bottle-like cells; *d*, position of crenated cells; *e e*, layer of coloured cells merging into *f f*, the large cells which form the innermost membrane, filled with mucilage.

RESULTS OF THE MICROSCOPICAL AND CHEMICAL ANALYSIS OF TWENTY-SIX SAMPLES OF

CURRY-POWDER,

PURCHASED AT THE ESTABLISHMENTS OF VARIOUS GROCERS AND OILMEN IN THE METROPOLIS.

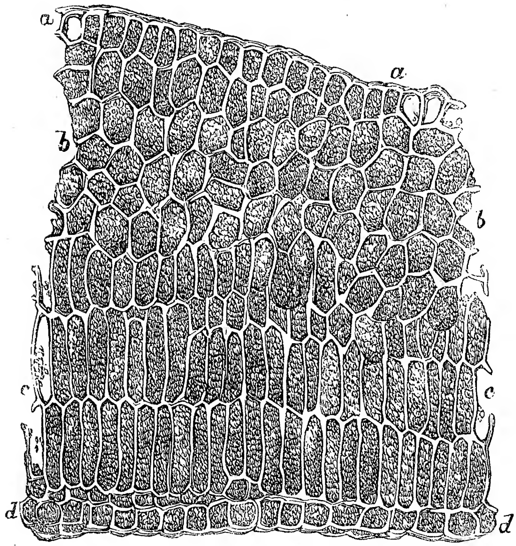
1*st Sample.*—Purchased of W. M. Nicholson, 86. Upper-street, Islington. *Contains* a small quantity of *salt.*

2*nd Sample.*—Purchased of Gluckner & King, 17. Mount-row, Islington. *Contains* very much *ground rice.*

Fig. 143.

TRANSVERSE SECTION OF LOBE OF FŒNUGRECK SEED.

(Magnified 220 diameters.)



a a. Layer of small angular cells on the surface. *b.* Rounded or angular cells. *c.* The same cells gradually becoming more elongated as they approach the inner part of lobe. *d.* Single row of cells forming the innermost margin of lobe.

3*rd Sample.*—Purchased of H. Davis & Co., 23. High-street, Islington.
Contains a proportion of *ground rice.*

4*th Sample.*—Purchased of C. Young, 8. High-street, Islington.
Genuine.

5*th Sample.*—Purchased of Beckett & Young, 3. High-street, Islington.
Genuine.

6*th Sample.*—Purchased of C. Roads, 11. Black Prince-row, Walworth.
Contains a proportion of *ground rice.*

7*th Sample.*—Purchased of W. Bourne, 109. Blackman-street, Borough.
Genuine, but consists principally of *turmeric-powder* and *cayenne.*

8*th Sample.*—Purchased of S. Jackson, 75. Blackman-street, Borough.
Contains a very small quantity of *salt.*

9*th Sample.*—Purchased of J. North, 135. High-street, Borough.
Contains a small proportion of *salt.*

10*th Sample.*—Purchased of Harrington and Lucas, 113. High-street, Borough.
Contains RED-LEAD and *salt.*

11*th Sample.*—Purchased of G. Pike, 77. High-street, Borough.
Contains very much *ground rice.*

12*th Sample.*—Purchased of Way & Co., 272. Oxford-street.
Contains a considerable quantity of RED-LEAD.

13*th Sample.*—Purchased of R. Drewe, 118. Tichfield-street.
Contains a considerable quantity of RED-LEAD, and a little *salt.*

14*th Sample.*—Purchased of J. Edwards, 10. Cambridge-street, Golden-square.
Genuine.

15*th Sample.*—Purchased of J. Bishopp, 51. Brewer-street, Golden-square.
Contains an immense quantity of *ground rice.*

16*th Sample.*—Purchased of R. C. Hall, 72. Princes-street, Leicester-square.
Contains RED-LEAD and a small quantity of *salt.*

17*th Sample.*—Purchased of G. Mills, 33. South Molton-street.
Genuine, but contains a small quantity of *powdered cassia.*

18*th Sample.*—Purchased of W. J. Brown, 12. High-Street, Islington. In package, labelled

"GENUINE INDIA CURRY-POWDER."

Contains RED-LEAD, a considerable quantity of *potato-flour*, and much *salt.*

19*th Sample.*—Purchased of White & Fairchild, 63. Borough. In package labelled

"SCHAH SOOJAH INDIA CURRY-POWDER."

Contains a considerable quantity of *ground rice*, and a little *salt.*

20*th Sample.*—Purchased of Fortnum & Mason, Piccadilly.
Genuine.

21*st Sample.*—Purchased of S. Dummer & Co., 14. Marylebone-street.
Contains very much RED-LEAD.

22*nd Sample.*—Purchased of Robinson, Piccadilly. In package labelled

"CAPTAIN WHITE'S CURRY-POWDER,
(Originally called SELIM'S.)"

Genuine.

23*rd Sample.*—Purchased of Bardsley & Co., 103. Tottenham-court-road.
Contains a large quantity of *ground rice.*

24*th Sample.*—Purchased of Andrews & Co., 107. Tottenham-court-road.
Contains a considerable quantity of RED-LEAD.

25*th Sample.*—Purchased of Salmon & Co., 69. Tottenham-court-road.
Contains RED-LEAD and a very large quantity of *ground rice.*

26*th Sample.*—Purchased of W. Gilbert, 92. Tottenham-court-road.
Contains a considerable quantity of *ground rice.*

From a review of the above Table of Analyses, the following conclusions may be deduced:—

Of the *twenty-six* samples of curry-powder submitted to microscopical and chemical examination,

1st. That *seven* only were *genuine.*
2nd. That *nineteen*, or nearly four-fifths were *adulterated.*
3rd. That *ground rice*, usually in very large quantities, was present in *nine* samples.
4th. That *potato-farina* was detected in *one* sample.
5th. That *salt* was present in *eight* of the samples.
6th. That the highly poisonous metallic oxide, RED-LEAD, was detected in no less than *eight* of the samples.
7th. That in *seven* of the samples, the adulteration consisted of *ground rice* only.
8th. That in *one* sample, the adulteration consisted of *ground rice* and *salt.*
9th. That in *one* sample, the adulteration consisted of *ground-rice* and RED-LEAD.
10th. That in *three* samples, the admixture consisted of *salt only.*
11th. That in *three* samples, the adulteration consisted of *salt* and RED-LEAD.
12th. That in *three* samples the adulteration consisted of RED-LED only.
13th. That in *one* sample, the adulteration consisted of RED-LEAD in combination with *potato-farina* and *salt.*

The above results do not give the whole of the adulterations to which the twenty-six samples have been subjected, since they do not include the FERRUGINOUS EARTHS, which were shown, in our article on Cayenne, to be so frequently employed to impart colour to that substance. In consequence of the large and variable quantity of iron present in genuine curry-powder, it is not easy accurately to determine in what cases that metal exists in excess. The ferruginous earths consist of alumina, in combination with a small and variable amount of iron in the condition of red oxide.

We have thus shown that curry-powder is adulterated to nearly the same extent, and frequently with ingredients equally pernicious, as the subject of our last report, namely, cayenne.

The presence of RED-LEAD in curry-powder is due, no doubt, to the adulterated cayenne pepper employed in its preparation. The same explanation accounts also, in many cases, for the presence of the salt.

Since the quantity of curry-powder taken at a meal is so considerable, its adulteration with RED-LEAD is even more prejudicial and dangerous than in the case of cayenne pepper.

The whole of the ingredients required for making curry-powder may be obtained of most seedsmen, and may be readily procured of Mr. Butler, of Covent Garden Market.

With a common pestle and mortar the seeds may be reduced to powder, and thus the housekeeper may herself prepare genuine curry-powder, of the best quality, at a cost of about 2*d.* per ounce. Since curry-powder is retailed at 6*d.*, 8*d.*, and even 1*s.* an ounce, it evidently bears an enormous profit. What, then, must be the gain upon the sale of an article which is made up principally of turmeric powder, salt, ground rice, and inferior capsicum berries? and of such a mixture many of the curry-powders purchased at the shops almost entirely consist.

ON POISONOUS BOTTLED FRUITS AND VEGETABLES.

IN the Report on Preserved Provisions already published, the following observations were made respecting the preservation of bottled fruits:—

" Currants, gooseberries, cherries, and other soft fruits, have been preserved for use in winter by gathering them when not too ripe, and when very dry, putting them unbruised into dry bottles, which are afterwards well corked, and then buried in the earth. This method acts partly by the exclusion of the air, and partly by the low and uniform temperature which prevails beneath the surface of the earth.

" The efficiency of this method of preservation is increased by immersing the bottles containing the fruit for a few minutes, and previous to corking, in hot water. By this proceeding the vegetable albumen, which is so prone to pass into a state of decomposition, is solidified, and rendered less disposed to undergo putrefactive changes.

" A further improvement on this method was suggested so far back as the year 1807, by Mr. Saddington, who received from the Society of Arts a premium for ' A Method of Preserving Fruits without Sugar for House or Sea Stores.'

" The fruit is to be gathered before it is too ripe; the bottles are to be well filled with it, and loosely corked; they are next to be placed in a vessel containing cold water, which should reach as high as the necks of the bottles; heat is then to be applied, and the temperature raised to from 160° to 170°, and maintained at this for half an hour; but the heat must not be raised higher nor continued longer, as the fruit would be liable to burst. Lastly, the bottles are to be filled to within an inch of the corks with boiling water; they are to be well corked immediately, and laid upon their sides, so that the water may swell the corks, whereby the entrance of the air will be more effectually prevented."

An attentive examination with the eye alone, of various samples of bottled fruits and vegetables, served to raise suspicion, and to produce the impression that the method of preservation adopted by modern preservers of these articles was not quite so harmless as that originally proposed by Mr. Saddington. We felt, indeed, a strong conviction that the same means of coloration was resorted to in the case of bottled fruits and vegetables as we had already ascertained to be employed with pickles. In order to determine whether this conviction was well founded or not, we resolved to institute a series of rigorous analyses, the results of which we are now about to make known.

The extraordinary effect of copper, in heightening and rendering permanent the green colour of fruits and vegetables, has already been remarked upon in the Report on Pickles. This action is exerted upon the green contents of the cells, the chlorophylle, and hence it is the coloured portions of vegetables and fruits, as those invested by the epidermis, which are most affected by this substance. The copper used accumulates in this membrane as a salt, as an acetate, a citrate, or a malate of copper.

The presence of copper, however, in fruits and vegetables is not confined to the coloured portions; it penetrates through the whole tissue, and a considerable part of the metal used even remains diffused throughout the fluid in which the vegetable substance is contained: hence it is desirable to analyse for copper not only the preserved article itself, but also the fluid in which it is immersed.

The processes for examination adopted in the subjoined analyses were as follows:—

First. About three ounces of the juice or fluid in which the fruit or vegetable was preserved were measured out, placed in a test-glass, and the acidity having been slightly increased by the addition of about three drops of strong nitric acid, a polished rod of iron was placed in the fluid, and allowed to remain for about twenty-four hours. If copper was present in considerable amount, the surface of the rod, from top to bottom, became covered with a continuous and bright coating of that metal. If the amount of copper was less considerable, the upper half or so only of the rod received the coating. If the quantity was very small indeed, no perceptible deposit of copper took place.

Hence we perceive that the iron rod affords a simple and most conclusive test for copper in fruits and vegetables, when present in anything like considerable amount; and that it even serves to indicate, to a certain extent, the quantity of copper with which the juice of different samples is impregnated, as shown by the rapidity with which the deposit occurs, by the thickness of the coating, and by the extent of surface covered by it.

Second. Three ounces of each of the fruits and vegetables were weighed out, placed in crucibles, and incinerated until nearly the whole of the carbon was dissipated, the colour of the ash being carefully noted. In those cases in which the fruit or vegetable was not contaminated with copper, the residual ash was observed to be either white or greyish white, while in those instances in which copper was present it was constantly of a pink colour; the depth varied uniformly with the amount of copper present.

When fruit or vegetable substances are carefully incinerated without being in any way disturbed, the general form of the fruit, &c., is in most cases tolerably well preserved; and it is then perceived that the pink colour is confined principally to the surface of the substance incinerated.

In those cases in which the amount of copper is but very small, the pink will be seen on the surface, only here and there, and will be of a pale tint. Where the quantity is larger, although still but small, the colour will be more general and more decided. Where it is abundant, the whole surface of the ash will be of a bright and beautiful rosy pink hue. Lastly, when the quantity of copper present is very considerable, the residual ash will be of a deep pink colour.

Olives, when incinerated, do not leave a clean white ash, so that although the pink colour may be very well detected in them, it is not of so bright a colour as in other fruit; but the colour is not confined, as in most other cases, to the surface of the fruit, but extends through the whole substance.

When a portion of the juice was incinerated along with the fruit, as was usually the case, the crucibles, if copper was present, became tinted with the same rosy pink colour as was observed on the surface of the fruit or vegetable incinerated. In some cases where the amount of copper was considerable, the bottoms of the crucibles became deeply and beautifully stained of a bright and iridescent pink.

The pink colour of the ash is thus explained: In the course of incineration, the vegetable acid with which the copper was combined, is destroyed, the highly characteristic pink oxide remains in the fruit perhaps in combination with lime, and its presence becomes revealed by its peculiar colour.

We have, then, in the colour of the ash a certain and beautiful test for the presence of copper, even in the most minute quantities, and likewise for the determination of its amount to a certain extent, not only in bottled fruits, but in most vegetable substances, and especially in pickles.

Third. The tint having been carefully noted, a scruple of strong nitric acid was added to the ash, and after the lapse of two or three hours, six drachms of distilled water were poured upon it; and the solution, after standing another hour or so, was filtered; to the filtered and clear solution a few drops of concentrated solution of ammonia were added, when, if copper was present, the mixture became of a blue colour, the tint varying through all shades and degrees, from a pale and scarcely perceptible bluish hue to a rich and deep azure, according to the quantity of the metal present.

Fourth. The ammoniacal solution was diluted with an ounce or so of distilled water, rendered slightly acid, and the polished iron rod immersed in it. In this way a coating of copper was often obtained from the acidulated solution of the ash, in cases where no deposit of metal took place on immersion of the iron in the juice in which the fruit or vegetable was preserved.

Results of the Chemical Examination of Thirty-four Samples of —

BOTTLED FRUITS AND VEGETABLES.

Purchased at the Establishments of many of the principal Preservers of these Articles; as also obtained from Grocers, Fruiterers, and other Retailers resident in the Metropolis.

BOTTLED FRUITS.

Red Currants.

1st Sample.—Purchased of T. Snelling, 30. Fenchurch-street.
Contains a *trace of copper* only. Ash nearly *white;* solution of the ash, tested with ammonia, exhibiting a *faint blue tinge* only, and no deposition of the metal taking place on the iron rod immersed in the acidulated solution.

Raspberries and Currants.

2nd Sample.—Purchased of E. Fenning, 5. Poultry.
Not a trace of copper to be detected. Ash *white.*

3rd Sample.—Purchased of Crosse & Blackwell, 21. Soho-square.
Not a trace of copper to be detected. Ash *white.*

Cherries.

4th Sample.—Purchased of Crosse & Blackwell, 21. Soho-square.
Not a trace of copper to be detected. Ash *white.*

Gooseberries.

5th Sample.—Purchased of G. Waybrow & Co., 4. Minories.
Contains *a good deal of* COPPER. Ash of a *pink* colour. Solution of the ash, tested with ammonia, *decidedly blue.* An iron rod immersed in the acidulated solution of the ash became covered with *a thin coating of copper.*

6th Sample.—Purchased of T. Snelling, 30. Fenchurch-street.
Contains *a good deal of* COPPER. Ash of a *pink* colour. Solution of the ash, tested with ammonia, of *a pale blue:* an iron rod immersed in the acidulated solution received *a coating of copper.*

7th Sample.—Purchased of E. Fenning, 5. Poultry.
Contains *a very large quantity of* COPPER. A polished iron rod immersed in the fluid in which the fruit was preserved became *completely coated with copper.* Ash of a *deep pink colour.* Solution of the ash, tested with ammonia, of a *rich* and *deep blue.* An iron rod immersed in the acidulated solution became *thickly coated with copper in a few minutes.* The fruit, when boiled, changing to a *deep-bluish* and *most unnatural green colour.* Of all the samples of preserved fruits and vegetables analysed, this contained the most copper.

8*th Sample.*—Purchased of E. & J. Freeman, 3. Wigmore-street.
Contains *a small quantity of* COPPER. Ash *somewhat pink.* Solution of the ash, tested with ammonia, of a *faint blue.*

9*th Sample.*—Purchased of Crosse & Blackwell, 21. Soho-square.
Contains *a good deal of* COPPER. Ash of a *light* but *decided pink.* Solution of the ash, tested with ammonia, becoming of a *pale blue* colour; *a coating of copper* also being deposited on a rod of iron immersed in the acidulated solution.

10*th Sample.*—Purchased of Castell & Brown, 45. Princes-street, Leicester-square.
Does not contain copper. Ash of a *white* colour. The appearance of the gooseberries, in this case, differs remarkably from those of all the previous samples. The fruit is of a yellow colour, with scarcely a tinge of green. We have seen, in shop-windows at the West-end, gooseberries precisely resembling these in colour, and we believe, if inquiries were made, that in most cases it would turn out that the parties were supplied by Messrs. Castell & Brown.

Greengages.

11*th Sample.*—Purchased of G. Whybrow & Co., 4. Minories.
Contains *a very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became covered with *a thick coating of copper.* Ash of a *decided and rather deep pink* colour. Solution of the ash, tested with ammonia, changed to a *decided blue.*

12*th Sample.*—Purchased of Crosse & Blackwell, 21. Soho-square.
Contains *a very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *thickly coated all over with copper.* Ash of a *decided and rather deep pink* colour; solution of the ash, tested with ammonia changed to a *bright blue.*

13*th Sample.*—Purchased of E. Lazenby, 6. Edwards-street, Portman-square.
Contains *a very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *thickly coated with copper.* Ash of a *decided and rather deep pink colour*; solution of the ash tested with ammonia changed to a *bright blue.*

14*th Sample.*—Purchased of R. & C. Faulkner, 44. Jermyn-street.
Contains a *very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *thickly coated with that metal.* Ash of a *decided pink colour;* solution of the ash tested with ammonia changing to a *bright blue.*

It should be remarked, that in all the above cases, the greengages, as contained in the bottles, presented to the eye a suspicious and unnatural deep bluish-green colour, which was much heightened by boiling; in this state the fruit exhibited, in fact, the characteristic verdigris hue.

15*th Sample.*—Purchased of Hedges & Butler, 155. Regent-street.
Contains *a trace of copper only.* Ash *nearly white,* with a *shade of pink* here and there; solution of ash treated with ammonia became of *a very faint blue colour.*

16*th Sample.*—Purchased of Fortnum & Mason, 182. Piccadilly.
Contains *a small quantity of copper.* Ash *decidedly pink;* solution of ash treated with ammonia became *light blue.*

17*th Sample.*—Purchased of Castell & Brown, 45. Princes-street, Leicester-square.
Contains *a trace of copper.* Ash *slightly pink here and there.* Solution of ash treated with ammonia became *very faintly blue.* The greengages in this case were of large size, firm, and plump, the colour being well preserved and natural.

18*th Sample.*—Purchased of Howis & Masson, 216. Piccadilly.
Contains *a very small quantity of* COPPER. Ash *here and there slightly pink.* The greengages in this case were of large size, firm, and plump, the colour being well preserved without presenting an unnatural appearance.

French Olives.

19*th Sample.*—Purchased of J. Wilmott & Co., 66. Gracechurch-street.

Contains *a very large quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *thickly coated with copper.* Ash of a *deep but dirty pink* colour; solution of the ash tested with ammonia changed to *a rich blue.*

20*th Sample.*—Purchased of J. Burgess & Son, 107. Strand.

Contains a *considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *coated with copper.* Ash of a *deep but obscure pink* colour; solution of the ash tested with ammonia turning *decidedly blue.*

21*st Sample.*—Purchased of C. Wix & Sons, 22. Leadenhall-street.

Contains *a considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *coated with copper.* Ash of an *obscure pink* colour; solution of the ash treated with ammonia *decidedly blue.*

22*nd Sample.*—Purchased of Harrington & Lucas, 74. Princes-street, Leicester-square.

Contains *a small quantity of* COPPER; solution of the ash tested with ammonia became of *a pale blue colour,* a *slight deposit of copper* taking place on a polished iron rod immersed in the acidulated solution of the ash. The fruit of a yellowish-olive colour, very different from that of the other samples.

23*rd Sample.*—Purchased of Sams & Co., 173. Piccadilly.

Contains *a very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the fruit is preserved became *quickly covered with a thick deposit of copper.* Ash of a *deep but obscure pink* colour; solution of the ash treated with ammonia turned of a *deep blue.*

24*th Sample.*—Purchased of G. Neighbour & Sons, 149. Regent-street.

Contains *a small quantity of copper.* Ash *slightly pink;* solution of the ash treated with ammonia, *faint blue.* As viewed through the bottle, the olives in this sample appeared of a deep green colour, conveying the impression that they were highly coloured with copper. On removing them, however, from the bottle, they were seen to be of a dull yellowish-brown, and it then became evident that the green colour was entirely due to the intensely-coloured bottle.

Spanish Olives.

25*th Sample.*—Purchased of Hedges & Butler, 155. Regent-street.,

Not a trace of copper. Ash *white.* The olives in this case were of a fawn colour, without a tinge even of green. We believe that Spanish olives are generally sold in their natural state, and are almost invariably free from any contamination with copper. In the case of French olives the object appears to be to render them as green as possible; and this is effected by the free use of copper, as well as enclosing them in deep green bottles.

Limes.

26*th Sample.*—Purchased of J. Boyd, 59. Piccadilly. In bottle, labelled thus:

AUGUSTUS S. LEVY,
ENGLISH AND FOREIGN FRUITERER,
59. PICCADILLY.

Contains *a very small quantity of* COPPER. Ash *a little pink here and there.* Solution of the ash treated with ammonia became of *a faint blue* colour.

27*th Sample.*—Purchased of Fortnum & Mason, 182. Piccadilly.

Contains *a good deal of* COPPER. Ash of *a decided pink* colour; solution of the ash treated with ammonia, *light blue;* an iron rod immersed in the acidulated solution of the ash became *slightly coated with copper.*

BOTTLED VEGETABLES.

Rhubarb.

28*th Sample.*—Purchased of Batty & Feist, 102. Leadenhall-street.

Contains *a very considerable quantity of* COPPER. An iron rod immersed in the fluid in which the rhubarb is preserved became *thickly coated all over with copper.* Ash of *a rather deep pink* colour. Solution of the ash treated with ammonia of *a decided blue.* Fruit to the eye very unnaturally green, and when cooked of *a deep coppery green* colour.

29*th Sample.*—Purchased of Westbrooke & Co., Oxford-street.

Contains *a very large quantity of* COPPER. A rod of iron immersed in the fluid in which the vegetable is preserved became *very thickly coated with copper.* Ash of *a deep pink* colour; solution of the ash treated with ammonia changed to *deep blue.*

30*th Sample.*—Purchased of Russell and Co., 22. King-street, Covent garden.

Contains *a considerable quantity of* COPPER. An iron rod immersed in the fluid in which the vegetable is preserved becomes *decidedly coated with copper.* Ash of *a light but decided pink;* solution of the ash on the addition of ammonia changing to *a pale blue colour.*

31*st Sample.*—Purchased of Castell and Brown, 45. Princes-street, Leicester-square.

Does not contain copper. The rhubarb in this case differs from that of the previous samples, it being of a yellowish colour, with scarcely a tinge of green; it is also in excellent preservation, and retains its natural flavour.

Rhubarb and Gooseberries.

32*nd Sample.*—Purchased of J. Willmott and Co., 66. Gracechurch-street.

Contains *a little* COPPER. Ash of a *light but decided pink;* solution of the ash on the addition of ammonia changing to *a light blue;* an iron rod immersed in the acidulated solution became coated with *a slight deposit of copper.*

33*rd Sample.*—Purchased of J. Wingrove and Co., St. Paul's Churchyard.

Contains *a good deal of* COPPER; an iron rod immersed in the fluid in which the vegetable is preserved becoming *coated with copper.* Ash of *a decided pink* colour; solution of the ash treated with ammonia changing to *a decided blue.*

Peas.

34*th Sample.*—Purchased of Howis Masson, 216. Piccadilly. In bottle, labelled—

"Joseph Colin,
9. Rue des Salorges,
PETITS POIS,
au Naturel
a Nantes,
Conserves Alimentaires."

Does not contain copper. Ash *white.* Seen through the bottle in which they were contained, the peas presented a decided green appearance; but when taken from it, they were found to be *quite yellow.* The colour in this case was therefore entirely due to the glass bottle, which was of an intense green.

The above results of the different analyses will be more easily appreciated as arranged in the Table (pp. 484-5.).

From a careful review of those results, the following conclusions may be deduced:—

1st. That of the *thirty-three* samples of preserved fruits and vegetables *seven were free from contamination with copper.*
2nd. That *twenty-seven* samples *were more or less impregnated with that metal.*
3rd. That *traces of copper were discovered* in *three* of the samples.
4th. That in *seven* of the samples *copper was present in small amount only.*
5th. That *eight* samples contained it *in considerable amount.*
6th. That in *six* samples the metal *was present in very considerable amount.*

7th. That *four* of the samples contained this poisonous impregnation *in very large quantities.*

8th. That the samples of *limes contained copper*, the one in *small amount* only, the other in *amount more considerable.*

9th. That *gooseberries* as commonly preserved contain *a considerable amount of copper, and some samples even a very large quantity.*

10th. That *rhubarb* usually contains an amount of copper *more considerable, some samples being contaminated with it to a very large extent.*

11th. That *greengages* in general contain *a still greater quantity of copper*, the metal being frequently present *in highly dangerous amounts.*

12th. That in *olives* this *poisonous impregnation is in the largest amount*, although its effect in heightening the colour of the fruit is less marked than in the other cases.

13th. That the preserved *red fruits*, as currants, raspberries, and cherries, are *not as a rule contaminated with copper.*

14th. That the only preservers of bottled fruits, of whom purchases were made, whose fruits and vegetables were ascertained to be, with the exception of the greengages, free from copper, were

MESSRS. CASTELL AND BROWN,

CONFECTIONERS,

45, PRINCES-STREET, LEICESTER-SQUARE.

This fact is so creditable to the parties referred to, and so important in itself, since it shows that fruits may be preserved so as to present their natural appearances without the aid of copper, that we deem the special mention of their names an act of public duty.

The absence of copper in red fruits, and the variation of the quantity of that metal in green fruits, according to the requirements in each case, afford clear evidence that this dangerous impregnation does not arise from the mere use of copper utensils, but that it is purposely introduced, the quantity being systematically adjusted in different proportions, determined by the kind of fruit preserved.

According to the method of preservation recommended by Mr. Saddington, the fruit was not suffered to come into contact with copper; the presence, therefore, of a trace even of that metal in bottled fruits and vegetables could not be accounted for on the supposition that the method now adopted was similar to that proposed by Mr. Saddington. We have therefore instituted inquiries, in order to ascertain the process at present followed by the preservers of fruits and vegetables, and find it to be essentially as follows:—

The fruit or vegetable is taken directly from the baskets or sieves in which it is received from the country, and carefully packed in bottles; these are next filled up with a liquid, consisting of water holding a small quantity of alum in solution; they are then loosely corked, and submitted for a certain time to the heat of a water-bath, so as to ensure the coagulation of the vegetable albumen; they are afterwards more tightly corked, tied over with string or wire, and further secured with resin and bladder, or with a metallic capsule.

Now it will be perceived that in this process, also, no copper utensils are made use of; and therefore the presence of copper in bottled fruits and vegetables, on this view, is only to be explained on the supposition that it has been purposely introduced; and this, we have been informed on good authority, is really the case. The preparation of copper used is the acetate of copper, commonly known as *verdigris*. This is added, in variable quantities, to the water containing the alum, with which the bottles are filled, according to the nature of the fruit or vegetable to be preserved.

In the preservation of red fruits, no copper is used; but here, again, we are informed, that red colouring matter, as decoction of logwood, or infusion of beet-root, is not unfrequently employed, especially where the fruit is damaged or of inferior quality.

The colour of green fruits and vegetables is sometimes apparently heightened by a second device; the bottles in which they are enclosed are made of a highly coloured glass; those in which French olives are preserved are of so

TABLE SHOWING THE RESULTS OF THE CHEMICAL ANALYSES
FRUITS AND

	Name.	Fruit or Vegetables.	Colour previous to Cooking.	Colour when Cooked.
1	T. Snelling.	Red currants.	Natural.	Natural.
2	E. Fenning.	Raspberries and Currants.	Natural.	Natural.
3	Crosse and Blackwell.	Ditto ditto.	Natural.	Natural.
4	Crosse and Blackwell.	Cherries.	Natural.	Natural.
5	G. Whybrow and Co.	Gooseberries.	Unnaturally green.	Deep bluish green.
6	T. Snelling.	Ditto.	Grassy green.	Coppery green.
7	E. Fenning.	Ditto.	Unnaturally green.	Coppery green.
8	E. and J. Freeman.	Ditto.	Dull, unnatural green.	Bluish green.
9	Crosse and Blackwell.	Ditto.	Grassy green.	Coppery green.
10	Castell and Brown.	Ditto.	Natural.	Natural.
11	G. Whybrow.	Greengages.	Very unnaturally green.	Deep coppery green.
12	Crosse and Blackwell.	Ditto	Unnaturally green.	Deep coppery green.
13	E. Lazenby.	Ditto.	Unnaturally green.	Deep coppery green.
14	R. and C. Faulkner.	Ditto.	Very unnaturally green.	Deep coppery green.
15	Hedges and Butler.	Ditto.	Natural.	Natural.
16	Fortnum and Mason.	Ditto.	Rather too green.	Rather too green.
17	Castell and Brown.	Ditto.	Natural.	Natural.
18	Howis and Masson.	Ditto.	Natural.	Natural.
19	J. Willmott and Co.	French Olives.	Unnaturally green.	.. ..
20	Burgess and Son.	Ditto.	Unnaturally green.	.. ..
21	C. Wix and Sons.	Ditto.	Unnaturally green.	.. ..
22	Harrington and Lucas.	Ditto.	Olive yellowish green.	.. ..
23	Sams and Co.	Ditto.	Unnaturally green.	.. ..
24	Neighbour and Sons.	Ditto.	Natural.	.. ..
25	Hedges and Butler.	Spanish Olives.	Natural.	.. ..
26	A. S. Levy.	Limes.	Intense olive-green.	.. ..
27	Fortnum and Mason.	Ditto.	Deep green.	.. ..
28	Batty and Feist.	Rhubarb.	Very unnaturally green.	Deep coppery green.
29	Westbrooke and Co.	Ditto.	Unnaturally green.	Very deep coppery green.
30	Russell and Co.	Ditto.	Unnaturally green.	Coppery green.
31	Castell and Brown.	Ditto.	Natural.	Yellowish green.
32	J. Willmott and Co.	Rhubarb & Gooseberries.	Unnaturally green.	Coppery green.
33	J. Wingrave.	Ditto ditto.	Unnaturally green.	Coppery green.
34	Joseph Colin.	Peas.	Very yellow.	Very yellow.

OF THIRTY-FOUR SAMPLES OF PRESERVED BOTTLED VEGETABLES.

Action of Juice on Rod of Iron.	Colour of Ash.	Colour of Solution of Ash, treated with Ammonia.	Action of Acidulated Solution of Ash on Iron Rod.	COPPER.	
None.	Nearly white.	Faint blue.	None.	A trace.	1
None.	White.	None.	None.	None.	2
None.	White.	None.	None.	None.	3
None.	White.	None.	None.	None.	4
Thin coating of copper.	Pink.	Decided blue.	Thick coating of copper.	Considerable.	5
Slight coating of copper.	Pink.	Pale blue.	Coating of copper.	Considerable.	6
Very thick coating of copper.	Deep pink.	Rich deep blue.	Very dense coating of copper.	Most of all.	7
None.	Somewhat pink.	Faint blue.	None.	Small quantity.	8
None.	Light pink.	Pale blue.	Coating of copper.	Considerable.	9
None.	White.	None.	None.	None.	10
Thick coating of copper.	Rather deep pink.	Decided blue.	Dense coating of copper.	Very considerable.	11
Thick coating of copper.	Rather deep pink.	Bright blue.	Thick coating of copper.	Very considerable.	12
Thick coating of copper.	Rather deep pink.	Bright blue.	Thick coating of copper.	Very considerable.	13
Thick coating of copper.	Decided pink.	Bright blue.	Very dense coating of copper.	Very considerable.	14
None.	Nearly white.	Very faint blue.	None.	A trace.	15
None.	Decided pink.	Light blue.	None.	Small quantity.	16
None.	Slightly pink here and there	Very faint blue.	None.	A trace.	17
None.	Delicate pink.	None.	None.	Very small quantity.	18
Very thick coating of copper.	Deep, dirty pink.	Rich blue.	Very dense coating of copper.	Very large quantity.	19
Thick coating of copper.	Deep obscure pink	Decided blue.	Very thick coating of copper.	Considerable.	20
Thick coating of copper.	Obscure pink.	Decided blue.	Thick coating of copper.	Considerable.	21
None.	Somewhat pink.	Pale blue.	Slight coating of copper.	Small quantity.	22
Dense coating of copper.	Deep obscure pink	Deep blue.	Very thick coating of copper.	Very considerable.	23
None.	Pink, scarcely perceptible.	Faint blue.	None.	A little.	24
None.	Brownish white.	None.	None.	None.	25
None.	Slightly pink.	Faint blue.	None.	Very small quantity.	26
None.	Rather deep pink.	Light blue.	Slight coating.	A good deal.	27
Very thick coating of copper.	Rather deep pink.	Decided blue.	Very dense coating of copper.	Very considerable.	28
Very thick coating of copper.	Deep pink.	Very decided blue.	Dense coating of copper.	Very large.	29
Decided coating of copper.	Decided pink.	Pale blue.	Thick coating of copper.	Considerable.	30
None.	White.	None.	None.	None.	31
None.	Decided pink.	Light blue.	Slight coating of copper.	A little.	32
Coating of copper.	Decided pink.	Decided blue.	Decided coating of copper.	Considerable.	33
None.	White.	None.	None.	None.	34

intense a green as to impart to the fruit as seen through the bottle a deep green colour.

As a rule, the amount of copper ordinarily present in many kinds of bottled fruits and vegetables, is greater for even equal quantities than in pickles, which, as we some months since showed, also frequently contain that metal in large and almost poisonous quantity. Add to this the fact that while pickles are used in small quantity only, a whole bottle of preserved fruit is consumed by two or three persons at one time; hence we perceive how much more dangerous is the employment of copper in the case of fruits than in that of pickles.

The present adds another instance to the many which have already been adduced, in which manufacturers, in order to heighten the colour of articles, and as they conceive, often very erroneously, to preserve their appearance, have sacrificed their flavour and quality, and have risked health, and even safety.

" *To the Editor of* THE LANCET.

SIR, — Having taken considerable interest in the reports of the Analytical Sanitary Commission, I too have had my eyes opened to the necessity of watchfulness in the purchase of articles of food. Of this I will give you a late instance.

I had bought a bottle of preserved gooseberries from one of the most respectable grocers in this town, and had had its contents transferred into a pie. It struck me that the gooseberries looked fearfully green when cooked; and on eating one with a steel fork, its intense bitterness sent me in search of the sugar. After having sweetened and mashed the gooseberries with the same steel fork, I was about to convey some to my mouth, when I observed the prongs to be completely coated with a thin film of bright metallic copper. My testimony can be borne out by the evidence of three others, two of whom dined at my table.

It is a fortunate circumstance that, considering the frequent presence of copper in pickles and preserves, its detection is so easy. I hope you will excuse my troubling you.

I remain, Sir, yours respectfully,

ALBERT J. BERNAYS, F.C.S., &c.

Chemical Laboratory, Derby, Jan. 1853.

Our correspondent's communication is in many respects valuable, especially as showing the dangerous adulterations practised by the manufacturers of bottled fruits, and also the correctness of the Analytical Sanitary Commission; but it is deficient in the most important point—viz., Mr. Bernays has omitted to give the name of the party from whom the preserved gooseberries were procured. Why should all the respectable grocers in Derby be exposed to suspicion, because one of them has sold preserved gooseberries strongly impregnated with a poisonous solution? The name of the vendor should be published; and his integrity will not be impugned in the slightest degree, if he, in his turn, publishes the name and address of the manufacturer by whom he was supplied with the poisonous commodity. The publication of the names and addresses of the offending parties has been throughout the boldest feature of our Commission, and has excited for it universal attention and respect. — ED. L."

MESSRS. CROSSE AND BLACKWELL.

The following remarks appeared in THE LANCET recently, amongst Answers to Correspondents: —

" The samples were entirely free from copper. The practice referred to, of imparting to bottled and preserved fruits and vegetables a bright green colour by means of a poisonous salt of copper, still prevails extensively. Nothing can be more pernicious than this practice; it has, however, received a considerable check by the publication of the Reports of the Analytical Sanitary Commission on this subject. One firm we know, that of Messrs. Crosse and Blackwell, whose establishment is the most extensive of any engaged in this branch of trade, has gone to a very considerable expense in fitting up a large silver vessel, as well as several steam-pans, which latter are lined with a thick coating of glass enamel, for the preparation of their various manufactures; thus taking every precaution to guard against contact with copper. The difference in the appearance of fruits and vegetables which are artificially coloured by this means, and those which have not had any colouring matter added, is very great — so striking, indeed, that a practised eye can readily distinguish the one from the other. The former are of a bright and almost metallic-green hue, much deeper than that of the recent fruit; while the latter are of a pale, yellowish-green colour, the tint varying with the nature of the fruit or vegetable preserved. As to the difference in the wholesomeness of the two articles, there can be but a single opinion, while, in our estimation, the appearance in the uncoloured sample is much the most pleasing and natural. The reckless manner in which poisonous pigments are employed in articles of diet, merely for the sake of colour, is in the highest degree reprehensible, and calls for active interference on the part of government. The disclosures contained in the Report of the "Analytical Sanitary Commission" on "Poisonous Coloured Sugar Confectionary," which will shortly be published, will furnish some remarkable examples in corroboration of the above remarks."

VINEGAR, AND ITS ADULTERATIONS.

[SECOND REPORT.]

In our former Report, published some months since, we gave the analyses of thirty-two samples of Vinegar, purchased of various retail dealers, grocers, oilmen, and publicans resident in the metropolis: on that occasion, however, we were unable to furnish the names of the different makers.

This important omission, after very considerable labour, we now supply; and we believe it will be found that the analyses given below include samples of the vinegar of almost every maker of any note, by whom the entire metropolis and its suburbs are supplied.

It may be objected that since the samples analysed were not procured direct from the makers, but through retail dealers, these may, in some cases, have committed the adulterations described; this is no doubt possible, and in some few cases may have happened, although probably not very frequently, as will appear from the following considerations.

Nearly all vinegar-makers supply at least four different strengths or qualities of vinegar, named respectively Nos. 24, 22, 18, and 16, the first being the strongest, and the last the weakest.

No. 24, or Standard vinegar, as it was called at the time when the Excise levied a duty on this article, is now seldom made; but when a very strong vinegar is required, the strength of the ordinary kind is raised by the direct addition of acetic or even pyroligneous acid.

No. 22 is in most cases the strongest vinegar really manufactured; the other and weaker kinds are not, however, prepared from this by the addition of certain quantities of water, but from separate worts, as it would not pay to make a weak vinegar by the dilution of a strong one.

Further, these numbers do not indicate *absolute*, but merely *relative* strengths, so that the vinegars of different makers having the same number vary considerably in the amount of acetic acid contained in them.

It is thus evident that, according to this system, much inducement for sophistication on the part of retail dealers is removed, who, if they wish to be supplied with a poor and cheap vinegar, have only to order a cask of the Nos. 18 or 16 vinegars of any of the makers.

The adulteration of vinegar then, when practised, as it still frequently is, rests partly with the manufacturer, and partly with the retailer. In some cases the sulphuric, pyroligneous, and acetic acids are added by the former, and in others, in addition to these, water and burnt sugar by the latter.

There is little question, therefore, but that, in the majority of cases, the following analyses represent the actual qualities and condition of the vinegars of the several manufacturers by whom London is suppled. The samples were not procured direct from the makers, because of the difficulty experienced in obtaining them by parties not engaged in the trade.

The same ingenious system as that pointed out above, prevails in the article mustard. The manufacturer of this prepares three different qualities—double superfine, superfine, and fine—which may be thus characterised: much flour and turmeric, and a little mustard; still more flour and turmeric, and less mustard; nearly all flour and turmeric, with scarcely any mustard.

In our first Report on Vinegar, the quantity of sulphate of baryta thrown down, on the addition of chloride of barium, was determined in the following manner:—

The precipitate was collected on a filter, both being afterwards burned in a platinum crucible, to get rid of the organic matter, and the residue weighed, the previously ascertained weight of the ash left by the filter being deducted.

In the present case, the precipitates were obtained by decantation; after being once or twice washed with distilled water, they were dried in a glass capsule, and their weight taken. This method is both more simple and perhaps more accurate, the only objection to it being, that, in some instances, the precipitate requires many hours fully to subside, in consequence of a portion being held in suspension by the organic matter contained in the vinegar.

Results of the Chemical Examination of Twenty-eight Samples purporting to be from the Vinegars of the different Makers and Merchants by whom London and its Suburbs are supplied, and as procured from various Grocers, Publicans, and Oilmen.

1*st Sample.*—Purchased of J. Owtram, 6. Connaught-terrace, Edgware-road. Sold as the vinegar of

R. BURNETT & CO.,
Vinegar Makers,
Vauxhall.

Contains a *considerable quantity of sulphuric acid.* 1000 grains by measure of this vinegar yield 54·46 grains of *acetic acid*, or 5·44 *per cent.*, and 1·44 of *monohydrated sulphuric acid.*

2*nd Sample.*—Purchased of J. C. Holden, 48. Cambridge-street, Hyde-park-square. Sold as the vinegar of

R. BURNETT & CO.
Vinegar Makers,
Vauxhall.

Contains a *considerable quantity of sulphuric acid.* 1000 grains yield 50·50 grains of *acetic acid*, or 5·05 *per cent.*, and 1·54 of *sulphuric acid.*

3*rd Sample.*—Purchased of W. Fontaine, 10. Vere-street, Clare-market. Sold as the vinegar of

R. BURNETT & CO.,
Vinegar Makers,
Vauxhall.

Contains a *considerable quantity of sulphuric acid.* 1000 grains yield 51·84 grains of *acetic acid*, or 5·18 *per cent.*, and 1·60 of *sulphuric acid.*

4*th Sample.*—Purchased of E. Chappell, 1. Ranelagh-terrace, Pimlico. Sold as the vinegar of

MESSRS. BEAUFOY & CO.,
Vinegar Makers,
Nine Elms.

Contains an *immense quantity of sulphuric acid.* 1000 grains yield 35·13 grains of *acetic acid*, or 3·51 *per cent.* and 4·00 of *sulphuric acid.*

5*th Sample.*—Purchased of J. Christmas, 34. South Audley-street. Sold as the vinegar of

MESSRS. BEAUFOY & CO.
VINEGAR MAKERS,
NINE ELMS.

Contains an *immense quantity of sulphuric acid.* 1000 grains yield 40·12 grains of *acetic acid*, or 4·01 *per cent.*, and 4·02 of *sulphuric acid.*

6*th Sample.*—Purchased of R. & C. Faulkner, 44. Jermyn-street. Sold as the vinegar of

MESSRS. POTTS & CO.,
VINEGAR MAKERS,
BRIDGE-STREET, SOUTHWARK.

Contains a *very small quantity of sulphuric acid.* 1000 grains yield 48·33 grains of *acetic acid*, or 4·83 *per cent.*, and ·63 of *sulphuric acid.*

7*th Sample.*—Purchased of T. Wood, Bridge-terrace, Harrow-road. Sold as the vinegar of

MESSRS. POTTS & CO.,
VINEGAR MAKERS,
BRIDGE-STREET, SOUTHWARK.

Contains a *very small quantity of sulphuric acid.* 1000 grains yield 48·33 grains of *acetic acid*, or 4·83 *per cent.*, and ·63 of *sulphuric acid.*

8*th Sample.*—Purchased of E. Price, 45. Coleshill-street, Pimlico. Sold as the vinegar of

MESSRS. GRIMBLE, PODMORE, & CO.,
VINEGAR MAKERS,
No. 1. NORTH-PLACE, ALBANY-STREET.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 41·99 grains of *acetic acid*, or 4·19 *per cent.*, and 1·86 of *sulphuric acid.*

9*th Sample.*—Purchased of S. Hardstaffe, 114. Edgware-road. Sold as the vinegar of

MESSRS. GRIMBLE, PODMORE, & CO.,
VINEGAR MAKERS,
No. 1. NORTH-PLACE, ALBANY-STREET.

Contains *an immense quantity of sulphuric acid.* 1000 grains yield 27·63 grains of *acetic acid*, or 2·76 *per cent.*, and 4·13 of *sulphuric acid.*

10*th Sample.*—Purchased of G. Mills, 124. Edgware-road. Sold as the vinegar of

CHAMPION & CO.,
VINEGAR MAKERS,
OLD-STREET-ROAD.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 39·40 grains of *acetic acid*, or 3·94 *per cent.*, and 2·04 of *sulphuric acid.*

11*th Sample.*—Purchased of W. Hudson, 16. Crawford-street, Bryanston-square. Sold as the vinegar of

CHAMPION & CO.,
VINEGAR MAKERS,
OLD-STREET-ROAD.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 43·29 grains of *acetic acid*, or 4·32 *per cent.*, and 2·00 of *sulphuric acid.*

12*th Sample.*—Purchased of F. Tuck, 138. St. Alban's-place, Edgware-road. Sold as the vinegar of

MESSRS. HILLS & UNDERWOOD,
VINEGAR MAKERS,
NORWICH.

Does not contain free sulphuric acid. 1000 grains yield 56·38 grains of *acetic acid*, or 5·63 *per cent.*, and ·44 of *combined sulphuric acid.*

13*th Sample.*—Purchased of J. Hopkinson, 132. High Holborn. Sold as the vinegar of

MESSRS. HILLS & UNDERWOOD,
VINEGAR MAKERS,
NORWICH.

Does not contain free sulphuric acid. 1000 grains yield 56·66 grains of *acetic acid*, or 5·66 *per cent.*, and 0·38 of *combined sulphuric acid.*

14*th Sample.*—Purchased of J. Leigh, 122. Whitechapel-road. Sold as the vinegar of

MESSRS. HILL, EVANS, & CO.,
VINEGAR MAKERS,
WORCESTER.

Does not contain free sulphuric acid. 1000 grains yield 51·84 grains of *acetic acid*, or 5·18 *per cent.*, and *combined sulphuric acid*, as stated below.

15*th Sample.*—Purchased of J. Swinge, 3. Arbour-terrace, Commercial-road East. Sold as the vinegar of

MESSRS. HILL, EVANS, & CO.,
VINEGAR MAKERS,
WORCESTER.

Does not contain free sulphuric acid. 1000 grains yield 33·57 grains of *acetic acid*, or 3·35 *per cent.*, and *combined sulphuric acid*, as stated below.

16*th Sample.*—Purchased of C. Batty, Grand Junction-terrace, Edgware-road. Sold as the vinegar of

MESSRS. HILL, EVANS, & CO.,
VINEGAR MAKERS,
WORCESTER.

Does not contain free sulphuric acid. 1000 grains yield 49·24 grains of *acetic acid*, or 4·92 *per cent.*, and *combined sulphuric acid*, as stated below.

The vinegars of Messrs Hill, Evans, & Co. have been recently analysed by Professors Graham, Hofmann, and Playfair. The quantity of *combined* sulphuric acid given in their analyses ranged from 1·23 to 1·33: this is derived from the grain and well-water used, but principally from the latter, which contains a considerable quantity of sulphate of lime, in which respect it is like the Burton water, only that the quantity of lime is greater.

17*th Sample.*—Purchased of Messrs. Smith and Tyers, Vinegar Merchants, 58. High-street, Borough. Sold as the vinegar of

MR. J. P. OSBORNE,
VINEGAR MAKER,
COLCHESTER.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 44·77 grains of *acetic acid*, or 4·47 *per cent.*, and 2·41 of *sulphuric acid.*

18*th Sample.*—Purchased of W. Fontaine, 10. Vere-street, Clare-market. Sold as

COUNTRY VINEGAR.

Contains *an immense quantity of sulphuric acid.* 1000 grains yield 35·19 grains of *acetic acid*, 3·51 *per cent.*, and 3·65 of *sulphuric acid.*

From inquiries made, we believe that this vinegar, as also that of the two succeeding samples, were made by Mr. OSBORNE, of Colchester.

19*th Sample.*—Purchased of W. Fontaine, 55. High-street, Whitechapel. Sold as

COUNTRY VINEGAR.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 52·33 grains of *acetic acid*, or 5·23 *per cent.*, and 2·60 of *sulphuric acid.*

20th Sample. — Purchased of Mr. Hughes, 12. King-street, St. James's. Sold in bottle, and labelled

ROYAL STANDARD VINEGAR,
Manufactured entirely from
MALT,
And highly recommended for its purity and strength. Stated to have been sold by
MESSRS. BULL & AMBLER,
VINEGAR MERCHANTS, BILLITER-STREET.

Contains *an enormous quantity of sulphuric acid.* 1000 grains yield 44·13 grains of *acetic acid*, or 4·41 *per cent.*, and 6·02 of *sulphuric acid.*

21st Sample. — Purchased of J. Holmes, 180. Brick-lane, Whitechapel. Sold as the vinegar of

MESSRS. BUMSTEAD & Co.,
VINEGAR MERCHANTS, 86. LOWER THAMES-STREET.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 34·40 grains of *acetic acid*, or 3·44 *per cent.*, and 2·60 of *sulphuric acid.*

From information we have received, we believe that this vinegar, as also that of the succeeding sample, was made by Mr PANTER, of Bristol.

22nd Sample.— Purchased of F. Duckett, 18. High-street, Kensington; and sold as the vinegar of

MESSRS. BUMSTEAD & Co.,
VINEGAR MERCHANTS, 86. LOWER THAMES-STREET.

Contains *a very considerable quantity of sulphuric acid.* 1000 grains yield 38·65 grains of *acetic acid*, or 3·86 *per cent.*, and 2·31 of *sulphuric acid.*

23rd Sample. — Purchased of Mr. Moore, Hickman's-folly, Dock-head, Bermondsey. Sold as the vinegar of

MESSRS. TAYLOR,
VINEGAR MAKERS, LONG-LANE, BERMONDSEY.

Contains a *very considerable quantity of sulphuric acid.* 1000 grains yield 40·60 grains of *acetic acid*, or 4·06 *per cent.*, and 1·90 of *sulphuric acid.*

24th Sample. — Purchased of Mr. Messent, 42. St. George's-street, Ratcliffe-highway. Sold as the vinegar of

MESSRS. TAYLOR,
VINEGAR MAKERS, LONG-LANE, BERMONDSEY.

Contains a *very considerable quantity of sulphuric acid.* 1000 grains yield 51·56 grains of *acetic acid*, or 5·15 *per cent.*, and 2·39 of *sulphuric acid.*

25th Sample. — Purchased of G. Pike, 77. High-street, Borough. Sold as the vinegar of

MESSRS. PAYNE & SLEE,
VINEGAR MAKERS, 6. CHURCH-STREET, HORSLEYDOWN.

Contains *an enormous quantity of sulphuric acid.* 1000 grains yield 32·74 grains of *acetic acid*, or 3·27 *per cent.*, and 5·51 of *sulphuric acid.*

26th Sample. — Purchased of W. Ingram, Broadway, Hammersmith. Sold as the vinegar of

MESSRS. PAYNE & SLEE,
VINEGAR MAKERS, 6. CHURCH-STREET, HORSLEYDOWN.

Contains *an immense quantity of sulphuric acid.* 1000 grains yield 46·72 grains of *acetic acid*, or 4·67 *per cent.*, and 3·88 of *sulphuric acid.*

27th Sample.—Purchased of Mr. Portch, 3. Silver-street, Notting-hill. Sold as the vinegar of

MESSRS. WILKINSON & SMETHURST,

VINEGAR MERCHANTS, NAG'S HEAD-BUILDINGS, BOROUGH.

Does not contain sulphuric acid. 1000 grains yield 47·70 grains of *acetic acid*, or 4·77 *per cent.*, and ·42 of *combined sulphuric acid.*

From information received, we believe that this vinegar, as also that of the succeeding sample, were made by Messrs. SWANN & Co., Stourport.

28th Sample.—Purchased of Warton & Co., 13. North Audley-street, Grosvenor-square. Sold as the vinegar of

MESSRS. WILKINSON & SMETHURST,

VINEGAR MERCHANTS, NAG'S HEAD-BUILDINGS, BOROUGH.

Does not contain sulphuric acid. 1000 grains yield 45·87 grains of *acetic acid*, or 4·58 *per cent.*, and ·56 of *combined sulphuric acid.*

The results contained in the above analyses will be more fully comprehended as arranged in the three following tables.

TABLE I.

Table showing the Results of the Analysis of Twenty-eight Samples of Vinegar.

No.	Retailers.	Makers.	Dried Carbonate of Soda required to Neutralise 1000 Grains.	Pure Acetic Acid in 1000 Grains.	Acetic Acid, per cent.	Monohydrated Sulphuric Acid or Vitriol in 1000 Grains.	Combined Sulphuric Acid.
1	J. Owtram.	R. Burnett & Co.	58·00	54·46	5·44	Considerable - 1·44	
2	J. C. Holden.	R. Burnett & Co.	54·00	50·50	5·05	Considerable - 1·54	
3	W. Fontaine.	R. Burnett & Co.	55·30	51·84	5·18	Considerable - 1·60	
4	E. Chappell.	Beaufoy & Co.	40·60	35·13	3·51	An immense quantity - 4·00	
5	J. Christmas.	Beaufoy & Co.	45·80	40·12	4·01	An immense quantity - 4·02	
6	R. & C. Faulkner.	Potts & Co.	50·80	48 33	4·83	A very small quantity - ·63	
7	T. Wood.	Potts & Co.	50·80	48·33	4·83	A very small quantity - ·63	
8	E. Price.	Grimble & Podmore.	45·50	41·99	4·19	Very considerable - 1·86	
9	S. Hardstaffe.	Grimble & Podmore.	34·50	27 63	2·76	An immense quantity - 4·12	
10	G. Mills.	Champion & Co.	43·00	39·40	3·94	Very considerable - 2·04	
11	W. Hudson.	Champion & Co.	47·00	43·29	4·32	Very considerable - 2·00	
12	F. Tuck.	Hills & Underwood.	58·50	56·38	5·63	None.	·44
13	J. Hopkinson.	Hills & Underwood.	58·80	56·66	5·66	None.	·38
14	J. Leigh.	Hill, Evans, & Co.	56·00	51·84	5·18	None.	1·23
15	J. Swinge.	Hill, Evans, & Co.	37·50	33·57	3·35	None.	to
16	C. Batty.	Hill, Evans, & Co.	54·00	49·24	4·92	None.	1·33
17	Smith & Tyers.	J. P. Osborne.	49·00	44·77	4·47	Very considerable. - 2·41	
18	W. Fontaine.	J. P. Osborne.	40·30	35·19	3·51	An immense quantity - 3·65	
19	W. Fontaine.	J. P. Osborne.	57·00	52·33	5·23	Very considerable - 2·60	
20	W. Hughes.	J. P. Osborne.	53·50	44·13	4·41	Most of all - 6·02	
21	J. Holmes.	Panter & Co.	38·50	34·40	3·44	Very considerable - 2·60	
22	F. Duckett.	Panter & Co.	42·50	38 65	3·86	Very considerable - 2·31	
23	Mr. Moore.	Taylor & Co.	44·10	40·60	4 06	Very considerable - 1·90	
24	Mr. Messent.	Taylor & Co.	56·00	51·56	5·15	Very considerable - 2·39	
25	G. Pike.	Payne & Slee.	40·00	32·74	3·27	An enormous quantity - 5·15	
26	W. Ingram.	Payne & Slee.	52·50	46·72	4·67	An immense quantity - 3·88	
27	Mr. Portch.	Swann & Co.	49·50	47·70	4·77	None.	·42
28	Warton & Co.	Swann & Co.	47·60	45·87	4·58	None.	·39

From the quantities of sulphuric acid given in the following table a small deduction should be made for that portion which exists in a state of combination, and which is derived from the ingredients from which the vinegar is prepared. The quantity of combined acid varies considerably in different samples; we have found it to range between ·44 and ·39 in 1000 grains, except in the case of Messrs. Hill, Evans, & Co.

TABLE II.

Table showing the Amount of Sulphuric Acid present in the several Samples, arranged in order from the lowest to the highest.

No.	Retailers.	Makers.	Monohydrated Sulphuric Acid or Vitriol in 1000 grains.
1	J. Hopkinson.	Hills & Underwood.	None.
2	F. Tuck.	Ditto.	None.
3	Mr. Portch.	Swann & Co.	None.
4	Warton and Co.	Ditto.	None.
5	J. Leigh.	Hill, Evans, & Co.	None.
6	J. Swinge.	Ditto.	None.
7	C. Batty.	Ditto.	None.
8	R. & C. Faulkner.	Potts & Co.	A very small quantity - - ·63
9	T. Wood.	Ditto.	Ditto - - - ·63
10	J. Owtram.	Burnett & Co.	Considerable - - 1·44
11	J. C. Holden.	Ditto.	Ditto - - - 1·54
12	W. Fontaine.	Ditto.	Ditto - - - 1·60
13	E. Price.	Grimble & Podmore.	Very considerable - - 1·86
14	Mr. Moore.	Taylor & Co.	Ditto - - - 1·90
15	W. Hudson.	Champion & Co.	Ditto - - - 2·00
16	G. Mills.	Ditto.	Ditto - - - 2·04
17	F. Duckett.	Panter & Co.	Ditto - - - 2·31
18	Mr. Messent.	Taylor & Co.	Ditto - - - 2 39
19	Smith and Tyers.	J. P. Osborne.	Ditto - - - 2·41
20	J. Holmes.	Panter & Co.	Ditto - - - 2·60
21	W. Fontaine.	J. P. Osborne.	Ditto - - - 2·60
22	W. Fontaine.	J. P. Osborne.	An immense quantity - - 3·65
23	W. Ingram.	Payne & Slee.	Ditto - - - 3·88
24	E. Chappell.	Beaufoy & Co.	Ditto - - - 4·00
25	J. Christmas.	Ditto.	Ditto - - - 4·02
26	S. Hardstaffe.	Champion & Co.	Ditto - - - 4·12
27	G. Pike.	Payne & Slee.	Ditto - - - 5·51
28	W. Hughes.	J. P. Osborne.	An enormous quantity - - 6·02

TABLE III.

Table showing the Amount of Acetic Acid present in the several Samples, arranged in order from the highest to the lowest.

No.	Retailers.	Makers.	Acetic Acid in 1000 grains.	Acetic Acid per cent.
1	J. Hopkinson.	Hills & Underwood.	56·66	5·66
2	F. Tuck.	Ditto.	56·38	5·63
3	J. Owtram.	Burnett & Co.	54·46	5·44
4	W. Fontaine.	J. P. Osborne.	52·33	5·23
5	W. Fontaine.	Burnett & Co.	51·84	5·18
6	J. Leigh.	Hill, Evans, & Co.	51·84	5·18
7	Mr. Messent.	Taylor & Co.	51·56	5·15
8	J. C. Holden.	Burnett & Co.	50·50	5·05
9	C. Batty.	Hill, Evans, & Co.	49·24	4·92
10	R. C. Faulkner.	Potts & Co.	48·33	4·83
11	J. Wood.	Ditto.	48·33	4·83
12	Mr. Portch.	Swann & Co.	47·70	4·77
13	Mr. Ingram.	Payne & Slee.	46·72	4·67
14	Warton and Co.	Swann & Co.	45·87	4·58
15	Smith and Tyers.	J. P. Osborne.	44·77	4·47
16	W. Hughes.	Ditto.	44·13	4·41
17	W. Hudson.	Champion & Co.	43·29	4·32
18	E. Price.	Grimble & Podmore.	41·99	4·19
19	Mr. Moore.	Taylor & Co.	40·60	4·06
20	J. Christmas.	Beaufoy & Co.	40 12	4·01
21	G. Mills.	Champion & Co.	39·40	3·94
22	F. Duckett.	Panter & Co.	38·65	3·86
23	W. Fontaine.	J. P. Osborne.	35·19	3·51
24	E. Chappell.	Beaufoy & Co.	35·13	3·51
25	J. Holmes.	Panter & Co.	34·40	3·44
26	J. Swinge.	Hill, Evans, & Co.	33·57	3·35
27	G. Pike.	Payne & Slee.	32·74	3·27
28	S. Hardstaffe.	Grimble & Podmore.	27·63	2·76

It should be particularly observed, that the above Table gives no clue to the strength of the different qualities of the vinegars manufactured by the several makers, but simply shows that vinegar, as retailed to the public, is subject to considerable variation of strength. The manufacturers, as already described, send out several qualities of vinegar, and it was not stated by the sellers in the above cases what the professed quality of the vinegars sold by them was, so that in some of the instances given, it may have been the inferior number or strength, and in others the highest.

From an examination of the preceding Tables of Analysis the following results may be deduced:—

1st. That *seven* of the samples were entirely free from sulphuric acid, or oil of vitriol.

2nd. That *eighteen* were adulterated with that powerful and corrosive mineral acid, the amount of which was variable, and often very considerable; from ·63, the lowest, to 6·02, the highest quantity in 1000 grains.

3rd. That *two* of the samples contained it in very small quantity only.

4th. That in *three* samples it was present in considerable amount.

5th. That *six* contained it in very considerable amount.

6th. That in *seven* samples it was present in immense quantity.

7th. That the acetic acid also varied very considerably in amount in different samples, the highest proportion being, in 1000 grains by measure, 56·66 grains, or 5·66 per cent., and the lowest, 27·63, or only 2·76 per cent.

8th. That in *eight* samples, the acetic acid was present in amount over *five* per cent., which is above the standard strength.

9th. That in *twelve* samples the quantity exceeded *four* per cent.

10th. That in *seven* it was over *three* per cent.

11th. That in *one* the quantity of acetic acid present was so exceedingly small as to be *under three* per cent.,—that is, but little more than half the proper strength.

12th. That the vinegars which were ascertained to be *free* from sulphuric acid or oil of vitriol were those of the following makers:—

MESSRS. HILL, EVANS, AND CO.,
WORCESTER.

MESSRS. HILLS AND UNDERWOOD,
NORWICH.

MESSRS. SWANN AND CO.,
STOURPORT.

The London agents for this vinegar are—

MESSRS. WILKINSON AND SMETHURST,
NAG'S HEAD BUILDINGS,
BOROUGH.

Here also ought to be mentioned the firm of

MESSRS. POTTS AND CO.,
BRIDGE-STREET, SOUTHWARK,

since the amount of sulphuric acid detected in the samples of their vinegar submitted to examination was so exceedingly small, that they might be considered nearly free from that acid.

To the names of the above makers who do not use sulphuric acid in the manufacture of their vinegars, we may add those referred to in a previous report, of

MESSRS. KENT AND SONS,
UPTON-ON-SEVERN.

The fact of the vinegars of these different makers being found to be entirely free from sulphuric acid, we regard as most important, since it proves most convincingly that the use of that highly objectionable acid, even in small quantities, is not necessary to ensure the preservation of vinegar, and shows that its addition is made rather for the purpose of increasing its apparent strength.*

Families may manufacture for themselves, by a simple process, the whole of the vinegar they require either for the table or for the purpose of pickling, and so make themselves independent of the vinegar-maker, and insure the purity of the article, and its freedom from oil of vitriol.

Sugar or treacle contains the elements out of which, under a new arrangement, vinegar may be formed, the only thing necessary to the change being the addition of a suitable ferment. This is found in the form of a fungus, which, under the name of the *vinegar-plant*, has been employed in different parts of the country for inducing the requisite fermentation.

We were favoured, some months ago, with the following particulars in reference to the vinegar-plant, by Mr. Fletcher, surgeon, Bromsgrove:—

* In page 372. it is stated that an improvement in the manufacture of Malt Vinegar was invented by Mr. Ham of *Norwich;* this is erroneous, as the inventor and patentee of the improvement was the late Mr. John Ham of Bristol.

"A few weeks ago I had a young vinegar-plant sent me, with the following directions:—'Put the plant in an earthen jar, add to it half a pound of the coarsest most sugar, and half a pound of treacle, with five pints of milk-warm water; cover it lightly over, so as to keep out the dust, but not the air, and then put it in a moderately warm place; there let it remain seven weeks, not disturbing it more than you can help. At the end of that time pour off what is now the clear vinegar, and keep it in well-corked bottles for use. Again add to the plant the same quantity of water, sugar, and treacle, as before. At the end of the second seven weeks, the plant will have become like two thick pancakes, and they may be easily divided, care being taken not to tear the old or new plant. If the plant is exposed to the cold, or kept too long out of the liquid, it will become black and die.'

"I herewith send you," continues Mr. Fletcher, "a sample of vinegar thus manufactured. Should the sample be worthy of your attention, I will send you a larger quantity of vinegar, a young plant, and a sample of pickles made with this kind of vinegar."

In a second letter, Mr. Fletcher writes: "The plant I have, was given me early in the winter, and it not only has supplied me with several young plants for friends, but vinegar enough to last me for years."

The Vinegar of Messrs. Champion and Co.

To the Editor of The Lancet.

"Sir,— Our attention has just been called by our travellers, who report the loss of several orders in consequence of a most gross libel published in your paper of the 28th of August last, in stating in your No. 2. table, Vinegar Analyses, that vinegar bought of a Mr. Hardstaffe, and represented to contain 4·12 sulph. acid, was vinegar made by Champion & Co. We beg to state, we never supplied, nor do we know the party; and we must hold your responsible for all loss we may sustain by your giving publicity to a charge so utterly false and unfounded as it is.

"Having been thus necessitated to address you, we feel ourselves in some measure compelled to notice your statement in other respects, so far as it refers to vinegar made by Champion & Co., and which we shall do by simply stating, that it is equally incorrect and groundless in its premises, and unfounded in fact.

We are, sir, yours respectfully,

Widow Champion & Co."

"Sept. 14. 1852."

We ought, being under the government of our most gracious lady the Queen, to entertain great respect for the ladies, and for female authority; we shall therefore not reply to the rather angry note of Mrs. Champion in any harsh or severe terms. If this lady-manufacturer will take the trouble to look at the published analyses, she will perceive it is not even stated that any sample of her vinegar was purchased of Mr. Hardstaffe. In Table 2., it should be "Grimble and Podmore," in place of Champion & Co., which is a mere misprint, as is plainly shown by the analysis and the other tables. The tables, with the exception of such a misprint as that pointed out to our notice by Widow Champion & Co., are mere compilations from the analyses.

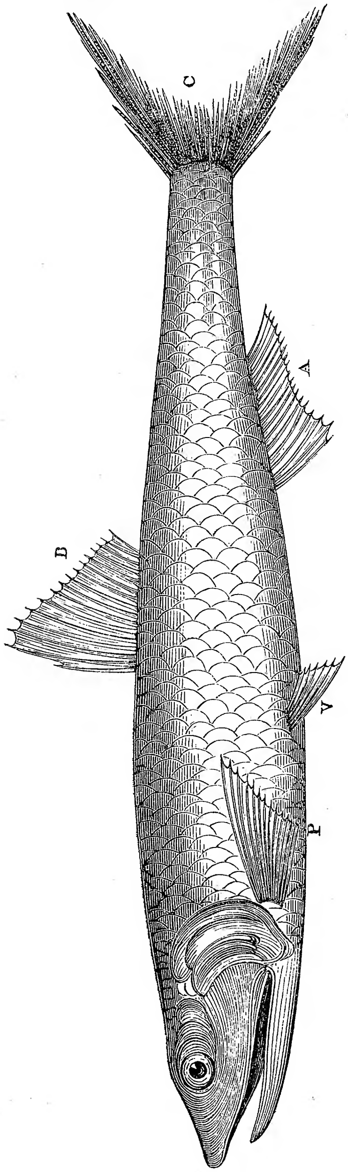
ANCHOVIES, THEIR SUBSTITUTIONS AND ADULTERATIONS.

We find but little in works on the adulteration of food, in reference to the substitution of inferior kinds of fish for this much-esteemed variety; although, if common report is to be credited, but few articles of consumption are more subject to substitution and adulteration than the anchovy, whether in the entire state, or in the form of paste and sauce.

On the present occasion, we have to treat of the entire fish. The only observations with which we are acquainted, relating to this are the following:—

"I have been told," writes Mr. Mitchell, "by many parties, that handsome profits are made annually by the manufacture of a spurious anchovy from the common sprat; and not only is this not confined to those who sell the fish, but even private families deceive themselves into the idea that 'anchovy' sprats are at least as good as the real fish; in most cases, they are as good as the fish sold as anchovies, which, indeed, are nothing but prepared sprats. This is, however, easily detected, for the appearance of the two fish is very different. An attentive examination of the form of the anchovy and the sprat will suffice to point out the distinguishing characteristics of each, in such a marked manner that the fraud is very apparent.

Fig. 144.
THE TRUE ANCHOVY.
Engraulis encrasicolus, FLEMING.



D, dorsal fin; P, pectoral fin; V, ventral fin; A, anal fin; C, caudal fin.

According to M'Culloch, "the sardine, a fish which is flatter and larger than the anchovy, is frequently substituted for it."

Before proceeding to give the results of the examination and analyses of various samples of anchovies, as vended in the metropolis, we insert an original figure, as also a scientific description, of the fish, taken from Yarrell's excellent work on the British Fishes.

"*Generic Characters.*—Distinguished from the herring in having the head pointed: the upper jaw the longest; the mouth deeply divided; the opening extending backwards behind the line of the eyes; the gape branchial apertures very large; the ventral fins in advance of the line of the commencement of the dorsal; abdomen smooth; branchiostegous rays twelve.

"I have followed Dr. Fleming, in preserving to the anchovy the old name by which it was formerly known. It was called *Lycostomus*, from the form of its mouth; and *Engraulis encrasicolus*, because, from its bitterness, it was supposed to carry its gall in its head. For this reason, the head, as well as the entrails, are removed when the fish is pickled.

"The anchovy is a common fish in the Mediterranean, from Greece to Gibraltar, and was well known to the Greeks and Romans, by whom the liquor prepared from it, called *garum*, was in great estimation. Its eastern range is extended into the Black Sea.

"The fishing for them is carried on during the night, and lights are used with the nets.

"The anchovy is common on the coasts of Portugal, Spain, and France; it occurs, I have no doubt, at the Channel Islands, and has been taken on the Hampshire coast, and in the Bristol

Channel. In the Appendix to Willughby's work, it is mentioned as having been taken on the coast of Wales; Pennant obtained it near his own residence, at Downing, in Flintshire; and Mr. Bicheno has very recently obtained several on the coast of Glamorganshire. It is said to be sold frequently in Liverpool market, and is reported to be at this time an inhabitant of the piece of water below Blackwall, called Dagenhall Breach.

"Its range to the north is extensive, as it is occasionally taken in the Baltic, and on the coast of Norway; but is not included by Linnæus in his *Fauna Suecica.*

"The anchovy appears to attain a much larger size than has usually been accorded to it: from four to five inches in length is the more ordinary size; but Mr. Couch says, 'I have seen it in the Cornish seas of the length of seven inches and a half; and I have met with specimens from autumn, through the winter, to the middle of March. It is therefore probable that a fishery might be established with good prospect of success, for though the nets employed for other fish can take but few of them, the numbers found in the stomachs of the whiting, and other ravenous fishes, show that they are in considerable abundance.

"The anchovy is immediately recognised among the species of the family to which it belongs by its sharp-pointed head, with the upper jaw considerably the longest. The length of the head, compared with the length of the body alone, is as one to three; the depth of the body but two-thirds of the length of the head, and compared to the length of the whole fish, is as one to seven; the first ray of the dorsal fin arises half-way between the point of the nose and the end of the fleshy portion of the tail; the third ray of the dorsal fin, which is the longest, is of the same length as the base of the fin; the pectoral fin small; the ventral fins arise in a vertical line in advance of the commencement of the dorsal fin, which is over the space between the ventral and anal fins; the base of the anal fin is as long as the distance from its commencement to the origin of the ventral fins; the rays short; the tail deeply forked. The fin rays in number are—

D, 14; P, 15; V, 7; A, 18; C, 19.

The breadth of the eye is one-fifth of the length of the whole head; the peculiarity in the comparative length of the jaws has been previously noticed; the gill-covers are elongated; the scales of the body large and deciduous; the colour of the top of the head and back blue, with a tinge of green; irides, gill-covers, sides, and belly, silvery white; the fins delicate in structure, and greenish white; the membranes connecting the rays almost transparent.

"In a series of notes on the occurrence of rare fish at Yarmouth and its vicinity, with which I have been favoured by Dawson Turner, Esq., there is mention of a specimen of the anchovy, taken on the beach, which measured six inches and a half in length; an additional proof of the large size acquired by this fish on our shores."

To the above we would add a description of the condition of the true anchovy when bottled.

The head and intestines are removed; the scales and fins, with the exception of the pectorals, are allowed to remain; the fish is of small size, silvery, and rather flat, the line of the back slightly curved, and the flesh is usually of a pink or salmon colour, the depth varying considerably in different samples according to age; if an anchovy be three months old, it will be pale, if six months, rather pink, and if twelve months, a beautiful deep pink colour.

The number of the fin-rays, which may be counted in the fish in its preserved state, is greater than that given in the description we have quoted; thus, when complete, the dorsal fin is composed of sixteen rays, the anal fin of nineteen, and the caudal of twenty-six rays.

Anchovies are imported in barrels preserved in brine, made with rock salt; the bottling is performed in this country, chiefly by the wholesale pickle and fish-sauce makers.

Results of the Microscopical, Chemical, and General Examination of Twenty-eight Samples of Anchovies, purchased of Oilmen, Grocers, and Bottlers of this Fish, resident in the Metropolis.

1*st Sample.*—Purchased of G. Whybrow, 4. Minories. In diamond-shaped bottle. Price 1*s*.

Consisting entirely of Dutch fish; the fish, as well as the brine, being intensely coloured with an immense quantity of a ferruginous earth, resembling *Venetian red*, or *reddle.*

2*nd Sample.*—Purchased of Batty & Feist, 102. Leadenhall-street. In square bottle. Price 1*s*. 6*d*.

Fish and brine deeply coloured with a considerable quantity of red ferruginous earth, resembling *Venetian red.*

3*rd Sample.*—Purchased of C. Wix & Son, 22. Leadenhall-street. In jar Price 1*s*. 6*d*.

Brine of a brownish colour, and does not contain *Venetian red*, *bole Armenian*, or any other red ferruginous earth.

4*th Sample.*—Purchased of T. Snelling, 30. Fenchurch-street. In square bottle. Price 1*s*.

Fish, as well as the brine, highly coloured with a large quantity of red earth, resembling *Venetian red*, which falls to the bottom as a copious precipitate.

5*th Sample.*—Purchased of E. Fenning, 5. Poultry. In glass barrel. Price 1*s*. 6*d*.

Brine rendered thick with *wheat-flour*, and slightly coloured with a red earth, resembling *bole Armenian.*

6*th Sample.*—Purchased of J. Wingrave, 90. St. Paul's Churchyard. In square bottle. Price 1*s*. 3*d*.

Brine of a deep brown colour, from admixture with a large quantity of an earth, resembling *bole Armenian.*

7*th Sample.*—Purchased of J. Burgess & Son, 107. Strand. In square bottle, Price 1*s*. 6*d*.

Brine decidedly coloured with a red earth, resembling *Venetian red.*

8*th Sample.*—Purchased of J. Prosser, 202. Fleet-street. In diamond-shaped bottle. Price 1*s*.

Fish *mixed*, consisting in part of Dutch fish; the brine being highly coloured with a considerable quantity of red earth, probably *Venetian red.*

9*th Sample.*—Purchased of Phythian, 430. West Strand. In bottle having upon it the label of Messrs. Crosse & Blackwell. Price 1*s*. 3*d*.

Brine decidedly coloured with red earth, probably *bole Armenian.*

10*th Sample.*—Purchased of J. E. Imbrie, Strand. In square bottle. Price 1*s*.

Consisting entirely of Dutch fish; the brine being vividly coloured with an immense quantity of a bright red earth, like *Venetian red*, which falls to the bottom, forming a copious precipitate.

11*th Sample.*—Purchased of J. Weston, 26. Hungerford-market. In diamond-shaped bottle. Price 1*s*.

The fish and the brine intensely coloured with an enormous quantity of a reddish-brown earth, resembling *bole Armenian;* drachms of the earth might be obtained from this bottle.

12*th Sample.*—Purchased of Trowell & Co., 93. St. Martin's-lane. In small glass barrel. Price 6*d*.

Fish and brine very highly coloured with a large quantity of a reddish earth, resembing *bole Armenian;* about a third of the contents of this barrel is made up of *rock salt, scales, and broken fragments of fish.*

13*th Sample.*—Purchased of J. Scott, 18. Coventry-street. In square bottle. Price 1*s*.

Fish *mixed*, consisting in part of Dutch fish, highly coloured with *bole Armenian.*

14*th Sample.*—Purchased of J. Quinn, 40. Haymarket. In square bottle. Price 1*s*. 6*d*.

Brine decidedly coloured with a red earth; resembling *Venetian red*, which is visible as a sediment at the bottom of the vessel. Nearly a third of the contents of this consisted of *bay salt*, scales, and broken fragments of fish.

15*th Sample.* — Purchased of Crosse & Blackwell, 21. Soho-square. In small oblong square bottle. Price 1*s*.

Brine coloured with a small quantity of red earth, resembling *bole Armenian.*

16*th Sample.*—Purchased of Fortnum & Mason, 182. Piccadilly. In square bottle. Price 1*s*. 6*d*.

Brine very highly coloured with a large quantity of red earth, resembling *bole Armenian*, which is visible at the bottom of the bottle as a dense precipitate.

17*th Sample.* — Purchased of Hedges & Butler, 155. Regent-street. In square bottle. Price 2*s*. 6*d*.

Brine decidedly coloured with a reddish earth, probably *bole Armenian.*

18*th Sample.*—Purchased of J. Wilson, 5. Oxford-street. In glass barrel. Price 9*d*.

Consists entirely of Dutch fish; the fish, as well as the brine, intensely coloured with an immense quantity of red earth, resembling *Venetian red.*

19*th Sample.* —Purchased of J. P. R. Jacquet, 25. James-street, Covent-garden. In glass barrel. Price 7½*d*.

Consisting entirely of Dutch fish; the brine, as also the fish, being highly coloured with a large quantity of red earth, similar to *bole Armenian.*

20*th Sample.*—Purchased of E. Lazenby, 6. Edwards-street, Portman-square. In octagonal bottle. Price 1*s*. 6*d*.

Brine highly coloured with much earth, of a reddish-brown colour, probably *bole Armenian.*

21*st Sample.*—Purchased of E. & J. Freeman, 3. Wigmore-street. In square bottle. Price 1*s*. 6*d*.

Brine decidedly coloured with red earth, resembling *bole Armenian.*

22*nd Sample.*—Purchased of Russell & Co., King-street, Covent-garden. In glass barrel. Price 10*d*.

Consisting entirely of Dutch fish; brine highly coloured with *bole Armenian.*

Loose Anchovies.

23*rd Sample.*—Purchased of W. Nixey, 22. Moor-street, Soho.

Consists entirely of Dutch fish; brine of a dirty brown colour, but does not contain *bole Armenian*, nor any other ferruginous earth.

24*th Sample.*—Purchased of C. Crames, Lisle-street, Leicester-square.

Brine of a brown colour; but does not contain *bole Armenian*, or any other ferruginous earth.

25*th Sample.* —Purchased of T. Caplin, 6. Brewer-street, Golden-square.

Brine and fish very highly coloured with an immense quantity of red earth, similar to *Venetian red*, which forms a dense precipitate at the bottom of the jar.

26*th Sample.*—Purchased of J. Levy, 3. Crown-street, Soho.

Consists entirely of Dutch fish; brine does not contain red earthy colouring matter.

27*th Sample.* — Purchased of Mr. Green, 32. Little Newport-street.

Brine of a dirty brown colour, but does not contain *bole Armenian*, nor any other ferruginous earth.

28*th Sample.*—Purchased of W. Gilbert, 31. King-street, Golden-square.

Brine, as well as the fish, very deeply coloured with a large quantity of reddish-brown earth, probably *bole Armenian.*

From an examination of the above Table of Analyses it appears:—

1st. That *seven* of the samples consisted entirely of Dutch fish.

2nd. That *two* of the samples consisted of a mixture of Dutch fish and Anchovies.

3rd. That the brine in *twenty-three* of the samples was charged with either *bole Armenian* or *Venetian red*, the quantity varying considerably in amount, but in most cases the brine was saturated with these earthy powders to such an extent that they might be obtained and collected from the bottom of the bottles almost by tea-spoonfuls.

It is not to be inferred that those samples in which no Dutch fish were detected, consisted of the true anchovy, since we have ascertained that two other kinds of fish besides the Dutch are commonly imported and sold as "true anchovies," and "real Gorgonas,"—namely, French and Sicilian fish.

The *French* fish or anchovy is caught off the coasts of Nantz and Nice, and is imported into this country in barrels packed in brine made with rock salt.

This fish closely resembles in its characters the true anchovy, and is probably of the same genus. Like the anchovy, it is deprived of its head and intestines, but the scales, and not unfrequently the brachial rays and pectoral fins, are entire. Moreover, the fish is usually somewhat larger, thicker across the back, tapers more towards the tail, and the flesh much whiter than the Gorgona anchovy. These differences, however, are not sufficiently marked in general, to allow of this fish, *when bottled*, being satisfactorily distinguished from the true anchovy, by an ordinary observer. Its commercial value is about one-half that of the Gorgona anchovy.

The *Sicilian* fish resembles the anchovy closely, but is smaller than the Gorgona, of which, by some, it is considered to be the young. Whether it be a state of that species, or of the same genus, we are not able to determine with certainty; its value is at least one-third less than that of the Gorgona anchovy.

Now, we have no doubt but that the majority of the above samples consisted entirely of one or other of these fish, but we hesitate to pronounce a positive opinion in each case. Although it is not difficult to distinguish French and Sicilian fish from the Gorgona anchovy, when first taken from the barrels in which they are imported, yet, when contained in bottles, the discrimination is often a matter of considerable difficulty, and in many cases is even scarcely possible. This arises from the squeezing and mutilation of the fish in the process of bottling, as well as from the altered appearance due to the red earthy matters with which they are commonly covered. Whether those engaged in the trade know of any practical characters by which the discrimination of the fish, even when thus altered, may be effected, we are not certain.

We have, however, much reason to think that the Sicilian and French fish, notwithstanding the near resemblance which exists, may be distinguished, by experienced persons, even when bottled, from the true anchovy. With a view to determine this point we forwarded to a person engaged in the anchovy trade, twelve of the above samples, each being labelled with a distinct number; the following is his Report. The numbers given below do not correspond with those of the samples:—

1. Gorgona.
2. French fish.
3. Ditto.
4. Gorgona, not fine.
5. Sicilian Fish.
6. Gorgona.
7. Dutch, inferior.
8. Sicilian, good quality.
9. Gorgona.
10. Dutch Fish.
11. Sicilian.
12. Sicilian, best quality.

If this list be correct, then NOT ONE-THIRD OF THE TWENTY-EIGHT SAMPLES EXAMINED CONSISTS OF GORGONA ANCHOVIES.

The Dutch fish may be distinguished from the true anchovy, by its being invariably deprived of its scales, by its large size, white flesh, general coarseness, and by the very evident scale-marks which extend over the whole surface. The fins have the same disposition as the true anchovy, the same number of rays; and it is possible that this fish may be one of the genus *Engraulis*, of which there are three or even more species.

The French, and especially the Dutch, fish are not only of much less value, but also greatly inferior as an article of diet to the true anchovy. The difference in the cost of the anchovy and Dutch fish may be estimated by the fact, that dealers find it worth their while to mix them in different proportions in even the same bottle. There is no difficulty in distinguishing the Dutch fish by the characters pointed out above; but it would be very difficult to discriminate between the larger samples of the French anchovies, when denuded of their scales, and that which in this article is denominated *Dutch fish*, and hence we infer that the two may possibly be separate states and conditions of one and the same species.

In none of the samples have we met with either sprats or sardines, although there is no doubt that both these fish have been, and are still occasionally, sold as real Gorgona anchovies. The sprat may be readily distinguished from the anchovy, by the dorsal fin which consists of seventeen rays, but more particularly by the position of the ventral fin, which is placed in a vertical line directly under the first dorsal fin-ray. The sardine is a shorter and thicker fish than the anchovy; it has white flesh, and the relative position of the ventral and dorsal fins is different.

The practice of imparting an unnatural red or brown colour to the fish and brine, by means of Venetian red and bole Armenian, is in the highest degree reprehensible. To saturate an article of food with large quantities of earthy colouring matter, is objectionable on the score of cleanliness; it is equally so as regards health, for this earth contains a large quantity of iron. Now, this medicine is not suited to all cases, and it may even, in some instances, be productive of mischief; at all events, when it is desirable to take iron, we should prefer that it be prescribed under the advice of a physician, and not administered in an article of food by our grocer, fishmonger, or Italian warehouseman.

Again, it is not an uncommon thing for Venetian red to contain considerable quantities of red lead; and although, in the analyses we have made, we are happy to state that *we have not detected that poisonous metallic oxide in a single sample*, there is no question but that red lead is occasionally to be found in bottled anchovies.

But in what, it may be asked, does this disgusting practice of mixing dirty earthy substances with anchovies take its origin? Surely it is not practised for the mere sake of colour? In previous reports we have shown to what lengths manufacturers, for the sole sake of appearance, will go in the articles pickles, bottled fruits, Cayenne pepper, &c.

In the present case we believe the use of these substances does not arise solely from the desire to produce a brilliant and striking-looking article, but that it is intended to disguise and cover the dirty and muddy colour commonly presented by the brine in which the fish is imported; this dirty colour cannot be attributed entirely to the fish, but is due in part to the want of cleanliness in the salting, as well as to the impure character of the salt used.

Fortunately, most consumers of this fish rinse it in water before eating, and thus get rid of much of the earth; but still a considerable quantity remains attached to the fish, insinuating itself into the abdomen, between the scales, and into every portion of broken surface.

Anchovies, even when thus coarsely reddened, and put up in glass bottles, are not particularly sightly objects. Both for convenience and appearance, it would be much better that they should be enclosed in open-mouthed earthen jars, which might be made of different patterns, and as ornamental as desired; by this means the necessity for colouring would be done away with as well as the wax or resin, themselves frequently coloured with red lead, with which the corks of the bottles are smeared, and some of which, on the bottles being opened, usually finds its way into the contents. Now that glass is so cheap, if bottles continue to be used, it would at all events be better that they should be furnished with glass stoppers in place of corks.

THE ANALYTICAL SANITARY COMMISSION AND ANCHOVIES.

To the Editor of THE LANCET.

"SIR,

"My attention has been drawn to a Report published in THE LANCET a few days since, where I am accused of selling anchovies in bottles that are half filled up with bay salt and rubbish. Now, in the first place, allow me to call your attention to the facts respecting these bottled fish. They are not packed by myself or any person employed by me. At the time I bought them they were warranted genuine Gorgona anchovy fish, and nothing else. I was also told that they should be well packed in every respect; and had I known they were not agreeable to order, I should have returned them immediately to the rightful owner, whose name and address I enclose to you as follows:—Mr. Frederick Phillips, Fish Sauce Warehouse, opposite the Dun Cow, Old Kent Road, who is now in possession of all I have bought of him, I having returned them;

and as you ~~have~~ cast the stigma upon me undeservedly, I hope, as I have given you the whole truth ~~of~~ the grievance you have laid before the public against me, you will do me the justice and favour of retracting that stigma in your next publication. "I remain, Sir,

"Yours, with respect,

"THOMAS TROWELL."

*** Mr. Trowell will perceive on reconsideration, that we have nothing to "retract." In furnishing the name of the party by whom the anchovies were supplied, Mr. Trowell has acted like an honest man; and if other dealers whose names we publish from time to time would act in a similar manner, there would soon be an end to all adulteration. Perhaps Mr. Phillips will state of whom he purchased the anchovies in question? Our statement was to this effect:—

"Fish and brine very highly coloured with a large quantity of a reddish earth, resembling *bole Armenian;* about a third of the contents of this barrel is made up of *rock salt, scales, and broken fragments of fish.*"

Since the above was in print an exposure has been made by Dr. Letheby at a coroner's inquest of the mischief arising from the use of spurious anchovies prepared in this manner.

ON POTTED MEATS AND FISH, THEIR ADULTERATIONS.

FOLLOWING the course laid down, we have now to treat of the adulterations of potted meats and fish, as ham, tongue, beef, bloaters, anchovies, and shrimps.

The only attempt made in this country at anything like a systematic exposure of the various adulterations which prevail throughout almost every article of food and drink, was that by Accum in the year 1820. Valuable as that work was in its day, and indeed in some respects still is, its range is but very limited, many important subjects being entirely overlooked, and the majority of those which are considered being handled in an imperfect manner; the microscope, so invaluable in investigations of this nature, not having been employed in any case.

The works which have since been written, are, for the most part, compilations rather than original productions, and they all have this very great fault, that they do not attempt to distinguish between those adulterations which are actually practised at the present time, and certain other alleged adulterations which have no better foundation than mere rumour, or even the imagination of the writers themselves. Hence the portion of truth contained in these works is completely overlaid with a mass of error and fiction, so that it is not possible for an ordinary reader to distinguish between what is true and what is false in the contents of these works.

In none of the works on food known to us, do we find a syllable in reference to the adulterations of ham, tongue, beef, bloaters, or shrimps; the only observations which we have met with relate to anchovy paste and sauce. These are by Mr. Mitchell, to the following effect:—

"The fraud as regards the fish, is, however, unimportant when compared with the deleterious nature of the substance employed in manufacturing anchovy sauce and paste. It may not be generally known that the red colour of both these preparations is due to an admixture of Venetian red, which, in itself, is comparatively harmless, but which taken in quantity might occasion serious obstructions in the bowels; this, however, is not the worst, for Venetian red is sometimes mixed with red lead to enhance its colour; and it is to be feared that the more unscrupulous of the manufacturers of anchovy paste and sauce, purposely add this poisonous colouring matter. One thing, however, is certain, that it does exist in some samples, and that too in considerable quantities.

"The admixture of any preparation of lead may be detected by the means already pointed out in several sections, for the determination of the existence of that metal.

"Anchovy sauce and paste are adulterated in other ways; some of them cannot be detected, others can.

"It is very common for sprats, and other cheap fish, to be bruised up into a pulp, mixed with flour and the necessary seasoning for anchovy sauce, and then the flavour of the latter fish is imparted by means of a small quantity of the liquor obtained in salting it, or even an admixture of a small per-centage of the fish.

"Flour is an ingredient in the manufacture both of the paste and sauce; yet a very large quantity of it is often fraudulently introduced, to the exclusion of a certain per-centage of fish; and not only is flour employed for this purpose, but large quantities of Venetian red, chalk, plaster of Paris; and it is generally when the two latter ingredients are added, that red lead is also added to make up for the decrease of colour the white admixture occasions." *

Results of the Microscopical and Chemical Examination of Twenty-eight Samples of Potted Meats and Fish.

POTTED MEATS.

Tongue.

1*st Sample.* — Purchased of Hedges & Butler, 155. Regent-street. In pot, marked with the initials R. W. Price 1*s.* 6*d.*

Colour pale pink, and perfectly natural; does not contain red earthy colouring matter.

Beef.

2*nd Sample.* — Purchased of E. Lazenby, 6. Edwards-street, Portman-square. In pot, marked with the initials R. W. Price 1*s.* 6*d.*

Colour pink, and perfectly natural; does not contain red earthy colouring matter.

3*rd Sample.* — Purchased of J. Snelling, 30. Fenchurch-street. In pot. Price 1*s.*

Colour deep brownish red, arising from the presence of *bole Armenian.*

4*th Sample.* — Purchased of J. Burgess & Son, 107. Strand. In pot. Price 1*s.* 6*d.*

Colour deeper than natural; contains a small quantity of *bole Armenian.*

Hamburgh Beef.

5*th Sample.* — Purchased of E. & J. Freeman, 3. Wigmore-street, Cavendish-square. Price 1*s.* 6*d*

Unnaturally red, from the presence of *bole Armenian.*

6*th Sample.* — Purchased of Messrs. Crosse & Blackwell, 21. Soho-square. Price 1*s.*

Colour reddish-brown, from the presence of much *bole Armenian.*

Ham.

7*th Sample.* — Purchased of E. Lazenby, 6. Edwards-street, Portman-square. In pot, marked with the initials R. W. Price 1*s.* 6*d.*

Of a pale and natural pink colour; does not contain *bole Armenian,* or any other red ferruginous earth.

8*th Sample.* — Purchased of Hedges & Butler, 155. Regent-street.

Of a pale and natural pink colour; does not contain *bole Armenian,* or any other red ferruginous earth.

Westphalian Ham.

9*th Sample.* — Purchased of Fortnum & Mason, 182. Piccadilly.

Of a pale and natural pink colour; does not contain *bole Armenian.*

POTTED FISH.

Bloaters.

10*th Sample.* — Purchased of Fortnum & Mason, 182. Piccadilly. In pot.

* Treatise on the Falsification of Food, p. 251.

Price 1*s*. Labelled, THORN'S YARMOUTH BLOATERS; manufactory, 223. High Holborn.

Of a very deep and most unnatural red colour, arising from the presence of a large quantity of *bole Armenian;* the pot also contains much *starch.*

11*th Sample.*—Purchased of J. Prosser, 202. Fleet-street. In pot. Price 1*s*. Labelled, J. BANGER'S YARMOUTH BLOATERS.

Unnaturally red, from the presence of *bole Armenian.*

12*th Sample.*—Purchased of Thomas Snelling, 30. Fenchurch-street.

Of a very deep and unnatural red; contains very much *bole Armenian.*

13*th Sample.*—Purchased of Messrs. Crosse & Blackwell, 21. Soho-square. In pot. Price 1*s*.

Of a bright red colour; contains a ferruginous earth, producing *bole Armenian* in considerable amount.

14*th Sample.*—Purchased of E. & J. Freeman, 3. Wigmore-street, Cavendish-square. Price 1*s*. 6*d*.

Of a very deep and most unnatural red colour; contains a large quantity of *bole Armenian.*

15*th Sample.*—Purchased of Hedges & Butler, 155. Regent-street. Price 1*s*.

Colour deeper than natural; contains a small quantity of *bole Armenian.*

SHRIMPS.

16*th Sample.*—Purchased of J. Prosser, 202. Fleet-street. In pot. Price 1*s*. Labelled, JOHN BANGER'S POTTED SHRIMPS.

Of a pale pink colour; contains a very small quantity of *bole Armenian.*

17*th Sample.*—Purchased of Batty & Co., 102. Leadenhall-street. In jar. Price 1*s*. 6*d*.

Consisting in a part of anchovy paste, and highly coloured with an immense quantity of *bole Armenian.*

ANCHOVY PASTE.

18*th Sample.*—Purchased of Hedges & Butler, 155. Regent-street. In pot, marked with the initials R. W. Price 1*s*. 6*d*.

Of a deep and unnatural red colour; contains much *bole Armenian.*

19*th Sample.*—Purchased of Thomas Snelling, 30. Fenchurch-street. Price 1*s*.

Of a deep and earthy red colour; contains an immense quantity of *bole Armenian.*

20*th Sample.*—Purchased of Wix & Son, 22. Leadenhall-street. Price 1*s*. 6*d*.

Of a vivid red colour; contains an immense quantity of a red earth, probably *Venetian red,* and also some *starch.*

21*st Sample.*—Purchased of J. Prosser, 202. Fleet-street. In pot, labelled, JOHN BANGER & SON'S ANCHOVY PASTE. Price 1*s*. 6*d*.

Of a deep and most unnatural red colour; contains a very large quantity of *bole Armenian,* and also much *wheat-flour.*

22*nd Sample.*—Purchased of Fortnum & Mason, 182. Piccadilly. Price 1*s*. 3*d*.

Of a deep red colour; contains very much *bole Armenian.*

23*rd Sample.*—Purchased of J. Burgess & Son, 107. Strand. Price 1*s*. 6*d*.

Of a deep red colour; contains much *bole Armenian.*

24*th Sample.* — Purchased of J. Wingrave & Co., 80. St. Paul's-churchyard. In barrel. Price 1*s*. 6*d*.

Colour deeper than natural; contains *bole Armenian.*

25*th Sample.*—Purchased of Batty & Feist, 102. Leadenhall-street. In barrel. Price 1*s*. 6*d*.

Of a bright red colour; contains an immense quantity of *bole Armenian.*

26*th Sample.*—Purchased of Crosse & Blackwell, 21. Soho-square. In barrel. Price 1*s*.

Unnaturally red; contains much *bole Armenian.*

27*th Sample.* — Purchased of E. Lazenby & Son, 6. Edwards-street, Portman-square. In bottle. Price 1*s*. 6*d*.

Very red, from admixture with an immense quantity of *bole Armenian.*

28*th Sample.*—Purchased of J. & E. Freeman, 3. Wigmore-street. In barrel. Price 1*s*. 6*d*.

Unnaturally red; contains a considerable quantity of *bole Armenian.*

From an examination of the above table of analyses, the following conclusions may be deduced :—

1st. That the samples of *Potted Tongue* and *Ham* were entirely free from adulteration.

2nd. That four out of the five samples of *Potted Beef* were artificially coloured by means of the red earth, *bole Armenian.*

3rd. That the whole of the samples of *Potted Bloaters* examined were highly coloured with the before-named earthy substance.

4th. That one of the samples of *Bloater Paste* was adulterated in addition with a large proportion of *starch* or *flour*, probably wheat-flour boiled.

5th. That the entire of the samples of *Anchovy Paste* analysed were still more highly, and even vividly, coloured with very large quantities of *bole Armenian.*

6th. That two of the *Anchovy Pastes* were in addition adulterated with *flour*; one with a large per-centage of *wheat-flour.*

7th. That of the twenty-eight samples of *Potted Meats* and *Fish* subjected to analysis, no less than twenty-three were more or less impregnated with the red earthy material, *bole Armenian.*

This picture of the adulteration of potted meats and fish is surely bad enough and disgraceful enough; it is yet satisfactory to know that it is not quite so bad as the remarks quoted at the beginning of this Report would lead us to infer.

The difference in the appearance presented by the uncoloured samples, contrasted with those in which the bole Armenian had been added, was most striking, and usually sufficient to enable the observer to distinguish by the eye alone the samples to which this scandalous addition had been made. While in the one case the paste was of a pale pink, and perfectly natural hue, in the other the colour was such as the flesh, when pounded, of no fish or animal ever presents, it being of a deep, earthy, and brick red.

In less obvious or doubtful cases the red earthy colouring matters may be detected by shaking a portion of the paste well up with water; this will set the earth free, some of which, on account of its weight, will fall as a sediment, and then become visible either to the eye alone, or under the microscope.

A still better and more ready method is, to place a minute portion of the paste on a slip of glass; and after having spread it out by means of a little water, to view it as an opaque object under the microscope, with an object-glass of one half-inch focus. In this way very minute quantities of the red earth may be detected.

In a previous article we showed that one of the principal reasons why artificial colouring matters are employed in the case of bottled anchovies, is to conceal the dirt contained in the brine in which the fish is imported. In the present instance there is not even this poor excuse; the only purpose served by the employment of the bole Armenian being to cause the articles to present a striking appearance, but one which at the same time is, in our opinion, most unnatural, and but little inviting.

In the case too of potted meats and fish, the colouring ingredients cannot, as in anchovies, be got rid of, to some extent at least, by washing; for since they are incorporated with the paste, they must be entirely consumed with the meat or fish.

That the practice of adding large quantities of coloured earthy substances to articles of diet is dirty, injurious to health, and, in some cases, even dangerous to life, cannot be doubted. The chief medicinal ingredient in bole Armenian is oxide of iron; this, although not dangerous, might in some instances be productive of prejudicial effects; but it sometimes happens that other red earths are used, and these as well as also occasionally, although rarely, bole Armenian itself, are contaminated with red-lead; *for this poisonous substance each of the above twenty-eight samples have been separately analysed, without however, we are happy to state, a particle of it being discovered in a single instance. The whole of the samples have likewise been examined for chalk and plaster of Paris.*

As long, then, as manufacturers continue to mix red earths with their potted meats and fish,—these delicacies of the table, as they are commonly considered, so often had recourse to by the gourmand and the invalid to rouse a flagging appetite—so long we recommend the public to refrain from purchasing and using them.

But there is another objection which may be urged against the use of potted meats and fish, as ordinarily met with in the shops—viz., that they do not, in many cases, really consist of that which they profess; and if they be really genuine, there are no sufficient means known whereby the quality and condition of the meat or fish employed can be determined. This remark applies particularly to anchovy paste. In the Report on Anchovies, we stated that not more than one-third of the samples examined consisted of the real Gorgona anchovy, the rest being made up of Dutch, French, and Sicilian fish. Now, there is no doubt but that a still larger proportion of the anchovy pastes consists of the inferior fish above referred to, as well as probably also some other kinds of fish; a conclusion founded, in part, upon the impossibility of distinguishing between the several descriptions of fish when pounded and reduced to a pulp, for in this case the microscope even fails to give assistance. The scales of the fish, which in some cases might afford distinctive characters, are removed; and the difference in the size of the muscular fibres of different fish is in general not sufficiently great to furnish a satisfactory means of discrimination.

Although by the microscope we are not often able to distinguish between the muscular fibres of different kinds of fish, yet by the aid of that instrument, in some cases, different descriptions of fish and meats may be distinguished. Thus the muscular fibre of shrimps may be distinguished from that of the anchovy, of tongue from that of ham and bacon, and all these from the fibres of beef. These facts all admit of useful practical application to the subject of food and its adulterations.

But the preparation of potted meats and fish is so simple, that every intelligent cook and housekeeper may prepare the several kinds without much trouble, and with a very considerable saving of expense.

When meats are to be potted, they should be well trimmed, that is, all superfluous fat, tendon, and sinew should be removed, and the meats then cut, or torn into small pieces, and reduced in a large mortar, to a pulp or paste. The fish should be scaled, and carefully deprived of their bones. To both, salt, pepper, cayenne, spices, and such other seasoning should be added as is considered desirable. The paste, after having been potted—common preserve jars will answer the purpose very well—should be covered with a tolerably thick layer of either suet or lard, in order to prevent the access of the air, which soon renders the paste rancid, and occasions the development of fungi.

ON SAUCES, AND THEIR ADULTERATIONS.

A GREAT variety of substances, chiefly vegetable, enter into the composition of the various sauces in use; the following is an enumeration of the chief of these:—tomato, garlic, shallot, sorrel, mushroom and walnut catsup, raisins, tamarinds, the seeds of fœnugreck and cumin, the leaves of a variety of herbs, as tarragon, chervil, mint, thyme, marjoram, &c., the seeds of an Indian plant called *Dolichos soja* or *soya*, of which soy is made; a variety of spices and condiments, as pepper, cayenne, mustard, mace, cloves, ginger, and nearly all the other spices; salt, treacle and burnt sugar as colouring agents, and flour as a thickening ingredient; out of the above articles, variously combined, and in different proportions, nearly all the sauces in use are compounded. Into the composition of some few, however, animal substances enter, as the muscular fibre of shrimps, lobster, and anchovy. It may be well to give brief notices of one or two of the less common of the above vegetable productions.

Tomato is the seed-vessel or fruit, so remarkable when ripe for its brilliancy of colour, of a species of Lycopersicum, *L. esculentum;* its flavour is subacid, delicate, and peculiar; it is said to contain much oxalic acid in combination, and to possess anodyne properties; it enters into the composition of very many of the best and most celebrated sauces. The minute structure of the tomato, as seen with the microscope, is sufficiently characteristic to allow of its ready identification. The cells of which the epidermis is formed are rather small, flat, angular, and well-defined, while those of the pulp are several times larger, more or less round, and enclose the colouring matter, and a few globules also coloured, resembling oil; the cells of the ripe fruit do not contain starch, and hence do not become blue on the addition of a solution of iodine.

Garlic and *shallots* both belong to the same genus of plants as the onion, the first being named *Allium sativum*, and the second *Allium ascalonicum;* their flavour is stronger, but more delicate than that of the common onion. They are much used in French cookery, and enter into the composition of many sauces.

Tarragon, known in botany as the *Artemesia dracunculus*, is a mild aromatic herb; it is well suited for use in soups.

The whole of the above vegetable substances employed in the manufacture of sauces may be detected, when not greatly altered by previous prolonged boiling, by means of the microscope; and many of them may even be recognised after having been subjected to the action of boiling water. The microscope is capable, therefore, of affording very valuable assistance in the determination of the ingredients which enter into the composition of many sauces; when, however, the composition is very complex, much time and patience are required before all the ingredients used can be identified.

The structure of very many of the productions above referred to has been already fully described and represented by woodcuts in previous articles, as mustard, pepper, cayenne, cumin and fœnugreck seeds, turmeric, mace, nutmeg, and all the spices. By a little previous study of the fresh roots, leaves, and seeds used in the preparation of sauces, and of which descriptions have not yet been given, the inquirer would soon find himself able to identify the majority of the ingredients entering into the formation of any particular sauce.

In the article on Potted Meats and Fish, we have already published the remarks of Mr. Mitchell in reference to the adulteration of anchovy paste and sauce; we will now quote the observations made by Accum, under the head of "Poisonous Anchovy Sauce."

"Several samples which we have examined of this fish sauce have been found contaminated with lead.

"The mode of preparation of this fish sauce consists in rubbing down the broken anchovy in a mortar; and this triturated mass, being of a dark-brown colour, receives, without much risk of detection, a certain quantity of Venetian red, added for the purpose of colouring it, which, if genuine, is an innocent (?) colouring substance; but instances have occurred of the pigment having been adulterated with orange-lead, which is nothing else than a better kind of minium or red oxide of lead.

"The conscientious oilmen, less anxious with respect to colour, substitute for this poison the more harmless pigment, called Armenian bole."

In the following analyses, the object in view has been, not so much to determine the nature of the ingredients entering into the composition of the several sauces, as the detection of adulteration. All that has been aimed at, with respect to the composition, has been, to afford some idea of the nature of certain of the sauces.

Results of the Microscopical and Chemical Examination of Thirty-three Samples of the Principal Sauces, obtained chiefly from Manufacturers.

India Soy.

1*st Sample.*—Purchased of Batty & Co., Pavement, Finsbury-square. Price 1*s*. 6*d*.

This article is dark, thick, and like syrup; it is made up to a great extent of treacle slightly burned; and judging from the consistence, appearance, and taste, it appears to be little else than *treacle* very strongly flavoured with *salt*. Examined with the microscope, there were detected in it numerous oval sporules of the fungus invariably present in treacle.

2nd Sample.—Purchased of Thomas Snelling, 30. Fenchurch-street. Price 1*s*. 3*d*.

Appearance, taste, and composition very similar to Sample 1.; it certainly consists in great part of *treacle* and *salt*.

3rd Sample.—Purchased of Fenning & Hale, 5. Poultry, London. Price 1*s*. 6*d*.

Composition the same as the previous samples, it consisting chiefly of *treacle* and *salt*.

4th Sample.—Purchased of J. Wingrave & Co., 80. St. Paul's-churchyard. Price 1*s*. 6*d*.

Composition apparently the same as in the previous samples, it consisting principally of *treacle* and *salt*.

5th Sample.—Purchased of John Burgess & Son, 107. Strand. Price 1*s*. 6*d*.

Composition apparently the same as in the previous samples, *treacle* and *salt* being the chief ingredients. Neither *copper* nor *lead* was detected in this or the above samples.

By the above observations, we do not mean to imply that the samples of Soy examined may not consist, either in part or entirely, of genuine India Soy; but this we do say, that, if genuine, then is Soy little better than a mixture of treacle and salt, out of which ingredients we undertake to produce an article scarcely if at all distinguishable from the samples referred to.

Harvey's Fish Sauce.

6th Sample.—Purchased of E. Lazenby & Son, 6. Edwards-street, Portman-square. Price 1*s*. 3*d*.

This sauce is of a blackish-brown colour, and is perfectly liquid, scarcely any sediment being deposited. It contains *vinegar*, *catsup*, and much *salt*. Examined with the microscope, there were detected in it a large quantity of the octohedral crystals of *oxalate of lime*, and very minute chips or fragments of charred *deal*. The oxalic acid is derived from some vegetable substance which contains a large quantity of combined oxalic acid, employed in the manufacture of the sauce; the presence of the charred wood can scarcely be accidental, and this is probably used to heighten the colour of the liquid. No *lead* or *copper* present.

Cocks's Reading Sauce.

7th Sample.—Purchased of J. Freeman, 3. Wigmore-street, Cavendish-square. Price 1*s*. 6*d*.

This sauce is of a blackish-brown colour, and perfectly clear and liquid. It contains *vinegar*, much *cayenne* and *salt*, *catsup*, and perhaps a small quantity of *shallots* or *garlic* and *soy*. No *lead* or *copper* detected.

Hickson's King of Oude Sauce.

8th Sample.—Purchased of J. Freeman, 3. Wigmore-street. Price 1*s*. 6*d*.

This sauce is thick, pulpy, and of a *green* colour. It contains *vinegar*, *pepper*, a little *cayenne*, *turmeric*, some green herb, probably *sorrel*, which imparts the colour to the sauce, and also a large quantity of some vegetable substance, the cells of which are about the size of those of the potato, and which turn blue on coming into contact with a solution of iodine. Neither *copper* nor *lead* was present.

Lazenby's King of Oude Sauce.

9th Sample.—Purchased of Lazenby & Son, 6. Edwards-street, Portman-square. Price 1*s*. 6*d*.

This sauce is thick, pulpy, and of a *yellow* colour; it contains *vinegar*, much *mustard*, *turmeric*, some *cayenne*, *wheat-flour*, finely-chopped *raisins* in abundance, probably *shallots*, and other vegetable substances. It is a totally different sauce from the preceding. Neither *lead* nor *copper* was present.

Wix's King of Oude Sauce.

10th Sample.—Purchased of Wix & Sons, 22. Leadenhall-street. Price 1*s*. 6*d*.

This sauce is thick, pulpy, and of a *brown* colour; its composition is complex; it contains a large quantity of a vegetable substance, the nature of which was not determined, a little *shallot* or *garlic*, and much *cayenne;* there were also detected in it numerous crystals of *oxalate of lime*, as well as very many of some other salt. The second kind of crystals proceeded evidently from the vegetable ingredients referred to, and which entered so largely into the composition of the sauce. No *lead* or *copper*.

It thus appears that there are no less than three King of Oude Sauces, each differing from the others totally in characters and composition. Now, as three kings cannot reign in the same country at the same time, we should be glad to know which is the real "King of Oude," and which pretenders; as we have no means of forming an opinion ourselves on this important historical question, perhaps one or other of the Messrs. Hickson, Lazenby, and Wix will furnish the required information.

Burgess's John Bull Sauce.

11*th Sample.*—Purchased of Burgess & Son, 107. Strand. Price 1*s.* 6*d.*

This sauce is of a blackish-brown colour, and deposits a brown sediment, which reaches about one-third up the bottle. It contains *vinegar*, *tomato*, *cloves*, *cayenne*, probably *catsup*, *dark-brown fibres*, striated, and resembling somewhat *muscular fibre*, and some other ingredients. The ash left on incineration is red, and contains *iron*, but neither *lead* nor *copper*.

Soyer's Sauce Succulente.

12*th Sample.*—Purchased of Messrs. Crosse & Blackwell, 21. Soho-square. Price 2*s.* 6*d.*

This sauce is thick, pulpy, and of a reddish-brown colour. It contains *vinegar*, a considerable quantity of *tomato*, *wheat-flour*, *shallots*, *garlic*, *red-currant jelly*, several herbs, &c. In flavour, it is exceedingly delicate and agreeable.

Soyer's Relish.

13*th Sample.*—Purchased of Crosse & Blackwell, 21. Soho-square. Price 1*s.* 3*d.*

This sauce is likewise of a reddish colour; it is much hotter than the former sauce, and contains *tomato*, *shallots*, *soy*, &c., and other flavouring ingredients. No *lead* or *copper* either in this or the preceding sauce.

Great Western Sauce.

14*th Sample.*—Purchased of Caleb Walker, the Manufacturer, 13. Spring-street, Paddington. Price 1*s.* 6*d.*

This sauce is of a blackish-brown colour, and deposits but little sediment; it contains *vinegar*, *walnut-catsup*, a small quantity of *shallots* or *garlic*, *salt*, much *cayenne*, *spice*, and probably other ingredients. On examination with the microscope there were detected in its cells, not coloured by iodine, crystals of *oxalate of lime*, and many dark *brown fibres*, some striated and resembling *muscular fibre*. This is a pleasant flavoured and stimulating sauce. No *lead* nor *copper* present, nor was any adulteration discovered.

Tomato Sauce.

15*th Sample.*—Purchased of J. Wilmot & Co., corner of Fenchurch-street. In bottle, with French label, bearing the name of "Joret." Price 1*s.* 3*d.*

The tomatoes, in this case, are simply reduced to a pulp, and bottled, without the addition of seasoning of any kind; their colour is perfectly natural.

16*th Sample.*—Purchased of J. Freeman, 3. Wigmore-street. In bottle, with French and English label. Price 1*s.* 6*d.*

Colour brilliant in the extreme, and most unnatural. The heightened colour is not due to admixture with any coloured mineral substance, but probably to *cochineal.* The tomatoes in this sample also are merely reduced to a pulp, and bottled without seasoning.

17*th Sample.*—Purchased of Lazenby & Son, Edwards-street, Portman-square. Price 1*s.* 6*d.*

Of an intense and unnatural red colour; this sauce consists of *tomato*, *vinegar*, *mace*, and probably some other seasoning ingredients, the whole being highly coloured with *bole Armenian*.

18*th Sample*.—Purchased of Messrs. Crosse & Blackwell, 21. Soho-square. Price 1*s*. 3*d*.

This sauce is of a very unnatural red colour, and consists principally of *tomato* and *vinegar*, highly coloured with *bole Armenian*.

19*th Sample*.—Purchased of Burgess & Son, 107. Strand. Price 1*s*. 6*d*.

Of a very unnatural red colour; consists of *tomato*, *vinegar*, and a blade or two of *mace*, the whole being reddened by the addition of a considerable quantity of *bole Armenian*.

20*th Sample*.—Purchased of Fenning & Hale, Poultry. Price 1*s*.

Of a most unnatural red colour, and consists chiefly of *tomato* and *vinegar*, deeply coloured with a very large quantity of *bole Armenian*.

21*st Sample*—Purchased of Wingrave & Co., St. Paul's-churchyard. In bottle. Price 1*s*. 6*d*. labelled thus: —

Sauce de Tomates.
D'un flaveur superieur,
Exportées à
J. Wingrave et Cie.,
à Londres, par Maille,
Vinaigrier-distillateur
du Roi et de LL. MM. les Empereurs d'Autriche et de Russie.

Of an intense and unnatural red colour; consists of *tomato*, *vinegar*, a little *mace*, and very much of the red earth, *bole Armenian*. Neither *lead* nor *copper* was detected in any of the samples of tomato sauce.

Essence of Lobsters.

22*nd Sample*.—Purchased of C. Wix & Sons, Leadenhall-street. Price 1*s*. 6*d*.

On being allowed to stand at rest for some time, a deposit of an intense red colour falls, which occupies about half the bottle, the remainder being filled with a black liquid; this liquid consists chiefly of *catsup*; while the sediment is made up of a little *muscular fibre*, *starch*, and an immense quantity of *Venetian red*.

23*rd Sample*.—Purchased of Batty & Co., Pavement, Finsbury. Price 1*s*. 6*d*.

Of a most unnatural red colour; contains *muscular fibre*, a little *mushroom catsup*, and an immense quantity of red earth, it being almost saturated with *bole Armenian*.

Essence of Shrimps.

24*th Sample*.—Purchased of Fenning & Hale, Poultry. Price 1*s*. 3*d*.

Contains a little *catsup*, scarcely any *muscular fibre*, but is nearly saturated with *bole Armenian*.

25*th Sample*.—Purchased of C. Wix & Sons, 22. Leadenhall-street. Price 1*s*. 6*d*.

Contains *mushroom catsup*, *starch*, some *muscular fibre*, and an immense quantity of *bole Armenian*. Neither *lead* nor *copper* was detected in any of the samples of essence of shrimp and lobsters.

Essence of Anchovies.

26*th Sample*.—Purchased of William Lazenby, 6. Edwards-street, Portman-square. Price 1*s*. 3*d*.

Intensely coloured with a very large quantity of *bole Armenian*.

27*th Sample*.—Purchased of Burgess & Son, 107. Strand. Price 1*s*. 6*d*.

Of a most unnatural red colour, from admixture with an enormous quantity of *bole Armenian*.

28*th Sample*.—Purchased of Mr. Phillips, Strutton-ground, Westminster. Price 1*s*.

Smells oily and offensive; on standing at rest for some time, a deposit falls which occupies two-thirds of the bottle, the other third being filled with a watery liquid; the sediment consists of *muscular fibre*, and an immense quantity of dirty-looking *bole Armenian*.

29*th Sample.*—Purchased of Fenning & Hale, 5. Poultry. Price 1*s.*

Of a most unnatural but dull red colour, arising from admixture with an immense quantity of *bole Armenian;* it contains, moreover, many of the scales of the fish.

30*th Sample.*—Purchased of J. Wingrave & Co., St. Paul's-churchyard. Price 1*s.* 3*d.*

Of a vivid and most unnatural red colour, which arises from admixture with a very large quantity of *bole Armenian.*

31*st Sample.*—Purchased of Thomas Snelling, 30. Fenchurch-street. Price 1*s.*

Of an intense and most unnatural red colour, it being almost saturated with *bole Armenian.*

32*nd Sample.*—Purchased of G. Wybrow, 4. Minories. Price 1*s.*

Of a very unnatural red colour. Contains scarcely any muscular fibre, but an immense quantity of *bole Armenian.* Neither *lead* nor *copper* was detected in this or any of the other samples of essence of anchovy.

Freeman's Fish Sauce.

33*rd Sample.*—Purchased of J. Freeman & Co., 3. Wigmore-street. Price 2*s.*

This sauce is of a pale-brown colour, liquid, and transparent, without a particle of sediment; it contains a very small quantity of *mushroom catsup,* much *salt,* and the juice or essence of the *anchovy;* it is free from all adulteration, and is certainly a much more pleasant and wholesome sauce than the highly-coloured and adulterated compound ordinarily sold under the misnomer "Essence of Anchovies."

The following are the chief results deducible from a consideration of the above Table of Analyses:—

1st. That *treacle* and much *salt* formed the bases of the five samples of India Soy examined, if they did not even entirely consist of these two ingredients.

2nd. That in Lazenby's Harvey's Fish Sauce much *oxalate of lime,* and numerous minute chips of *charred deal,* were detected, the presence of these last affording some countenance to the inference that they had been used for the purpose of imparting colour to the sauce.

3rd. That of the seven samples of Tomato Sauce analysed, six were artificially coloured, one probably with *cochineal,* and the rest by the addition of considerable quantities of the ferruginous pigment, *bole Armenian.*

4th. That the samples of Essence of Lobsters examined were almost saturated with very large quantities of *bole Armenian.*

5th. That the samples of Essence of Shrimps were saturated to an equal extent with *bole Armenian.*

6th. That the whole of the samples of Essence of Anchovies analysed were adulterated with immense quantities of the ferruginous oxide *bole Armenian.*

7th. That three of the samples of *Essence of Anchovy* contained but a small quantity of *muscular fibre.*

8th. That two of the samples contained a proportion of *flour*—one being a sample of essence of shrimps, and the other of essence of lobster.

9th. That out of the eighteen red sauces submitted to examination, no less than sixteen contained *bole Armenian,* and this usually in immense quantities, far exceeding what was detected in any of the potted meats and fish.

10th. That lead, for which separate analyses were made in each case, *was not detected in a single instance.*

11th. That *traces only of* copper *were discovered in some three or four samples.*

The above results, then, regarded as a whole, although bad enough, are yet not so bad or serious as the account given by Accum and some other writers, of the adulteration of anchovy paste, &c., would lead us to infer, since neither lead nor copper was detected in a single instance. Some idea of the quantity of pigment contained in many of the red sauces may be formed, when it is stated that, mixed with turpentine, they might be employed as paints in the priming of doors, windows, &c.

There is no reason why sauces should be regarded as secret and patent articles; every intelligent cook might readily succeed in preparing all the sauces which are ordinarily required for the table, by the exercise of a very slight amount of reflection and ingenuity. In order to aid such endeavours, we introduce a few receipts of some of the more useful and less known sauces: —

"Tomato Sauce.

Bruised tomatos - - - -	1 gallon.
Salt - - - - -	8 oz.

Mix, and after three days squeeze out the juice. To each half-gallon of the juice add,

Shallots - - - - -	4 oz.
Black pepper - - - -	2 drachms.

Boil for half an hour, strain, and add,

Mace, allspice, ginger, nutmeg, of each -	½ oz.
Coriander-seed, cochineal, of each - -	2 drachms.

Simmer gently for half an hour, strain, and when cold, bottle it."

Anchovy Sauce.

"Put ten or twelve anchovies into a mortar, and pound them to a pulp; put this into a very clean iron or well tinned copper saucepan; then put a tablespoonful of cold spring water into the mortar, shake it round, and pour it to the anchovies; set them over or by the side of a gentle fire, and stir them very frequently till they are melted; then add a quarter of a drachm (*avoirdupois*) of cayenne; let it remain by the fire a few minutes longer; then, while warm, rub it through a hair sieve with the back of a wooden spoon."

Soy.

"Boil four pounds of the seeds of *Dolichos soya* with water, until they become soft; then add four pounds of bruised wheat; keep the mixture in a warm place for twenty-four hours; then add four pounds of common salt, and eight pounds of water; put the mixture into a stone jar, and cork it up for two or three months; then press out the liquor. The best soy is imported from China."

Chetney Sauce.

"Stoned raisins - - -		4 oz.
Sour apples or crabs - - -		8 ,,
Brown sugar - - - -		4 ,,
Powdered ginger, Common salt, Cayenne pepper - -	of each	2 ,,
Garlic - - - -		1 ,,
Vinegar - - - -		*q. s.*

"Pound the solid ingredients together in a mortar, adding a little vinegar from time to time, until the whole is reduced to a pulpy mass; then add enough vinegar to reduce it to the consistence of cream, and bottle it for use."

The first, third, and fourth of the above receipts are copied from Gray's Supplement to the Pharmacopœia, edited by Theophilus Redwood; while the second receipt is taken from "The Cook's Oracle."

M. Soyer, in "The Modern Housewife," gives the following account of Chetney: — "Chetney is a production of the East Indies, which, of late years, has come considerably into use; it is made by the mixing together of a variety of fruits, and allowing them to ferment until they become acid; some spices are mixed with them, and they are then bottled for use; the older it is, the better it becomes. That which is made in the Vale of Cashmere is considered the best; it is endeavoured to be imitated in this country, with little success."

POTTED MEATS AND ESSENCE OF ANCHOVY.

To the Editor of The Lancet.

"Sir, — We observe in your number for Nov. 13., that you mention our name together with Messrs. Burgess & Co., Fortnum & Mason, Hedges & Butler, Lazenby & Co., Crosse & Blackwell, and many other most respectable houses, as equally responsible for the coloured admixture in the anchovy paste sold by all alike. We, however, did not sell it as our own make, nor would we knowingly buy or sell any pernicious article whatever, even if marked with the maker's name, as this was; we think it but common justice that the makers, who alone knew the composition, should bear the obloquy. But your remarks on Fish Sauce are much more important in proportion to its greater use. The pure sauce of our own make, herewith submitted, would be more sold did not persons through prejudice, as we often find, reject it, and prefer the compound of paint and powder called essence of anchovies.

We remain, Sir,
Your obedient Servants,
FREEMAN & Co.

Wigmore-street, Cavendish-square, Nov. 1852.

*** In the course of our investigations we have frequently had occasion to refer to the Messrs. Freeman. In the last Report on Potted Meats and Fish we published the results of the analyses of three articles obtained at their establishment, and each of which was ascertained to be highly coloured with the ferruginous oxide, *bole Armenian.* It was simply stated in each case that the samples were purchased of the Messrs. Freeman, and not that they were the manufacturers of them. On a close examination of the pots, we found *at the bottom* of two of them, *in very small characters*, the names of Messrs. "Crosse & Blackwell," evidently intended as a private mark. We are well aware, as shown by the Report contained in THE LANCET of this week, that a pigment is generally employed in the colouring of the sauce called "Essence of Anchovy;" but what is the nature of the "powder" used? Will Messrs. Freeman be good enough to furnish us with this information?"

THE ANALYTICAL SANITARY COMMISSION AND THE KING OF OUDE'S SAUCE.

"*To the Editor of* THE LANCET.

SIR,—A question addressed to us in a report of the "Analytical Sanitary Commission," on the Composition of Sauces, &c.,—"Which is the real King of Oude, and which are the pretenders?"—had escaped our notice till within the last few days.

In the year 1825, a gentleman, long resident at the Court of Lucknow, described a sauce as a great favourite with the King of Oude, and, from his information, the sauce which we manufacture was originally compounded. On being submitted to him and approved of, it was made public under the name which it now bears; though so little at that time was known of the King of Oude, that numbers of persons who had lived in India stoutly maintained that there was no such person.

Having, at considerable pains and expense, established the name and success of the sauce, we soon found that many persons were ready to reap the fruit of our labours. One ingenious gentleman actually copied our label, *verbatim*, in all but our name (for which he substituted his own), and the date at which we stated the sauce to have been introduced, which he altered from 1825 to 1809, thus making it appear that we had imitated him!

We remain, Sir, your obedient servants,
Welbeck-street, Feb. 1853. SAMUEL HICKSON & SON."

ON THE CONTAMINATIONS AND ADULTERATIONS OF PRESERVES AND JELLIES.

We have repeatedly shown that the adulterators of our food do not scruple to employ, when it suits their purpose, the most deadly substances, undeterred by the serious consequences which but too frequently result from their use. Thus it has been shown that it is no uncommon thing for them to make use of various preparations of iron, lead, copper, arsenic, mercury, &c. It is not a little remarkable, that the majority of the substances are had recourse to, not on account of bulk or weight, but for the mere sake of colours, which, thus procured, are frequently in a high degree glaring and unnatural, these colours being obtained too at the expense of quality and flavour.

Amongst the articles which have already been treated of and in which foreign colouring ingredients have been detected, are tea, cocoa, cayenne, mustard, pickles, bottled fruits and vegetables, potted meats and fish. The list is, however, far from complete as yet, and on the present occasion we have to add to it other articles.

The fruits from which our more common preserves are made, are usually so abundant and cheap, that little inducement, we believe, exists for the substitution of other and inferior ingredients for the fruit itself. It is true, however, that with respect to at least one preserve, the ordinary belief entertained is very different from this, it being supposed that a variety of cheaper substances, such as apples, pumpkins, and turnips, enter into its composition—we allude of course to orange marmalade. It will presently be seen whether there is any foundation for this belief or not.

Marmalade, as is well known, is made from the Seville or bitter orange, much in the same manner as ordinary preserves, the chief peculiarity being in the slicing of the peel; this, when the jam is made on a large scale, is done by a machine, in order to save time and labour. There is no doubt but that some of what professes to be real "Scotch marmalade," consists of a mixture of sweet and bitter oranges, if, indeed, in some cases, inferior ingredients do not partly compose it. Why the Scotch marmalade should be preferred, we know not, except that the Scotch excel in the manufacture of cakes and confectionary in general.

Although it is not very often that one fruit is substituted for another, there is a species of deception very frequently practised, which is scarcely less culpable. Vegetable jellies consist of the thick and transparent part of the fruit only, the husks and seeds being removed; now, these really worthless portions of the fruit are rarely, if ever, thrown away by the manufacturers of preserves; but, mixed with a little fresh fruit, they are passed off as good jams. In this practice housekeepers are furnished with a strong reason for preparing their own preserves, and also with an explanation of the general superiority of home-made preserves.

It is well-known that preserves made in copper vessels are of a much better colour than those boiled in iron ones—the latter soon becoming dark and discoloured. This change of colour results from the action of the sugar and acid of the fruit upon the iron, and the oxidation of the iron. Now these act equally on copper, with the difference, that the presence of a small quantity of that metal does not affect injuriously the colour of the preserve, in many cases even improving and heightening it; and this is the reason why copper vessels are so constantly employed in the preparation of preserves and for many culinary purposes. Copper vessels are, however, very objectionable, and their use, in some instances, is even attended with considerable danger. From the ascertained effects of acids, we should be led to suspect that copper may be detected in almost all preserves. We shall see presently whether this anticipation is realised or not, and whether, also, in some cases, copper be not purposely added to heighten the colour of certain green preserves.

With respect to *animal jelly*, most persons would at first suppose that little could be done in the adulteration of this article. In fact, it is usually considered that the jellies which appear at table or figure in confectioners' shops, are prepared either from isinglass or calves' feet. This, however, is often a very erroneous supposition, for commonly they consist of gelatine, a substance which, although very analogous to isinglass, is yet much inferior in value and flavour, and is sometimes itself adulterated.

As we are not acquainted with any trustworthy or practical account of the method of preparing gelatine, we have been at some pains to procure the following information respecting its manufacture.

Ordinary gelatines are made from those pieces of skins which are cut off by the tanner as unfit for making leather, in consequence of thickness. The best description is prepared from the skins of calves' heads; these are separated from the whole skins after they have passed through the process of liming, to remove the hair from them.

The skins are next well washed, to get rid of the lime, and all the pieces of flesh and fat are carefully cut out; some manufacturers soak them for a short time in a dilute solution of muriatic acid, to remove any remaining portion of lime; but this practice is both injurious and unprofitable. The acid forms with the lime chloride of calcium, which, if it is not carefully removed by washing, is boiled up with the skins, and, being soluble, remains in the gelatine; a portion of the skins is also dissolved by the acid, and is thrown away in the water employed in washing them, which thus occasions a loss in weight.

In some cases the skins are boiled whole, in others they are cut into small pieces, or even reduced to a pulp by a machine especially constructed for the purpose.

If the skins are cut into fine pieces, instead of being put into the boiler whole, the gelatine will be better; that is, it will be of a lighter colour; and the process is more economical, as one-half the time will be saved in the boiling, and much less heat and fuel required. As the gelatine is darkened and carbonised by prolonged boiling, the reduction of the skins to a pulp is a point of very great importance in the manufacture of gelatine — so much so, that Mr. Swinbourne has obtained a patent for this method of preparation.

The skins are boiled with water, in the proportion of about one gallon of water to seven pounds of skin; a small quantity of common salt is added to preserve the gelatine. After it has boiled for about twelve hours, it is strained and clarified with white of eggs, and then run upon glass plates; as soon as it is solid, it is cut into slices and laid upon nets to dry, in a room heated to a temperature of about 80°. If the room is not heated, the surface of the gelatine becomes covered with small air-bubbles; when the gelatine is dry, it is cut by a machine in the same manner as isinglass.

The size of the glass plates varies according to the fancy of the manufacturer. The ordinary size is from fifteen by eighteen inches; but in some cases they are three feet square; the plates or slices of gelatine are generally about fifteen inches long by three wide.

Though the skin of the head of the calf only is used for making gelatine, the whole of the skin both of the calf and ox is perfectly adapted for the purpose, but is not used, as it is much more valuable for conversion into leather.

In some cases, especially in warm weather, the skins used are somewhat decomposed, but this is not general. This condition, although removed to some extent by repeated washings, cannot be entirely remedied; hence gelatine made from such damaged skins will always retain a smell and taste more or less disagreeable.

The French gelatine is usually much whiter than the English; this is owing principally to the calves being killed in France much younger than in this country.

Inferior gelatine is used in large quantities by paper-makers, straw-hat and silk manufacturers; but these parties generally purchase the skins, and prepare the gelatine themselves.

Glue is quite a distinct manufacture from gelatine, and is seldom carried on by the same parties. It is made from bones, refuse pieces of skins, and hoofs.

We have, lastly, to refer to the *adulterations* of gelatine.

The addition of a small quantity of salt, with the view of ensuring the preservation of the gelatine, is, of course, allowable; but salt is frequently added in large quantities. It then causes the gelatine to absorb moisture from the atmosphere, its weight being thereby much increased.

In some cases, gelatine is adulterated with sugar, either brown or white, but not to any considerable extent, except with some of the inferior qualities, such as are so largely used by the manufacturers of canister meats.

The adulteration with brown sugar may be readily detected by means of the microscope; if a little of the gelatine thus adulterated be dissolved in warm water, the *acari* invariably present in moist sugar will be found either on the surface or at the bottom of the solution.

The jellies in bottles, and those sold by confectioners as isinglass and calves'-feet jelly, consist principally of gelatine variously flavoured. Jellies made from calves'-feet are much less firm, and dissolve quicker than those made from gelatine, if kept in a warm room.

Results of the Chemical and Microscopical Examination of Thirty-five Samples of Preserves of different kinds.

Raspberry Jam.

1*st Sample.* — Purchased of Russell & Co., King-street, Covent-garden.

Examined with the microscope, there were detected in this preserve several *sugar acari*, showing that brown sugar had been used to sweeten it; the *ash* was of a yellow colour; solution of the ash treated with ammonia became of a deep blue, proving the presence of a very large quantity of *copper*.

Gooseberry Jam.

2*nd Sample.* — Purchased of A. Marshall & Sons, Strand.

Ash grey; solution of the ash treated in the ordinary manner with ammonia became of a faint but decided blue, showing the presence of a small quantity of *copper*.

3*rd Sample.* — Purchased of Underwood Brothers, New-street, Covent-garden.

Ash pink in parts, and contains a very small quantity of *copper*.

4*th Sample.* — Purchased of A. Fraser & Co., 72. Piccadilly.

Ash of a deep grey, and, in places, obscure pink; contains a small quantity of *copper*.

5*th Sample.* — Purchased of Castell & Brown, Princess-street, Soho.

Colour of preserve clear and bright, flavour superior, *ash* light pink, and contains a very small quantity of *copper*.

Marmalade.

6*th Sample.* — Purchased of Crosse & Blackwell, Soho-square.

Ash of a yellow colour; does not contain *copper*.

7*th Sample.* — Purchased of Crosse & Blackwell, Soho-square.

Ash yellow, with a little pink, containing a very small quantity of *copper*.

8*th Sample.* — Purchased of Crosse & Blackwell, King-street, Soho.

Ash yellow; solution yellowish-brown, from the presence of iron; no *copper* detected.

9*th Sample.* — Purchased of Decastro & Peach, Piccadilly.

Preserve soft and watery; contains a considerable quantity of *a vegetable substance*, most probably *turnip* or *apple; ash* decided pink; solution rather deep blue, showing the presence of a considerable quantity of *copper*.

10*th Sample.*—Purchased of Decastro & Peach, Piccadilly.

Ash decidedly pink; contains a small quantity of *copper*.

11*th Sample.*—Purchased of Castell & Brown, Princes-street, Soho.

Preserve soft; contains a considerable quantity of *a vegetable substance*, most probably *turnip* or *apple; ash* decidedly pink, and contains much *copper*.

12*th Sample.*—Purchased of Castell & Brown, Princes-street, Soho.

Ash decidedly pink; solution bright and deep blue, containing very much *copper*.

13*th Sample.*—Purchased of W. Hale, 53. Brewer-street, Golden-square.
Ash very deep pink; contains a very considerable quantity of *copper.*

14*th Sample.*—Purchased of R. C. Hall, 70. Wardour-street.
Ash decidedly pink; solution bright blue; contains much *copper.*

15*th Sample.*—Purchased of A. Fraser & Co., 72. Piccadilly.
Ash decidedly pink; contains a small quantity of *copper* only.

16*th Sample.*—Purchased of Lazenby & Son, Edward-street, Portman-square.
Ash of a decided pink; contains a small quantity of *copper.*

17*th Sample.*—Purchased of Lazenby & Son, Edward-street, Portman-square.
Preserve soft; contains a considerable quantity of *a vegetable substance,* most probably *turnip* or *apple; ash* faint pink here and there; contains a trace only of *copper.*

18*th Sample.*—Purchased of Burgess & Son, Strand.
Ash yellow, with pink here and there; contains a little *copper.*

19*th Sample.*—Purchased of J. Wilmot & Co., Fenchurch-street, sold as James Keiller & Sons' Marmalade, Dundee.
Ash yellowish; contains scarcely a trace of *copper.*

Greengage Jam.

20*th Sample.*—Purchased of Mr. Faulkener, Jermyn-street.
Colour brown, with scarcely a tinge of green; *ash* slightly pink only in parts; contains merely a trace of *copper.*

21*st Sample.*—Purchased of E. Lazenby & Son, Edward-street, Portman-square.
Colour brown, with very little tinge of green; *ash* a little pink only; contains a very small quantity of *copper.*

22*nd Sample.*—Purchased of Decastro & Co., Piccadilly.
Preserve of a deep and unnatural green colour; *ash* very pink; solution deep blue, indicating the presence of a considerable quantity of *copper.*

23*rd Sample.*—Purchased of A. Fraser & Co., Piccadilly.
Preserve of a deep and unnatural green colour; *ash* very deep pink; solution of a bright and deep blue, showing the presence of much *copper.*

24*th Sample.*—Purchased of Mr. Hughes, 12. King-street, St. James-street.
Colour greenish-brown; *ash* decidedly pink, and contains a considerable quantity of *copper.*

25*th Sample.*—Purchased of Fortnum, Mason, & Co., Piccadilly.
Preserve of a much deeper green than natural; *ash* pink; contains some *copper.*

26*th Sample.*—Purchased of Castell & Brown, Princes-street, Soho.
Preserve of a rich and unnatural green colour; capsule, in which it was incinerated, tinted in places of a deep pink; *ash* itself pink, and containing not an inconsiderable quantity of *copper.*

27*th Sample.*—Purchased of Phythian, 430. West Strand.
Colour of preserve brownish-green; there were detected with the microscope a few sugar *acari;* capsule a little tinted; *ash* somewhat pink; solution treated with ammonia becoming of a deep blue colour, indicating the presence of a very considerable quantity of *copper.*

28*th Sample.*—Purchased of Batty & Co., Pavement, Finsbury.
Colour of preserve greener than natural; capsule, in which it was incinerated, tinted a little here and there; *ash* very pink, and contains not an inconsiderable quantity of *copper.*

Crystallised Fruits.

29*th Sample.*—Purchased of Hedges & Butler, Regent-street.
Ash of three greengages of a decided pink colour; contains not an inconsiderable quantity of *copper.*

30*th Sample.*—Purchased of Fortnum, Mason, & Co., Piccadilly.
Ash of three greengages of a decided pink colour; solution bright blue, indicating the presence of a considerable quantity of *copper.*

31*st Sample.*—Purchased of Crosse & Blackwell, Soho-square.
Ash of three greengages of a deep pink colour, and containing a considerable quantity of *copper.*

Fruit Preserved in Jelly.

32*nd Sample.*—Purchased of Hooper & Sons, confectioners, Holborn.

Ash of two greengages very pink; solution, treated with ammonia, bright blue, showing the presence of much *copper*.

The fruit in this sample was enclosed in a small glass jar, of a bell shape, and consisted of greengages, limes, sliced pears, &c., immersed in jelly. Similar glasses may be seen forming very pretty ornaments in a great number of shop-windows at the present time.

Candied Citron Peel.

33*rd Sample.*—Purchased of Pye & Co., 37. Little Pulteney-street.

Ash of a decided pink colour, and contains a small quantity of *copper*.

34*th Sample.*—Purchased of R. C. Hall, 70. Wardour-street.

Ash light pink, and contains a small quantity of *copper*.

35*th Sample.*—Purchased of William Hale, 53. Brewer-street.

Ash deep pink, and contains a considerable quantity of *copper*.

The following are the principal conclusions to be deduced from a consideration of the above Table of Analyses:—

1st. That the *Raspberry Jam* analysed contained a very considerable quantity of *copper*.

2nd. That the four samples of *Gooseberry Jam* examined all contained *copper*.

3rd. That copper, sometimes in large amount, was detected in twelve of the fourteen samples of *Orange Marmalade* analysed.

4th. That three of the *Marmalades* were adulterated with large quantities of *a vegetable substance*, most probably either *turnip* or *apple*. There is a kind of turnip, the seeds of which are frequently advertised in the Gardeners' Chronicle for sale, of a yellow colour, and which is called the orange turnip. We know not to what use this can be put unless in the adulteration of orange marmalade.

5th. That the nine samples of *Greengage Jam* were all more or less impregnated with *copper*, it being present in considerable amount in five of the samples.

6th. That the *Greengages* contained in three different boxes of *Crystallised Fruits* all owed their deep green colour to the presence of *copper*.

6th. That the *Limes* and *Greengages* present in a little glass jar of fruit preserved in jelly also owed their brilliant colour to a salt of *copper*.

8th. That *copper* was present in the three samples of *Candied Citron Peel* subjected to analysis.

9th. That *copper* was detected in no less than *thirty-three* of the *thirty-five* samples of different preserves analysed: three contained *traces* only; in *eleven* the metal was present *in small quantity;* and in nineteen either *in considerable*, or even *very large amount*.

Knowing well the powerful action of vegetable juices, and also of sugar, upon copper, we have long entertained the belief that that metal would be very frequently detected, on analysis, in preserves, jams, and jellies, as ordinarily prepared: we must acknowledge, however, that the result of actual investigation has far exceeded our expectations, since it has proved that preserves made in copper vessels not only almost invariably contain copper, but that the metal is often present in very considerable quantities, sufficient to tint the ash of a deep pink, and to cause the solution of the ash when treated with ammonia to become of a decided and sometimes even of a deep blue colour.

But the still larger quantities of copper detected in certain of the samples of greengage jam seem to show that, as was ascertained to be the case with bottled fruits and vegetables, some greening salt of copper, probably the acetate, is really intentionally introduced for the purpose of creating an artificial viridity.

It will be remembered that in a Report which we published some time since on bottled fruits and vegetables, copper was detected only in one of the samples purchased of Messrs. Castell and Brown, of Princes-street, Soho, namely, in the greengages, in which a very small quantity was discovered. From this circumstance, we were led to make favourable mention of this firm. It will be seen that the greengage jam procured from Messrs. Castell and Brown, and analysed by us on this occasion, contained an amount of copper so considerable as to render it difficult to believe that it could all be derived from the vessel in which it was prepared.

It will be perceived, also, that three of the samples of orange marmalade examined were adulterated with large quantities of a vegetable substance, resembling in its microscopic structure either *turnip* or *apple*. These samples were all purchased in the beginning of December. Many other samples purchased in the summer, and also several procured within the last few days, were all entirely free from any such admixture. This appears to prove that this adulteration is practised chiefly at a certain period of the year, when oranges become scarce, and in order to keep up the stock of marmalade, so called. The detection of this adulteration in three samples, two of them obtained at the establishments of different makers, appears also to show that the adulteration is a very general one.

The disclosures now made afford convincing proof how improper and even dangerous it is to make preserves, as is commonly done even by ordinary housekeepers, in copper saucepans. The vessels employed for this purpose should consist of earthenware, or, if metallic, should be lined with enamel.

Although we may fairly expect to find copper in any preserved vegetable substance prepared in the ordinary manner, yet we scarcely expected to meet with that poison in those tasteful and sparkling little boxes of bonbons, which at this season of the year are spread out in shop windows so attractively; neither did we expect to find it making its way, through the citron-peel used, into our very Christmas plum-pudding.

The evils and dangers arising out of the all-prevalent and very scandalous practice of adulteration, nothing but the strong arm of the law can sufficiently check, and the force of this, ere long, no doubt, will be felt. Nevertheless, we are happy to find, that great and immediate good very frequently results from the exposures which from time to time we are compelled to make; this is very evident in the case of pickles, and preserved fruits and vegetables. Although we still see in shop windows hundreds of bottles of these articles exposed, highly charged with copper, yet it must be allowed that a very great improvement has taken place in this respect since the period of our first Report on pickles. We have reason to believe that one very large manufacturing firm, which supplies some hundreds of retail establishments, both in town and country, has to a very great extent, if not entirely, abandoned the use of copper, and copper utensils, in the greening of their pickles and preserves. Such an example cannot but have an excellent effect on other manufacturers and preparers of similar articles.

Some of the samples, the analysis of which are given in this report, were purchased of retail dealers, others of manufacturers. It is scarcely necessary to remark, that the former, as a rule, are in no respect responsible for the contamination by copper discovered in so many of the samples subjected to analysis.

Although we have not introduced analyses of samples of vegetable jellies, yet, in so far as the method of preparation of these corresponds with that adopted for preserves, they will of course be subject to similar contamination by copper. We are informed on good authority that rasberry jelly frequently consists of nothing more than currant jelly to which the flavour of the rasberry has been communicated by means of orris-root, and that the rasberry flavouring for sugar confectionery consists of nothing but currant jelly and orris-root.

LARD, AND ITS ADULTERATIONS.

Lard is the oily portion of the fat of the pig. The process by which this is separated from the vesicular, fibrous, and vascular tissues in which it is either enclosed, or by which it is surrounded, is termed *lard-rending*.

The pieces of fat to be converted into lard are sometimes salted a little, the better to ensure their preservation, and are stored in barrels. The fat which immediately surrounds the kidneys yields the best and purest lard; this is owing to its being in a freer state, that is, it is less-highly organised. The process is as follows:—The pieces of fat are scored or sliced into lesser portions of an inch or so in diameter; they are placed, either with or without the addition of a little water, in cauldrons, which are usually of iron. The mode of applying heat to the flare varies in different cases. When lard is made on a small scale the flame is often applied directly to the containing vessel; sometimes the flare is melted in a water-bath, but usually the heating medium is steam, which is contained in the interval between the inner and outer vessel or pan; occasionally a jet of steam is thrown directly upon the flare contained in the copper. The soluble part of the fat melts out and floats on the surface, the animal matter and tissues either forming a scum, which is skimmed from time to time, or sinking as a deposit. As the oil has no affinity for either water or salt, it does not take up any of the water which may be present with it in the copper, while the salt used to preserve the fat falls as a sediment. The oil whilst still warm and fluid is turned out of the copper through a tap, and is received either into bladders or casks termed kegs, and hence the division of lard into *bladder-lard* and *keg-lard.* It is usually the best description of lard only which is stored in bladders, keg-lard being for the most part of inferior quality. Good and pure lard should be entirely free from either taste or smell; it should be firm and white, and when melted be almost as clear and transparent as water; subjected to a temperature of about 212° Fahr., it should liquefy without ebullition, thus showing the absence of water, and should not throw down a particle of deposit. Inferior or adulterated lards possess characters and properties almost the reverse of these.

Our supplies of lard are derived principally from Ireland, part also comes from America and Hamburgh, while London and our chief provincial cities possess lard manufactories. During the last year or two scarcely any lard has arrived from America.

We have long been aware that lard, like nearly every other article of consumption, is liable to adulteration; indeed, the fact that it is so is very generally known to dealers, as also the nature of the principal adulteration practised.

To this subject Mr. George Whipple has very recently drawn attention, in a communication brought before the Pharmaceutical Society, and which was briefly noticed in the *Pharmaceutical Journal* for January 1853. He states that he had detected large quantities of some farinaceous substance in lard. "This adulteration was discovered in the different varieties of lard—from the finest bladder to the common firkin lard. In an examination of the contents of two firkins, weighing 105½ lbs., a quantity of farinaceous substance, amounting to 22¼ lbs., was separated. The contents of another firkin, weighing 43¾ lbs., yielded 12¾ lbs. of a similar substance."

In the next number of the same journal, Mr. Calvert, of Manchester, published some further observations on the adulteration of "American Lard." He writes—"During the numerous analyses I made some three years since, of various articles of food employed in public establishments, I analysed several samples of American lard, and therefore may add to the fact already mentioned by Mr. George Whipple in your last number, that I found them to contain, in addition to starch, from ten to twelve per cent. of water, and from two to three per cent. of alum, and about one per cent. of quick-lime.

"A few months ago I was able to ascertain that the operation is conducted in the following manner:—

"The fatty matters, such as they arrive from America, are melted with a little water in false-bottomed copper pans, through which circulates a current of steam. The dirt and other heterogeneous matters fall to the bottom of the pans, and the clear grease is allowed to run into a wooden vessel, when it is stirred in contact with cold water; it is then put under revolving wheels with a thick paste made of potato-starch, mixed with a little potash-alum and quick-lime, which appears to facilitate the taking up of the water and starch by the fatty matter.

"The cause of the American lard appearing so white is, no doubt, the division of the fatty matter through the interposition of the starch, water, and alumina.

"The quantity of alum should be such that a small excess should remain to prevent the starch from becoming mildewed; and I believe that the manufacturer also adds it for the purpose of communicating to the lard the property of facilitating the raising and increasing the whiteness of the confectioners' paste, in which it is largely employed."

It should be understood, that American lard, as brought to this country, is not in general adulterated. The adulteration usually takes place subsequent to its arrival, and is the work of some of our own manufacturers. The reason why American lard is so frequently selected for adulteration is, that it is of very inferior quality and value, and so soft as to be almost fluid, some process of consolidation being indispensable before it can be employed as lard.

From information received from a respectable lard-render, it appears that the addition of a small quantity of mutton suet to lard is very common. It is used more particularly in warm weather, and with soft lards, especially American lard, which differs from ordinary lard, in that it consists of the entire fat of the pig melted down, and not, as is the case with the best English lard, of the fat only which surrounds the kidneys. Mutton suet, being a hard and firm fat, imparts to soft lards, even when added in very small quantities, the consistence and solidity requisite.

It appears, therefore, that water, starch, potash, alum, and caustic lime, have all been ascertained to be employed in the adulteration of lard. To these substances we may add the following: — carbonate of soda, carbonate of potash, and salt. The whole of the above adulterations may be readily discovered.

The first thing to be done in order to ascertain whether a lard be genuine or adulterated, is to melt it at about a temperature of 212° Fahr. If it dissolve without ebullition or without the occurrence of a deposit, we may safely conclude that the sample is genuine; but if ebullition take place, or a sediment is thrown down, the lard is unquestionably adulterated.

The adulteration with water, and the quantity present, may be thus determined:—A known weight of lard is to be exposed to heat until bubbles of vapour cease to escape; the loss indicates the per-centage of water.

The presence of starch may be discovered by thoroughly incorporating a solution of iodine with a few grains of the lard, placed upon a slip of glass; the lard will change colour, and become deep blue, or almost black. If now a little of this be viewed under the microscope, the starch-corpuscles will themselves be seen coloured by the iodine.

To determine the kind of starch contained in any sample, we must use the microscope. A minute piece of the lard should be placed on a glass slide, previously thoroughly warmed; the moment the lard is melted it must be viewed by the object-glass, when the starch-corpuscles will be distinguished standing out as clearly as though they were in water.

Another way in which the starch-corpuscles may be well seen by the microscope, is to spread out by gentle pressure, between two pieces of glass, a very thin stratum of the lard.

Although it is easy enough to detect starch in lard, it is by no means so to estimate the amount present.

Ether does not readily dissolve lard, particularly in cold weather, owing to the stearine of the lard being then in a more firmly crystalline condition, so that by this reagent it is very difficult to separate all the lard from the other ingredients with which it may be admixed. If, however, ether be used for the purpose, the lard should be melted, a little warm distilled water added, and lastly, while still warm, the ether should be poured upon it; we may then weigh, when properly dried, either the oil obtained, or the sediment left. Still, with every precaution, this method of separation is very troublesome, and often fails.

Another method is as follows:—Put one hundred grains of the lard in a wide-mouthed test-tube of known weight; heat below the boiling point of water until all escape of vapour ceases, and weigh again when cold. Fill nearly up with water; heat as before; allow the oil which has risen to the surface to become cold; collect; heat again with a little more water, when a second portion of oil will be obtained; add the two portions together, dry, and weigh.

Although this method is simple, it is very troublesome, and gives only approximate results, since it is almost impossible to separate all the oil by heat alone.

For the determination of the saline matters sometimes present, it is in most cases sufficient to melt the lard, collect the precipitates, free them from oil with ether, weigh, and afterwards taste them. Salt, soda, alum, and lime, may all be distinguished, provided quantities of lard sufficiently large be operated upon, by the taste alone.

There is no doubt but that the refuse fat of sheep and calves is sometimes mixed with lard, especially mutton fat; the last being a hard fat would give solidity and firmness to a soft lard. The detection of these adulterations would be most difficult, if not impossible.

Results of the Microscopical and Chemical Examination of Twenty-five Samples of Lard as obtained from the Docks, and as purchased of various Dealers in the Metropolis.

Lards as obtained from the Docks.

Although the names of the *manufacturers* of the lards were obtained with the samples, yet as in one or two cases some uncertainty exists as to their correctness, we refrain from publishing the names, and simply indicate the localities from which they were obtained.

1*st Sample.*— From Hamburgh.
Genuine.— When subjected to heat, it melted without ebullition, and without the formation of the slightest deposit.

2*nd Sample.*— From London.
Genuine.

3*rd Sample.*—From Bristol.
Enormously adulterated. Contains about seven per cent. of *water*, and an immense quantity of *potato-flour*.

Lard adulterated with flour is found invariably to contain a proportion of water, part of which is derived, no doubt, from the flour itself.

4*th Sample.* —From Liverpool.
Genuine.

5*th Sample.*—From the county of Cork.
Genuine.

6*th Sample.*—From Liverpool.
Enormously adulterated. Contains about four per cent. of *water*, and an immense quantity of *potato-flour*.

7*th Sample.*—From Waterford.
Genuine.

8*th Sample.*—From London.
Genuine.

9*th Sample.*—From Bristol.
Enormously adulterated. Contains about five per cent. of *water*, and an immense quantity of *potato-flour*.

10*th Sample.*— From Liverpool.
Adulterated. Contains about thirteen per cent. of *water* and a little *salt*.

11*th Sample.*— From Ireland.
Genuine.

12*th Sample.*—From Waterford.
Genuine.

13*th Sample.*— From Ireland.
Genuine. Contains less than one per cent. of *water*.

14*th Sample.*— From New Ross.
Genuine.

Lards purchased of Dealers.

15*th Sample.*—Purchased of M. Medwin, 2. Crown-row, Walworth-road.
Genuine. Contains a very small quantity of *salt*.

16*th Sample.* —Purchased of G. King, 46. High-street, Borough.
Enormously adulterated. Contains about four per cent. of *water*, and an immense quantity of *potato-flour*.

17*th Sample.*—Purchased of J. Batchelor, 7. Aldgate High-street.
Genuine. Contains ·50 per cent. of *water*.

18*th Sample.*— Purchased of J. Woolcott, 30. Little Newport-street.
Genuine.

19*th Sample.*— Purchased of Ling & Son, 216. Borough.
Enormously adulterated. Contains about five per cent. of *water*, much *saline matter*, and an immense quantity of *potato-flour.*
20*th Sample.*— Purchased of W. Kinlock, 48. Jermyn-street.
Genuine. Contains over one per cent. of *water*, and a very little *salt.*
21*st Sample.*—Purchased of W. Burnard, 4. Wentworth-terrace, Mile-end-road.
Adulterated. Contains a little *salt*, and a considerable quantity of impure *carbonate of soda*, which to the taste was caustic, owing, probably, to the presence of *lime.*
22*nd Sample.*— Purchased of J. Barnett, 96. Leadenhall-street.
Genuine. Contains ·80 per cent. of *water.*
23*rd Sample.*—Purchased of R. Ormston, 34. South-street, Manchester-square.
Contains about three per cent. of *water*, and a small quantity of *potato-flour.*
24*th Sample.*—Purchased of G. Holland, 26. Minories.
Genuine. Contains ·31 per cent. of *water.*
25*th Sample.*— Purchased of J. Westmarland, 34. Little Newport-street.
Genuine. Contains ·66 per cent. of *water.*

As the results then of our investigations we may draw the following conclusions:—

1st. That lard is not unfrequently *extensively adulterated*, the ingredients employed being *water* and *potato-flour*, as well as certain saline substances, as *salt*, *potash-alum*, *carbonates of potash*, and of *soda*, and *caustic lime*, these being intended either to cause the lard to hold water, or to improve its consistence and colour.

2nd. That the description of lard most liable to adulteration is *keg-lard*, and of this, particularly that which is manufactured in England; Irish keg-lard being but rarely adulterated.

3rd. That of upwards of *one hundred* samples of lard submitted to examination, and procured chiefly from retail dealers, *seven* only were found to be adulterated with *potato-starch.*

The adulteration of lard prevails not only in certain localities, but also chiefly at certain times—that is, whenever a sufficient supply of inferior lard, suitable for mixing, can be procured; for it is said not to answer to adulterate a lard of good quality, which commands a good price, and which is spoiled by tampering.

It will be readily perceived that the qualities of a lard thus adulterated would be seriously impaired for almost every purpose for which it is employed: thus, of course, it would not be nearly so economical for culinary purposes. In the presence of large quantities of potato-flour the cook will find a sufficient explanation for the extraordinary tenacity with which the fish sometimes adheres to the frying-pan. Again, the use of such lard in machinery might, in some cases, prove even of serious consequences by impeding its action. Lastly, the activity of all the ointments of the Pharmacopœia, made with such a lard, would be much injured, especially the simple and compound iodine ointments, which, if starch were present, would, to the astonishment of the dispenser, turn blue, or almost black, in the act of incorporation.

COFFEE, AND ITS ADULTERATIONS.

April 23rd, 1853.

At the outset of these reports we announced our intention of returning from time to time, as occasion might arise, to the consideration of different articles of food, with a view to ascertain whether any further adulterations were practised, and also what had been the effect of previous exposures. Up to this intention we have more than once acted in the articles coffee and chicory, in consequence of the scandalous sophistications to which these have been liable. On the present occasion special reasons exist for resuming the subject of coffee and its adulterations.

Some years since a Treasury minute was issued legalising the adulteration of coffee with chicory. This legalisation of adulteration gave rise to almost every species and degree of fraud and sophistication in these articles; and although it was long notorious that it was next to impossible to obtain coffee in a genuine state, yet as it was difficult, and even until recently considered impossible to obtain satisfactory evidence of these adulterations, nothing effectual could be done to get this most objectionable and demoralising Treasury minute rescinded.

About two years since, however, the reports of this Commission supplied the evidence which was wanting. These reports showed conclusively that by a knowledge of structural botany, combined with the use of the microscope, the whole of the adulterations practised upon chicory and coffee could be clearly and unmistakeably brought to light. They proved that it was scarcely possible to obtain in this great and rich city such an article as genuine ground coffee; that not only was it almost constantly extensively adulterated with chicory, burnt sugar, or black-jack, but that chicory itself was also enormously adulterated with roasted carrots, parsnips, mangel-wurzel, beans, a kind of lupine seeds, wheat, rye, dog and spoiled ship-biscuit, burnt sugar, acorns, exhausted tan, mahogany sawdust, an article called Coffina, and some red earth, probably reddle or Venetian red.

At length the evidence adduced became so accumulated and conclusive that it was impossible longer to resist it. The Chancellor of the Exchequer under Lord John Russell, Sir Charles Wood, did indeed do his utmost, and this not without considerable misrepresentation of facts, to prevent any alteration in the law: and in this object he was for a time successful. The Government which succeeded took the question up in a different spirit and with more correct views. The Chancellor under Lord Derby's Administration, Mr. Disraeli, publicly announced the resolution to withdraw the Treasury minute. Before this long-desired object could be fully effected, however, a change of Government once more occurred, and with it a change of policy on the subject of chicory. The present Chancellor of the Exchequer, Mr. Gladstone, hit upon another and certainly a novel method of dealing with the question. He does not object to the mixture of chicory with coffee, but simply stipulates that this mixture shall be sold in packages having the words "mixture of chicory and coffee" printed on the outside, a penalty for the omission of the words in question of the sum of one hundred pounds being incurred, and the law within the last few months has been altered to meet these views.

The object of the present report is to ascertain whether the law, as thus altered, either protects the honest trader or secures the interests of the public; without therefore attempting to consider what the probable operation of this change would be, we will at once proceed to record the results of some new analyses.

Results of the Examination, Microscopical and General, of Thirty-four Samples of Ground Coffee as purchased of various Dealers resident in the Metropolis.

The purchasers of the samples asked in each case to be supplied with Coffee.

1*st Sample.*— Purchased of Messrs. Barber & Co., 141. Lower Marsh, Lambeth.

Adulterated. This sample contains about one-third *chicory*.

2*nd Sample.*— Purchased of Messrs. Weller & Co., 4. Horace-terrace, Walworth-road.

Adulterated. Contains about one-third *chicory*.

3*rd Sample.*— Purchased of Messrs. Bushby & Co., late Dannan & Co., 2. Staverton-row, Walworth-road.

Adulterated. Contains much *chicory*.

4*th Sample.*— Purchased of J. W. Canton, 4. Newington-causeway.

Adulterated. Consists of *chicory* and coffee in about equal proportions.

5*th Sample.*— Purchased of Mitchell & Co., 17. Blackman-street, Borough.

Adulterated. Contains about one-half *chicory*.

6*th Sample.*— Purchased of W. Bourne, 109. Blackman-street, Borough.

Adulterated. Contains about one-half *chicory*.

7th Sample. — Purchased of G. Izod, 180. High-street, Borough.
Adulterated. Consists of about equal quantities of *chicory* and coffee.
8th Sample. — Purchased of Harris & Co., 91. High-street, Borough.
Genuine.
9th Sample. — Purchased of D. Plant, 76. High-street, Borough.
Genuine.
10th Sample. — Purchased of Messrs. White & Fairchild, 63. High-street, Borough.
Adulterated. Consists of about equal proportions of *chicory* and coffee.
11th Sample. — Purchased of W. Sentance, 52. Blackman-street, Borough.
Genuine.
12th Sample. — Purchased of J. Grainger, Borough.
Adulterated. Contains full one-half *chicory*, which is very gritty from the presence of much sand or earthy matter.
13th Sample. — Purchased of R. Jones, 16. Borough.
Adulterated. Contains about one-half *chicory*.
14th Sample. — Purchased of G. Maidman, 122. Lower Marsh, Lambeth.
Consists for the most part of *chicory*.
15th Sample. — Purchased of H. Hoole, 44. London-road, Southwark.
Consists of about one-third *chicory*.
16th Sample. — Purchased of G. Maidman, 124. Lower Marsh, Lambeth.
This sample consists of a mixture of *chicory* and coffee in equal proportions.
17th Sample. — Purchased of Messrs. Dovenor & Co., 77. Lower Marsh, Lambeth.
Contains about one-third *chicory*.
18th Sample. — Purchased of J. Diplock, 50. Lower Marsh, Lambeth.
Contains about equal quantities of *chicory* and coffee.
19th Sample. — Purchased of Messrs. Haynes & Co., Lower Marsh, Lambeth.
Consists of full one-half *chicory*.
20th Sample. — Purchased of W. Jennings, 22. Lower Marsh, Lambeth.
This sample consists of nearly one-half *chicory*.
21st Sample. — Purchased of Field & Co., 9. Walworth-road.
Consists of about one-half *chicory*.
22nd Sample. — Purchased of C. Woodroffe, 4. Crown-row, Walworth-road.
Consists of a mixture of *chicory* and coffee, the former constituting the chief portion of the article.
23rd Sample. — Purchased of Messrs. Lindsey & Co., 1. Waterloo-road.
This sample consists of full one-half *chicory*.
24th Sample. — Purchased of Messrs. Pinnock & Co., 102. London-road.
Nearly all *chicory*.
25th Sample. — Purchased of Horwood & Co., 69. Newington-causeway.
Contains *chicory* and coffee in nearly equal proportions.
26th Sample. — Purchased of Messrs. Walker & Co., 84. Blackman-street, Borough.
Consists of about half *chicory*.
27th Sample. — Purchased of J. Pringle, 35. Blackman-street, Borough.
More than one-half of this sample consists of *chicory*.
28th Sample. — Purchased of Messrs. Brocksopp, Sons, & Co., 234. Borough.
This sample contains nearly as much *chicory* as coffee.
29th Sample. — Purchased of J. Rose & Co., 213. Borough.
Consists of *chicory* and coffee in about equal proportions.
30th Sample. — Purchased of Russell & Co., 72. High-street, Borough.
The *chicory* in this sample forms about one-third of the article.
31st Sample. — Purchased of Messrs. Harrington & Lucas, 113. High-street, Borough.
Contains about equal proportions of *chicory* and coffee.
32nd Sample. — Purchased of Russell & Co., 42. High-street, Borough.
Contains about one-third *chicory*.
33rd Sample. — Purchased of Newsom & Williams, 50. High-street, Borough.
Consists of about one-half *chicory*.
34th Sample. — Purchased of White & Co., 107. Borough.
Consists of a mixture of *chicory* and coffee, the former constituting full one-half of the article.

From an examination of the above Table of Analyses it appears:—

1st. That out of the *Thirty-four* samples, ALL PURCHASED AS COFFEE, only *Three* were genuine; while no less than *Thirty-one* contained various proportions of *chicory*.

2nd. That in *Six* of the samples *chicory* was present in the proportion of about *one-third* of the article.

3rd. That in *Twenty-two* of the samples *chicory* formed about *one-half* of the article.

4th. That *Three* of the samples consisted *almost entirely* of *chicory*.

5th. That *Thirteen* of the samples were not labelled "Mixture of Chicory and Coffee," and yet *Ten* of these were *adulterated* with *chicory*,—the parties, the adulteration being brought home to them, being liable in each case to a fine of one hundred pounds.

6th. That the remaining *Twenty-one* samples, notwithstanding that COFFEE WAS DISTINCTLY ASKED FOR in each case, were labelled "Mixture of Chicory and Coffee."

The above results present only a fair average of those which would be obtained by a more extended and general investigation. The whole of the thirty-four samples were recently purchased on the same day; samples being procured from every shop that was noticed on both sides of the way on one nearly continuous line of road. It is important that this should be distinctly understood, since it proves that we have not made any selection either of dealers or of localities, and consequently it cannot be said that the method of proceeding adopted was otherwise than strictly impartial.

In one respect the results of the above analyses show a marked improvement, since in no case was any other ingredient than chicory discovered. Not, however, that coffee and chicory have ceased to be adulterated with burnt wheat and rye, carrots, beans, black-jack, and a variety of other substances; but still they are so to a very much less extent than was formerly the case. We know for a fact that chicory is now in certain parts of this metropolis being adulterated to an enormous extent. We have received intelligence on what we have every reason to believe good authority, of the existence of a factory in one of the suburbs of the metropolis, the sole business of which is the preparation of a spurious chicory consisting entirely of roasted carrots. We have also heard of another factory from which chicory is sent out extensively adulterated with spoiled ship-biscuit roasted. In consequence of the intended withdrawal of the Treasury minute the demand for chicory was so much lessened that the proprietor of the carrot factory was anxious to sell his plant; but since the recent regulations, chicory is once more "looking up," and he is now fully occupied.

There is an article selling at the present time in packages and in tin boxes called "Saccharine Chicory." This consists usually of either chicory with large quantities of burnt sugar or "Black-Jack," or of roasted carrots and burnt sugar. It is recommended as a "substitute for coffee," and as being "superior to the ordinary description of coffee."

We have then obtained most conclusive evidence that the recent order of the government regulating the sale of chicory and coffee fails entirely to protect either the fair trader or the consumer. It shows that chicory enters nearly as largely into the adulteration of coffee as it did even in the worst days of the Treasury minute; it shows that dealers palm off the "mixture" whenever they can venture to do so, and this even when coffee is particularly asked for: and again it shows that in very many cases they utterly disregard the order of the Lords of the Treasury, and sell the adulterated article without any label whatever.

We would now call attention to the spirit in which some of the dealers who even observe the regulation carry out the obvious intentions of the government.

In the majority of cases the words "mixture of chicory and coffee" occur in close connexion with the matter forming the ordinary shop wrapper or advertisement; the words moreover being sometimes concealed from view by the mode of folding the parcel. In other cases the parcel is folded up in two papers, the words being printed upon the inner side of the outer wrapper; while in others again, of the two wrappers the innermost one only bears the label.

We will now offer a few general considerations on the bearings of this new regulation regarding the sale of mixed chicory and coffee.

We would first ask, what is the object of permitting the sale of these two very distinct articles in a mixed state? If the purpose be a legitimate one, it would surely be answered as well by directing that the two things should be sold separately, leaving the choice of the use of chicory, and of the proportions in each case, to the consumer. But the real purpose is evidently neither fair nor legitimate. It is done with a view to create an artificial sale for chicory, for the benefit of the growers of that article and the retail and adulterating grocer, and this, too, at the expense of the fair trader, the revenue, and of our own coffee-growing colonies.

The "mixture of chicory and coffee" may consist of these articles in every proportion, as from fifteen or twenty per cent. to ninety-five per cent.; from, in fact, a pinch of coffee to a pound of chicory.

The trader disposed to adulterate his goods naturally argues, that since the Government authorises the mixture of chicory and coffee, on the plea that chicory is good and wholesome, he, too, could not be much to blame, if, in imitation of such high authority, he were to invent on a similar plea some nice little mixtures of his own for his customers; as, for example, a mixture of ground rice, sago-powder, or linseed-meal and pepper, to diminish the fiery and injurious action of the latter article on the delicate coats of the stomach; or of mustard with flour, to lessen its pungency and acrimony.

Again, the new regulation supposes that every person—man, woman, and child—purchasing coffee can read, and yet we know that a very large proportion of the inhabitants even of our cities and towns are unable to read; and when we go into remote country districts, this proportion is much greater. It must be remembered likewise that the Treasury Order applies to the whole of the United Kingdom. Of what use then are the words "mixture of chicory and coffee," and what protection do they afford to the Irishman or Welshman, acquainted only with his native tongue?

This last scheme, then, for the regulation of the sale of chicory and coffee is condemned by reason, by right, and, as this report incontestably proves, by its practical operation.

COFFEE, AND ITS ADULTERATIONS.

MAY 21st, 1853.

IN conformity with the notification given a short time since, we once more revert to the consideration of the subject of Coffee and its Adulterations, with the object more particularly of examining the practical working of the Treasury order recently issued, legalising the sale of mixed chicory and coffee.

It will be remembered that it was clearly proved, from the investigations contained in our report of April 23rd, that this order was an utter failure, either as regarded the producer, the consumer, or the honest vendor. We have thought it desirable, however, to adduce still further evidence of its inefficiency, especially since this vexed question has again assumed a different aspect.

We had at first proposed to ourselves to have given the results of the examination of samples of coffee obtained from dealers resident in a totally different part of the metropolis; on reconsideration, however, it appeared to us that it would be both interesting and important to ascertain, as nearly as possible, what has been the effect produced by our recent exposures. With this view we have procured samples from the very same parties whose names and addresses were published in the last report of the Commission. The districts visited, it will be recollected, were Lambeth, Newington, Walworth, and the Borough. Following certain main and continuous thoroughfares, we have taken the same course on the present occasion, extending the purchases to King William-street, Cheapside, and Ludgate-hill.

Results of the Examination, Microscopical and General, of Forty-four Samples purchased as Ground Coffee of various Dealers resident in the Metropolis.

The purchasers of the samples asked, in each instance, to be supplied with Coffee.

1*st Sample.* —Purchased of Messrs. Barber & Co., 141. Lower Marsh, Lambeth.
Adulterated. This sample contains about one-fourth *chicory.*

In making this purchase the question was asked, "Will you have the genuine or mixed?" Answer, "Genuine."

2*nd Sample.* — Purchased of G. Maidman, 122. Lower Marsh, Lambeth.
Contains nearly two-thirds *chicory.*

3*rd Sample.* — Purchased of H. Leake, 16. Lower Marsh, Lambeth.
Contains about one-fourth *chicory.*

4*th Sample.* — Purchased of G. Maidman, 124. Lower Marsh, Lambeth.
This sample consists of a mixture of *chicory* and coffee, the former constituting nearly two-thirds of the article.

5*th Sample.* — Purchased of Messrs. Dovenor & Co., 77. Lower Marsh, Lambeth.
Contains about one-half *chicory.*

6*th Sample.* — Purchased of J. Diplock, 50. Lower Marsh, Lambeth.
Contains about equal quantities of *chicory* and coffee.

7*th Sample.* — Purchased of Messrs. Haynes & Co., 84. Lower Marsh, Lambeth.
Consists of about one-third *chicory.*

8*th Sample.* — Purchased of W. Jennings, 22. Lower Marsh, Lambeth.
This sample consists of nearly one-half *chicory.*

9*th Sample.* — Purchased of Messrs. Lindsey & Co., 1. Waterloo-road.
This sample consists of nearly one-half *chicory.*

10*th Sample.* — Purchased of H. Hoole, 44. London-road, Southwark.
Consists of full one-half *chicory.*

In purchasing this sample the remark was made, "You are aware that the cheapest coffee is a mixture."

11*th Sample.* — Purchased of Messrs. Pinnock & Co., 102. London-road, Southwark.
Contains considerably more than one-half *chicory.*

12*th Sample.* — Purchased of Messrs. Weller & Co., 4. Horace-terrace, Walworth-road.
Contains considerably more than one-half *chicory.*

13*th Sample.*— Purchased of Messrs. Fisher & Co, 24. Crown-row, Walworth-road.
Consists of nearly three-fourths *chicory.*

14*th Sample.* — Purchased of C. Woodroffe, 4. Crown-row, Walworth-road.
Consists of a mixture of *chicory* and coffee, the former constituting more than one-third of the article.

15*th Sample.* — Purchased of Messrs. Field & Co., 9. Walworth-road.
Consists of about one-half *chicory.*

16*th Sample.* — Purchased of Messrs. Bushby & Co., late Dannan & Co., 2. Staverton-row, Walworth-road.
Genuine.

In making this purchase the question was asked, "Will you have it genuine, or mixed?" Answer, "Coffee." The names on the wrapper are Bushby & Co., late Dannan & Co., while over the door is the name of Phillips.

17*th Sample.* — Purchased of J. W. Dixon, 1. Staverton-row, Walworth-road.
Genuine.

18*th Sample.* — Purchased of J. W. Canton, 4. Newington-causeway.
Consists of *chicory* and coffee, the former constituting about one-fourth of the article.

19*th Sample.* — Purchased of Messrs. Horwood & Co., 69. Newington-causeway.
Contains *chicory* and coffee in nearly equal proportions.

20*th Sample.* — Purchased of W. Bourne, 109. Blackman-street, Borough.
Contains about one-half *chicory.*

21*st Sample.* — Purchased of Messrs. Walker & Co., 84. Blackman-street, Borough.
Contains full one-third *chicory.*

22*nd Sample.* — Purchased of W. Sentance, 52. Blackman-street, Borough.
Genuine.

23*rd Sample.* — Purchased of J. Pringle, 35. Blackman-street, Borough.
Nearly two-thirds of this sample consist of *chicory.*

24*th Sample.* — Purchased of Mitchell & Co., 17. Blackman-street, Borough.
Contains about one-half *chicory.*

25*th Sample.* — Purchased of G. Izod, 180. High-street, Borough.
Consists of about equal quantities of *chicory* and coffee.

26*th Sample.* — Purchased of Messrs. Underwood & Co., 147. High-street, Borough.
Contains nearly one-third *chicory.*

This and the following sample were bought separately, the question being asked of the purchaser in each case whether he wished it "pure" or "mixed." The answer in the one case was "Pure;" in the other "Mixed."

27*th Samples.* — Purchased of Messrs. Underwood & Co., 147. High-street, Borough.
Genuine.

28*th Sample.* — Purchased of Messrs. Harrington & Lucas, 113. High-street, Borough.
Genuine.

29*th Sample.* — Purchased of Messrs. Harris & Co., 91. High-street, Borough.
Genuine.

30*th Sample.* — Purchased of D. Plant, 76. High-street, Borough.
Genuine.

31*st Sample.* — Purchased of Messrs. Russell & Co., 72. High-street, Borough.
The *chicory* in this sample forms nearly one-half of the article.

32*nd Sample.* — Purchased of Messrs. White & Fairchild, 63. High-street, Borough.
Consists of nearly equal proportions of *chicory* and coffee.

33*rd Sample.* — Purchased of Messrs. Newsom & Williams, 50. High-street, Borough.
Genuine.

34*th Sample.* — Purchased of Messrs. Russell & Co., 42. High-street, Borough.
Contains scarcely one-fifth *chicory.*

35*th Sample.* — Purchased of J. Grainger, 64. Borough.
Genuine.

36*th Sample.* — Purchased of Messrs. Brocksopp, Sons, & Co., 234. Borough.
Genuine.

37*th Sample.* — Purchased of J. Rose & Co., 213. Borough.
Consists of *chicory* and coffee, the former constituting more than one-third of the article.

38*th Sample.* — Purchased of R. Jones, 16. Borough.
Genuine.

39*th Sample.* — Purchased of Messrs. White & Co., 107. Borough.
Consists of a mixture of *chicory* and coffee, the former constituting more than one-third of the article.

40*th Sample.* — Purchased of Messrs. Phillips & Co., King William-street, London-bridge.
Genuine.

41*st Sample.* — Purchased of Messrs. Ridgway & Co., King William-street, London-bridge.
Genuine.

42*nd Sample.* — Purchased of Messrs. Freshwater & Co., Poultry, Cheapside.
Genuine.

43*rd Sample.* — Purchased of Messrs. Dakin & Co., 1. St. Paul's-churchyard.
Genuine.

44*th Sample.* — Purchased of Messrs. Sidney & Wells, Ludgate-hill.
Genuine.

From an examination of the above Table, it appears, —

1st. That of the *thirty-four* samples, ALL PURCHASED AS COFFEE, and obtained from the same establishments as those, the results of the analysis of which were given in our last report, *nine* were genuine, while no less than *twenty-five* contained various proportions of chicory.

2nd. That in *eight* of the samples *chicory* was present in the proportion of about *one-third* of the article.

3rd. That in *fourteen* of the samples *chicory* formed about *one-half* of the article.

4th. That *three* of the samples consisted almost entirely of *chicory*.

5th. That *two* of the samples were not labelled "Mixture of Chicory and Coffee," and yet were adulterated with chicory, the parties — the adulteration being brought home to them — being liable in each case to a fine of one hundred pounds.

6th. That of the *twenty-five* samples containing chicory, notwithstanding that COFFEE WAS DISTINCTLY ASKED FOR in each case, *twenty-three* were labelled "Mixture of Chicory and Coffee."

The results derived from the analyses of the thirty-four samples procured a few days since from the very same establishments, were as follows: —

1st. That out of the *thirty-four* samples, ALL PURCHASED AS COFFEE, only *three* were genuine, while no less than *thirty-one* contained various proportions of *chicory*.

2nd. That in *six* of the samples *chicory* was present in the proportion of about *one-third* of the article.

3rd. That in *twenty-two* of the samples *chicory* formed about *one-half* of the article.

4th. That *three* of the samples consisted almost entirely of *chicory*.

5th. That *thirteen* of the samples were not labelled "Mixture of Chicory and Coffee," and yet *ten* of these were adulterated with *chicory*.

6th. That the remaining *twenty-one* samples, notwithstanding that COFFEE WAS DISTINCTLY ASKED FOR in each instance, were labelled "Mixture of Chicory and Coffee."

Contrasting these two tables of analyses, it appears, therefore, as consequences of our previous report, that greater caution is now observed in the sale of mixed chicory and coffee without a lable, an offence punishable with a fine of one hundred pounds; also, that a larger proportion of dealers sell the genuine article when asked for it; but that the "Mixture" is still palmed off as extensively as ever upon the public as coffee.

The results of the examination of the *ten* additional samples purchased as coffee, given in the present report, are as follows: —

Two were sold as coffee, being labelled "Mixture of Chicory and Coffee;"
One was sold as a "Mixture of Chicory and Coffee," which it really was; and —
Seven were *genuine*.

The following are the names of the parties published in the report of April 23rd, the coffee purchased of whom, although not labelled "Mixture of Chicory and Coffee," was found, on analysis, to be adulterated with chicory: —

Messrs. BARBER & Co., 141. Lower Marsh, Lambeth.
Messrs. WELLER & Co., 4. Horace-terrace, Walworth-road.
Messrs. BUSHBY & Co., 2. Staverton-row, Walworth-road.
J. W. CANTON, 4. Newington-causeway.
Messrs. MITCHELL & Co., 17. Blackman-street, Borough.
W. BOURNE, 109. Blackman-street, Borough.
G. IZOD, 180. High-street, Borough.
Messrs. WHITE & FAIRCHILD, 63. High-street, Borough.
J. GRAINGER, 64. Borough.
R. JONES, 16. Borough.

The names of the two firms given in this report from whom coffee similarly adulterated was procured were —

G. MAIDMAN, 124. Lower Marsh, Lambeth.
W. BOURNE, 109. Blackman-street, Borough.

The three firms of whom genuine coffee was obtained, as stated in the report of April 23rd, were—

Mr. W. Sentance, 52. Blackman-street, Borough.
Messrs. Harris & Co., 91. High-street, Borough.
Mr. D. Plant, 76. High-street, Borough.

The following are the names of the firms, out of the thirty-four, of whom purchases were made for the *second* time, whose coffee on analysis was found to be genuine: —

Messrs. Bushby & Co., 2. Staverton-row, Walworth-road.
W. Sentance, 52. Blackman-street, Borough.
Messrs. Harrington & Lucas, 113. High-street, Borough.
Messrs. Harris & Co., 91. High-street, Borough.
D. Plant, 76. High-street, Borough.
Messrs. Newsom & Williams, 50. High-street, Borough.
J. Grainger, 64. Borough.
Messrs. Brocksopp, Sons, & Co., 234. Borough.
R. Jones, 16. Borough.

The additional firms of whom *genuine* coffee has been procured on the present occasion are —

J. W. Dixon, 1. Staverton-row, Walworth-road.
Messrs. Underwood & Co., 147. High-street, Borough.
Messrs. Phillips & Co., King William-street, London-bridge.
Messrs. Ridgway & Co., King William-street, London-bridge. (Second trial.)
Messrs. Freshwater & Co., Poultry, Cheapside.
Messrs. Dakin & Co., 1. St. Paul's-churchyard.
Sidney & Wells, Ludgate-hill.

Again, then, it follows as the result of these further investigations, that the recent Treasury Order legalising the adulteration of coffee with chicory does not afford that protection to the three classes concerned which they have a right to expect—the grower of coffee, the vendor, and, what is of most consequence, the consumer.

Since the publication of our report, the Government has officially and distinctly acknowledged that the Treasury Order recently issued has entirely failed in effecting the objects for which it was framed, and that under it gross and extensive frauds have already been practised upon the public. The Treasury has even done more than this; it has abandoned the Order under which these frauds have been committed, and has issued a new regulation.

In the House of Commons the other evening, in reply to a question by Lord Claude Hamilton, Mr. Wilson is reported to have made the following remarks: —

"The noble lord had some time ago called the attention of the House to frauds which were committed upon a large scale by the words 'Chicory and Coffee Mixture' being placed upon packages intermingled with other printing; so that, though the letter of the law was complied with, its spirit was violated. He had had communications with the chairman of the Board of Inland Revenue upon the subject, and they had adopted another plan which he thought would be efficient for the purpose, and would effectually prevent anything like fraud in future. They had issued a circular requiring that every package of a mixture of chicory and coffee which was sold should have printed legibly on one side of the package, without any other printing, 'This is sold as a Mixture of Chicory and Coffee.' It was provided that no other printing of any description whatever, except the name of the vendor, shall be upon the package or canister containing the mixture."

Now it certainly appears to us that there is no very material difference between the words "Mixture of chicory and coffee" and "This is sold as a mixture of chicory and coffee;" and if under the first form of words frauds have been both common and extensive, can it be conceived for a moment that the other set of words would, according to Mr. Wilson, "effectually prevent anything like fraud in future?" We predict of the new form of words that it will have no such effect, and impositions on the public will still be practised almost as generally as heretofore. We have no doubt that when the proper time arrives we shall be able to adduce abundant evidence affirming the truth of this prediction.

The fundamental objection to the recent Treasury Order is that it is opposed to every principle of fair-dealing and morality, since it affords the highest possible sanction to fraud and adulteration. Now the alteration in the form of the words to be imprinted upon the package will not in any way diminish the force of this moral objection. The mixture, even with the new label affixed, will still be extensively palmed off for coffee. It will still be necessary, in order to derive the slight protection which the label might afford, that the purchaser, whoever he may be, the Irishman or Welshman, acquainted only with his native tongue, or the untaught child, should be able to decipher the words upon the wrapper. The mixture will still be sold made up of coffee and chicory in all proportions, from ounces of the one to pounds of the other, if the article do not even in some cases consist exclusively of chicory.

It might surely have been fairly expected that after the disclosures which have been made by this Commission now for upwards of two years, showing that the most extensive and disgraceful adulterations are practised upon almost every article of consumption, that the Government, in place of affording encouragement to adulteration, would earnestly have considered how it could best put a stop to practices so detrimental to the commercial character of the nation, and so fraught with danger to the public health.

We prophesied in the last Report that the recent Treasury Order, legalising the adulteration of coffee, could never stand; we predict the same of this new regulation, for it is equally opposed to right principles, and it will equally fail in its practical operation.

In April, 1851, the duty on coffee was reduced to 3*d.* per lb.

The quantity taken for home consumption was in

1850 - - - - -	31,226,840 lbs.
1851 - - - - -	32,564,164 ,,
1852 - - - - -	35,044,376 ,,
1853 - - - - -	37,091,814 ,,
And in the *six months* ending the 5th July 1854 - - - - -	19,095,914 ,,

BUTTER, AND ITS ADULTERATIONS.

As the method of making butter may not be known to many of the readers of this report, we will proceed, before entering upon the consideration of its adulterations, to give a very brief outline of the manner in which butter is usually prepared.

Butter is made for the most part from cream; the cream is collected from time to time, and placed in a covered jar, until sufficient has been obtained, when, having become sour by keeping, it is submitted to the process of churning.

Butter is also prepared in small quantities from sweet cream, and this kind is esteemed a great delicacy. Very excellent butter is likewise sometimes made from full or entire milk; the disadvantages of this method are, the large quantity of fluid to be acted on by the churn, which renders it necessary that steam or some other powerful mechanical means should be had recourse to, and the length of time which elapses before the butter forms.

As soon as the butter has formed, it is removed from the churn, and well washed in water, it being kneaded at the same time until as much as possible of the adherent and incorporated whey is removed; this is known by the water ceasing to become turbid and milky. If intended for salt butter, the salt should be added as soon as possible after churning and washing, as, left for any length of time, the butter is apt to become rancid. Great attention should be paid to the quality of the salt used; the best descriptions are rock salt, and that prepared from salt springs. Sea salt, generally, is not so good, on account of the presence of sulphate of magnesia, which renders it somewhat bitter, as well as of chloride of calcium, which has a strong affinity for water, even attracting it from the atmosphere.

It would be out of place in this report to enter into the practical minutiæ of butter-making, such as the temperature at which the cream or milk should be churned, the best kinds of churn, the methods of churning, &c., all points of the greatest importance.

The oily or buttery part exists in milk in the form of innumerable, very distinct globules, of various sizes. The effect produced by churning is to break down these globules, which then run together, and thus form butter. The operation of the churn is therefore chiefly, if not entirely, mechanical.

Referring to works treating on Food, we do not meet with any facts relating to the adulteration of butter. We will now proceed to give the results of the analyses which we have instituted.

Results of the Microscopical and Chemical Examinations of Forty-eight Samples of Butter, both Foreign and Home-made, as Imported, and as Purchased of Retail Dealers.

FOREIGN BUTTER AS IMPORTED.

Hollands.

1*st Sample.*

Analysis.—100 lbs. or parts consist of 17·07 *water*, 1·97 *salt*, and 80·96 parts of *butter*.

2*nd Sample.*

Analysis.—100 parts consist of 17·69 *water*, 1·53 *salt*, and 80·78 *butter*.

3*rd Sample.*

Analysis.—100 parts consist of 24·34 *water*, 4·37 *salt*, and 71·29 *butter*.

4*th Sample.*

Analysis.—100 parts consist of 18·89 *water*, 1·60 *salt*, and 79·51 *butter*.

5*th Sample.*

Analysis.—100 parts consist of 18·02 *water*, 3·94 *salt*, and 78·04 *butter*.

Bosh.

6*th Sample.*

Analysis.—100 parts consist of 8·48 *water*, 3·31 *salt*, and 88·21 *butter*.

This sample, as well as samples 7 and 9, were not submitted to analysis until some time after they had been received, and it was evident, from their dried and contracted appearance, although contained in a wooden box, that they had lost a considerable part of their water. This is also shown to have been the case by the results of the analyses. These analyses are instructive, then, as showing the loss of weight which butter sustains by keeping.

7*th Sample.*

Analysis.—100 parts consist of 9·16 *water*, 2·50 *salt*, and 88·34 *butter*.

8*th Sample.*

Analysis.—100 parts consist of 15·60 *water*, 1·59 *salt*, and 82·81 *butter*.

Ostend.

9*th Sample.*

Analysis.—100 parts consist of 4·18 *water*, 2·32 *salt*, and 93·50 *butter*.

Tralee.

10*th Sample.*

Analysis.—100 parts consist of 0·25 *water*, 4·53 *salt*, and 95·22 *butter*.

AS OBTAINED FROM RETAIL DEALERS.

SALT BUTTERS.

11*th Sample.*

Purchased of T. Hunt, 108. Whitechapel-road.

Analysis.—100 parts consist of 15·74 *water*, 4·94 *salt*, and 79·32 *butter*.

12*th Sample.* — Purchased of J. Reilly, 75. Whitechapel-road.

Analysis. — 100 parts consist of 16·84 *water*, 5·61 *salt*, and 77·55 *butter*.

13*th Sample.* — Purchased of W. Corney, 55. Whitechapel-road.

Analysis. — 100 parts consist of 14·69 *water*, 5·04 *salt*, and 80·27 *butter*.

14*th Sample.* — Purchased of E. Mellor, 36. Whitechapel-road.

Analysis. — 100 parts consist of 16·44 *water*, 3·49 *salt*, and 80·07 *butter*.

15*th Sample.* — Purchased of S. Garratt, 6. Whitechapel-road.
Analysis. — 100 parts consist of 14·53 *water*, 5·00 *salt*, and 80·47 *butter*.
16*th Sample.* — Purchased of J. Griggs, 123. Brick-lane, Spitalfields.
Analysis. — 100 parts consist of 14·36 *water*, 3·71 *salt*, and 81·93 *butter*.
17*th Sample.* — Purchased of R. W. Ormston, 116. Brick-lane, Spitalfields.
Analysis. — 100 parts consist of 13·73 *water*, 4·25 *salt*, and 82·02 *butter*.
18*th Sample.* — Purchased of J. Hooker, 18. Brick-lane, Spitalfields.
Analysis. — 100 parts consist of 16·46 *water*, 5·96 *salt*, and 77·58 *butter*.
19*th Sample.* — Purchased of J. Naylor, 9. Osborne-street, Whitechapel.
Analysis. — 100 parts consist of 16·91 *water*, 3·87 *salt*, and 79·22 *butter*.
20*th Sample.* — Purchased of J. Naylor, 9. Osborne-street, Whitechapel.
Analysis. — 100 parts consist of 26·22 *water*, 5·53 *salt*, and 68·25 *butter*.
21*st Sample.* — Purchased of J. H. Crump, 59. Hackney-road.
Analysis. — 100 parts consist of 15·00 *water*, 4·00 *salt*, and 81·00 *butter*.
22*nd Sample.* — Purchased of G. Edwards, 187. Kingsland-road.
Analysis. — 100 parts consist of 13·10 *water*, 3·32 *salt*, and 83·58 *butter*
23*rd Sample.* — Purchased of G. Deane, 1. Cross-street, Hoxton New Town.
Analysis. — 100 parts consist of 12·07 *water*, 8·24 *salt*, and 79·69 *butter*.
24*th Sample.* — Purchased of G. Webb, 234. Shoreditch High-street.
Analysis. — 100 parts consist of 28·60 *water*, 3·68 *salt*, and 67·72 *butter*.
25*th Sample.* — Purchased of J. F. Brooks, 160. Shoreditch.
Analysis. — 100 parts consist of 12·69 *water*, 7·12 *salt*, and 80·19 *butter*.
26*th Sample.* — Purchased of H. Dennis, 141. Shoreditch, High-street.
Analysis. — 100 parts consist of 17·48 *water*, 4·94 *salt*, and 77·58 *butter*.
27*th Sample.* — Purchased of J. Tate, 118. Shoreditch, High-street.
Analysis. — 100 parts consist of 21·61 *water*, 2·00 *salt*, and 76·39 *butter*.
28*th Sample.* — Purchased of C. Peowrie, 23. Church-street, Shoreditch.
Analysis. — 100 parts consist of 14·70 *water*, 5·17 *salt*, and 80·13 *butter*.
29*th Sample.* — Purchased of Messrs. Cory & Williamson, 177. Bishopsgate-street Without.
Analysis. — 100 parts consist of 16·55 *water*, 3·85 *salt*, and 79·60 *butter*.
30*th Sample.* — Purchased of W. Carr, 151. Bishopsgate-street Without.
Analysis. — 100 parts consist of 14·44 *water*, 4·48 *salt*, and 81·08 *butter*.
31*st Sample.* — Purchased of Beck & Murley, 149. Bishopsgate-street Without.
Analysis. — 100 parts consist of 14·00 *water*, 2·73 *salt*, and 83·27 *butter*.
32*nd Samvle.* — Purchased of Price & Son, 124. Bishopsgate-street Without.
Analysis. — 100 parts consist of 9·62 *water*, 3·10 *salt*, and 87·28 *butter*.
33*rd Sample.* — Purchased of Fitch & Son, 66. Bishopsgate-street Within.
Analysis. — 100 parts consist of 17·82 *water*, 6·16 *salt*, and 76·02 *butter*.

FRESH BUTTERS.

Ostend.

34*th Sample.* — Purchased of T. Hunt, 100. Whitechapel-road.
Analysis. — 100 parts consist of 13·37 *water*, 1·60 *salt*, and 85·03 *butter*.
35*th Sample.* — Purchased of G. Webb, 234. Shoreditch, High-street.
Analysis. — 100 parts consist of 13·66 *water*, 1·54 *salt*, and 84·80 *butter*.
36*th Sample.* — Purchased of H. Dennis, 141. Shoreditch, High-street.
Analysis. — 100 parts consist of 12·49 *water*, 2·91 *salt*, and 84·60 *butter*.
37*th Sample.* — Purchased of Auckland & Needham, 191. Shoreditch, High-street.
Analysis. — 100 parts consist of 12·60 *water*, 3·74 *salt*, and 83·66 *butter*.

This sample contains as much salt as many salt butters. The proportion of salt in Sample 36 is also more considerable than is usual in Ostend butter.

38*th Sample.* — Purchased of R. Nettleship, 67. Shoreditch, High-street.
Analysis. — 100 parts consist of 14·70 *water*, 1·98 *salt*, and 83·32 *butter*.
39*th Sample.* — Purchased of W. Carr, 151. Bishopsgate-street Without.
Analysis. — 100 parts consist of 15·43 *water*, 1·30 *salt*, and 83·27 *butter*.
40*th Sample.* — Purchased of Beck & Murley, 149. Bishopsgate-street Without.
Analysis. — 109 parts consist of 11·53 *water*, 1·49 *salt*, and 86·98 *butter*.
41*st Sample.* — Purchased of Price & Son, 124. Bishopsgate-street Without.
Analysis. — 100 parts consist of 11·56 *water*, 0·98 *salt*, and 87·46 *butter*.

42*nd Sample.* — Purchased of Fitch & Son, 66. Bishopsgate-street Within.
Analysis. — 100 parts consist of 12·23 *water*, 0·84 *salt*, and 86·93 *butter.*

43*rd Sample.* — Purchased of G. Edwards, 187. Kingsland-road.
Analysis. — 100 parts consist of 18·70 *water*, 4·43 *salt*, and 76·87 *butter.*
This, although sold as fresh, is evidently a salt butter.

44*th Sample.* — Purchased of J. Barnett, 96. Leadenhall-street.
Analysis. — 100 parts consist of 12·84 *water*, 6·44 *salt*, and 80·72 *butter.*
This, although sold as fresh, is likewise evidently a salt butter.

English.

45*th Sample.* — Purchased of C. Fenn, 27. Frith-street, Soho.
Analysis. — 100 parts consist of 13·19 *water*, 0·36 *salt*, and 86·45 *butter.*

46*th Sample.* — Purchased of Webber & Son, 1. Brewer-street, Golden-square.
Analysis. — 100 parts consist of 11·29 *water*, 0·64 *salt*, and 88·07 *butter.*

47*th Sample.* — Purchased of J. Howell, 53. Great Windmill-street.
Analysis. — 100 parts consist of 13·16 *water*, 0·30 *salt*, and 86·54 *butter.*

48*th Sample.* — Purchased of J. H. Stocker, 42. Great Ryder-street, St. James's.
Analysis. — 100 parts consist of 12·07 *water*, 0·07 *salt*, and 87·23 *butter.*

The above results will be best understood as arranged in the following table: —

RESULTS OF THE ANALYSES OF FORTY-EIGHT SAMPLES OF DIFFERENT BUTTERS,

Arranged in a Tabular Form.

No.	Names.	Water in 100 parts.	Salt in 100 parts.	Total Water and Salt.	Butter in 100 parts.	Remarks.
1	Hollands.	17·07	1·97	19·04	80·96	
2	Ditto.	17·69	1·53	19·22	80·78	
3	Ditto.	24·34	4·37	28·71	71·29	
4	Ditto.	18·89	1·60	20·49	79·51	
5	Ditto.	18·02	3·94	21·96	78·04	
6	Bosh.	8·48	3·31	11·79	88·21	Part of water lost by keeping.
7	Ditto.	9·16	2·50	11·66	88·34	Part of water lost by keeping.
8	Ditto.	15·60	1·59	17·19	82·81	
9	Ostend.	4·18	2·32	6·50	93·50	Part of water lost by keeping.
10	Tralee.	0·25	4·53	4·78	95·22	Unusually free from water.
11	T. Hunt.	15·74	4·94	20·68	79·32	Salt butter.
12	J. Reilly.	16·84	5·61	22·45	77·55	Ditto.
13	W. Corney.	14·69	5·04	19·73	80·27	Ditto.
14	E. Mellor.	16·44	3·49	19·93	80·07	Ditto.
15	S. Garratt.	14·53	5·00	19·53	80·47	Ditto.
16	J. Griggs.	14·36	3·71	18·07	81·93	Ditto.
17	R. W. Ormston.	13·73	4·25	17·98	82·02	Ditto.
18	J. Hooker.	16·46	5·96	22·42	77·58	Ditto.
19	Naylor.	16·91	3·87	20·78	79·22	Ditto.
20	Ditto.	26·22	5·53	31·75	68·25	Ditto.
21	J. H. Crump.	15·00	4·00	19 00	81·00	Ditto.
22	G. Edwards.	13·10	3·32	16·42	83·58	Ditto.
23	G. Deane.	12·07	8·24	20·31	79·69	Ditto.
24	G. Webb.	28·60	3·68	32·28	67·72	Ditto.
25	J. F. Brooks.	12·69	7·12	19·81	80·19	Ditto.
26	H. Dennis.	17·48	4·94	22·42	77·58	Ditto.
27	J. Tate.	21·61	2·00	23·61	76·39	Ditto.
28	C. Peowrie.	14·70	5·17	19·87	80·13	Ditto.
29	Cory and Williamson.	16·55	3·85	20 40	79·60	Ditto.
30	W. Carr.	14·44	4 48	18·92	81·08	Ditto.
31	Beck and Murley.	14·00	2·73	16·73	83·27	Ditto.
32	Price and Son.	9·62	3·10	12·72	87·28	Ditto.
33	Fitch and Son.	17·82	6·16	23·98	76·02	Ditto.
34	T. Hunt.	13·37	1·60	14·97	85·03	Fresh butter, Ostend.
35	G. Webb.	13·66	1·54	15·20	84·80	Ditto.
36	H. Dennis.	12·49	2·91	15·40	84·60	Ditto. Larger proportion of salt than usual.
37	Aukland and Needham.	12 60	3·74	16·34	83·66	Ditto. Much larger proportion of salt than usual.
38	R. Nettleship.	14·70	1·98	16·68	83·32	Fresh butter, Ostend.
39	W. Carr.	15 43	1·30	16·73	83·27	Ditto.
40	Beck and Murley.	11·53	1·49	13·02	86·98	Ditto.
41	Price and Son.	11·56	0·98	12·54	87·46	Ditto.
42	Fitch and Son.	12·23	0·84	13·07	86·93	Ditto.
43	G. Edwards.	18 70	4·43	23·13	76·87	Really salt, although sold as Ostend.
44	J. Barnett.	12·84	6·44	19·28	80·72	Really salt.
45	C. Fenn.	13·19	0·36	13·55	86·45	Sold as home-made fresh butter.
46	Webber and Son.	11·29	0·64	11·93	88·07	Ditto.
47	J. Howell.	13·16	0·30	13·46	86·54	Ditto.
48	J. H. Stocker.	12·07	0·70	12·77	87·23	Ditto.

From an examination of the above Table of Results it appears —

1st. That all the *salt butters* examined contained variable and usually very large quantities of *water*, the amount ranging, with one exception, from 8·48 to 28·60.

2nd. That the *fresh butters* likewise contained variable and often considerable quantities of *water*, but in most cases very much less than in the salt butters, the quantities ranging from 4·18 to 15·43.

3rd. That the quantity of *salt* contained in the *salt butters* varied from 1·53 to 8·24, showing that no fixed rule is acted upon in salting butter.

4th. That in the *fresh butters* the salt varied from 0·30 to 2·91.

5th. That the per-centages of butter contained in the samples ranged from 67·72 to 96·93; that is, some of the samples contained 20, 30, and in one case even nearly 35 per cent. of water and salt.

Now the presence of both water and salt in butter in excess cannot be regarded in any other light than as adulterations.

To many of the above samples, no doubt, a quantity of salt, over and above the amount necessary to insure the preservation of the butter, has been purposely added to increase the weight and bulk; in fact, for the sake of adulteration.

It is equally certain that water has been added for the same purpose, it being stirred up with the butter while this is in a semi-fluid state, and thus becoming incorporated with it in the act of consolidation. This fraud we showed in a previous report was sometimes practised with lard.

The quantity of water contained in some inferior descriptions of butter, especially "Bosh," and the worst kinds of "Hollands," is really enormous. A simple method of determining approximately the amount of water present in any sample, is to melt the butter, fill a small bottle with it, and place it near the fire for half an hour or so; the water, as also the salt, will sink on account of their weight. In many cases it will be found that the water constitutes a fourth, or even a third of the article. The water thus separated has usually a milky appearance, conveying the impression that it contains flour — an impression, however, which, in all the samples we have examined, has proved to be erroneous. This appearance has doubtless deceived many, and has led to the report that butter is frequently adulterated with various farinaceous substances. There is no question but that some butters, especially the low kinds known by the term "Bosh," were formerly adulterated in this way, and they may still be so in some rare cases. There is reason to believe that some years since the adulteration of butter with flour was rather common. Mr. Miller, a very intelligent butter-factor, of Wellington Chambers, London Bridge, some time since brought this subject before the Provost of Glasgow, who declared the whole of the butter so adulterated to be forfeited. More recently Mr. Miller directed the attention of the City authorities of London to this matter, but did not succeed in moving them to take any steps in it.

Perceiving, then, to what an extent salt butter is adulterated with both water and excess of salt, we very much doubt whether any saving is effected by the public by the use of this description of butter; although nominally cheaper, it is questionable whether it be not really dearer in the end. We believe that the most economical kinds of butter for general use, are the cheaper fresh butters, as Ostend. We believe also that dealers experience great loss on salt butters, since they so rapidly lose weight on exposure, by the evaporation of the water contained in them, as also by its escape in considerable quantity from every incision made into such butter. We were formerly under the impression that the beating of butter, which we so often see performed behind the butterman's counter, was for the purpose of incorporating an additional quantity of water with it; we now know that the real object is to impart a uniform appearance to the butter, and to freshen it up: there is in this process a further loss of water and consequently of weight.

THE ANALYTICAL SANITARY COMMISSION.

BUTTER AND ITS ADULTERATIONS.

"*To the Editor of* THE LANCET.

SIR, —Being attracted to the article in your publication of June 4th, on the 'Adulteration of Butter,' by the conspicuous mention of my name, I take the liberty of stating that, although I believe in the fidelity of your analyses, there are two things you are wrong in. First, the amount of adulteration in the worst sample is stated to be twenty-six per cent. I account for this thus: The adulterating process is to bring the butter to the melting point, then to stir it in water and salt until the mixture is cold. Fifty per cent. of water may be incorporated with butter in this way; but when you make your purchase, say half a pound, a considerable part of the water of adulteration will escape, and if you put it in paper considerably more will be lost. The next way you might be deceived is, if you ask for Repacks (Irish) or Black Jacks, or Bosh (Holland), the shopkeeper may suspect your scientific object, and give you better butter instead; but if the public adopt your suggestion of melting butter in a clear bottle, they will prove what I have above said, that twenty-six per cent. of adulteration in these butters is understating the amount.

In the name of the trade, I may thank you for your article; because a neighbouring shop selling 'cheap butter' compels other shops to do so also; but the trade are now aware of the iniquitous article, and are horrified by being thus compelled to cheat their poor customers with '*cheap butter*,' while they are also perfectly aware of the great loss of weight to themselves by cutting up this watery butter in small quantities. The trade would all be glad to give up the sale of adulterated butter if a public movement were made, so as to compel all the shopkeepers to do so at the same time.

I am, Sir, yours truly,

Wellington-chambers, London-bridge, June, 1853. ROBT. MILLER.

N. B.—40,000 to 50,000 casks of adulterated butter are annually sold in London, and the trade knows it as well as they know a bad shilling."

EPPING BUTTER.

"*To the Editor of* THE LANCET.

SIR, — Having taken apartments in the house of a butterman, I was suddenly awoke at three o'clock one morning with a noise in the lower part of the house, and alarmed on perceiving a light below the door of my bedroom: conceiving the house to be on fire, I hurried down stairs. I found the family busily occupied; and on my expressing alarm at the house being on fire, they jocosely informed me, they were merely making EPPING BUTTER!

They unhesitatingly informed me of the whole process. For this purpose they made use of Irish salted butter of a very inferior quality. This was repeatedly washed with water, in order to free it from the salt. This being accomplished, the next process was to wash it frequently with milk, and the manufacture was completed by the addition of a small quantity of sugar.

The amateurs of fresh "Epping butter" were supplied with this dainty, which yielded my ingenious landlord a profit at least one hundred per cent., besides establishing his shop as being supplied with Epping butter from one of the first-rate dairies.

I am, Sir, your obedient servant,

York-road, Lambeth, June, 1853. A STUDENT."

TOBACCO, AND ITS ADULTERATIONS.

TOBACCO consists of the dried leaves of several different species and varieties of plants belonging to the genus *Nicotiana*, of the family *Solanaceæ*, which includes, amongst other medicinal plants, hyoscyamus, belladonna, and stramonium.

The tobacco plant, according to Humboldt*, has been cultivated from time immemorial by the natives of Oronoko, but its introduction into Europe appears to have taken place subsequent to the discovery of America, although there is reason for believing that it was known to the Asiatics long before that time.

The custom of smoking cigars was beheld by Columbus and his followers for the first time on their arrival at Cuba in 1492.† The plant was afterwards introduced into Spain and Portugal by Hernandez de Toledo, and Joan Nicot about 1559-60 sent the seeds from the latter place to France.‡ On the return of Sir Francis Drake with the colonists from Virginia in 1586, the practice of smoking was introduced into England, and soon became general, Sir Walter Raleigh being one of the first to adopt it.§

Subsequent to its introduction into Europe, various attempts were made to prohibit the smoking and use of tobacco, but all the writings, pains, and penalties proved ineffectual, and the practice went on extending, until, as at present, it has become almost universal. One of the most celebrated of the treatises written against tobacco was the "Counterblaste to Tobacco,"‖ by King James the First.

In Great Britain the cultivation of tobacco is still restricted on account of the revenue, not more than half a pole (two yards and three-quarters) being allowed "in a physic or university garden, or in any private garden for physic or chirurgery."

The generic appellation of *Nicotiana* is evidently derived from Nicot, the name of the individual by whom the plant was first sent to France, while it is probable that the specific word *tabacum* given to one of the principal species, is derived from *tabac*, the name of the instrument used by the natives of America for smoking tobacco. Some, however, derive the word from Tobago, others from Tobasco, a town in New Spain.

The principal species of tobacco, and also that employed in medicine, is *Nicotiana Tabacum*, or *Virginian tabacco;* it is a herbaceous plant, reaching from three to six feet in height, with a viscid, gummy juice; the leaves are sessile, large, pale-green when fresh, oblong, lanceolate, acuminate, and clothed with short glandular hairs; it is extensively cultivated nearly all over the world, but chiefly in the United States of America, Virginia being the most celebrated for its growth.

Of this species several varieties are cultivated; Virginian, Kentucky, Maryland, and Columbian tobacco, are all obtained from it.

The leaves of *N. latissima* (Miller), *N. macrophylla* (Sprengel) yield the *large-leaved* or *Oronoko tobacco*. This is probably merely a variety of the preceding species; it likewise presents certain modifications or varieties dependent upon the size and form of the leaves, as also upon whether they are sessile, or furnished with leaf-stalks. According to Don the large Havannah cigars are probably made from the leaves of this species.

The leaves of the *N. rustica*, *common green tobacco*, furnish the tobacco of Salonica or Thessalonica; also the Turkish tobacco grown on the coasts of the Mediterranean, so highly valued in India; and probably also the celebrated Latakia. The leaves of this species are petiolate, ovate, and quite entire. It ripens earlier, and is more hardy than *N. Tabacum*. It is frequently cultivated

* Personal Narrative, vol. v. p. 666.
† History of the Life and Voyages of Columbus, Washington Irving, vol. i. p. 287.
‡ Bauhin's Pinax. § Biograph. Brit. vol. v. p. 3471. ‖ Works, p. 214, f. 1616.

in gardens in England, and is used by gardeners to destroy insects. It is indigenous in America, and grows wild in Europe, Asia, and Africa.

N. Persica (Lindl.) yields the celebrated Shiraz or Persian tobacco. Of the leaves of *N. repanda* (Willd.), a native of Cuba, near Havannah, the small Havannah or Queen's cigars are said to be made.

N. quadrivalvis (Parsh.) grows spontaneously, and is also cultivated on the banks of the Missouri by the Indians. The tobacco prepared from it is described as excellent; the most delicate is made from the dried flowers.

N. nana (Lindl.) grows in the Rocky Mountains; the Indians are said to prepare the finest of their tobacco from the leaves of this species.

The last species which need be noticed is *N. multivalvis*, cultivated by the Indians who inhabit the banks of the Columbia; the calyx, which is very fœtid, being preferred to any other part.

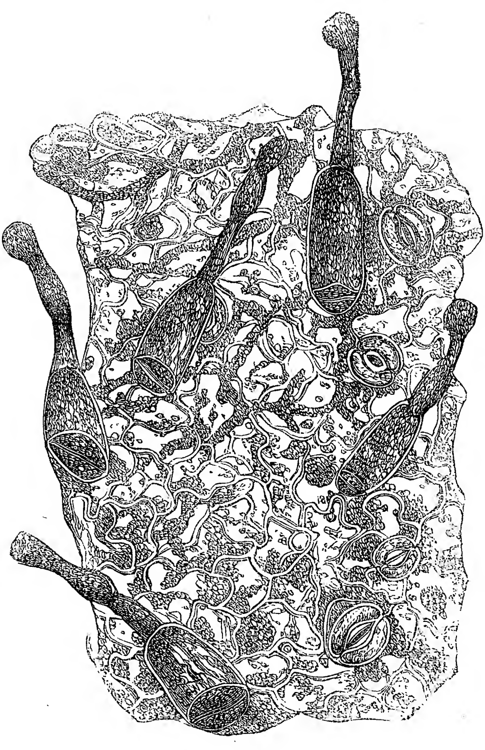
The tobacco plant is propagated in Virginia and Maryland from seeds. These are first sown in beds: as soon as the young plants have five or six leaves, exclusive of the seminal leaves, they are transplanted, during the month of May, into fields, the seedlings being placed two or three feet apart, in rows. When nearly full-grown, the tops are pinched off, to prevent the formation of flowers and seeds, and to promote the development of leaves. The harvest takes place in August; the mature plants are cut off above the roots, dried under cover, and stripped of their leaves, which are tied in bundles and packed in hogsheads, &c.

The leaves of tobacco present several well-marked *peculiarities of structure*, by which they may be readily distinguished, even in their manufactured state,

Fig. 145.

Upper Surface of Leaf of Tobacco.

(Magnified 220 diameters.)



from those of most other plants. These peculiarities can only be satisfactorily determined by means of the microscope, and it is very important that they should be clearly understood, for without a knowledge of them it is often impossible to discriminate between genuine and adulterated tobacco—a point of the greatest consequence, since no less than about four millions and a half pounds sterling are derived annually from the duty on tobacco, and since it is known that the revenue is defrauded to a large extent with comparative impunity by the adulteration of tobacco. Most leaves may be divided into two parts, the broad expanded part or lamina, and the mid-rib or stalk and veins, as they are called, which traverse this, imparting to it strength and solidity in the same way as the bones of an animal.

The lamina is composed chiefly of cellular tissue, and the veins of woody fibre and vessels.

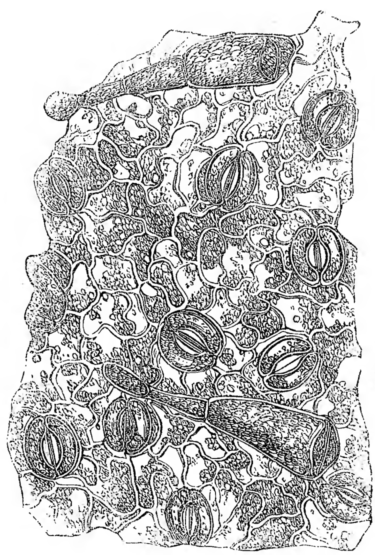
A minute fragment of tobacco-leaf, viewed on its upper surface with a half or quarter-inch object glass, is seen to consist of a number of cells, joined together, and having smooth and waved borders, with here and there stomata and numerous hairs. These hairs are peculiar; they are of the kind termed glandular—that is, they terminate in a roundish swelling or enlargement, very clearly seen even in the dried leaf; further, the hairs vary greatly in size, and occasionally they are divided or compound. *Fig.* 145.

The under surface of the leaf presents a nearly similar structure, but the stomata are much more numerous, and the hairs fewer. *Fig.* 146.

Fig. 146.

UNDER SURFACE OF LEAF OF TOBACCO.

(Magnified 220 diameters.)



The veins and mid-ribs, viewed in transverse sections are of a crescentic or horseshoe form. It has been considered by some that the stalks of tobacco may always be distinguished from those of other plants by this character. It appears, however, that sections of the stalks of stramonium and hyoscyamus present a nearly similar outline; but these plants are scarcely likely to be used, under any circumstances, by the manufacturer, for the adulteration of tobacco.

Transverse sections of the smaller veins under an inch object-glass present the appearances shown in the following figure:—

Fig. 147.
TRANSVERSE SECTION OF MID-RIB OF LEAF OF TOBACCO.
(Magnified 40 diameters.)

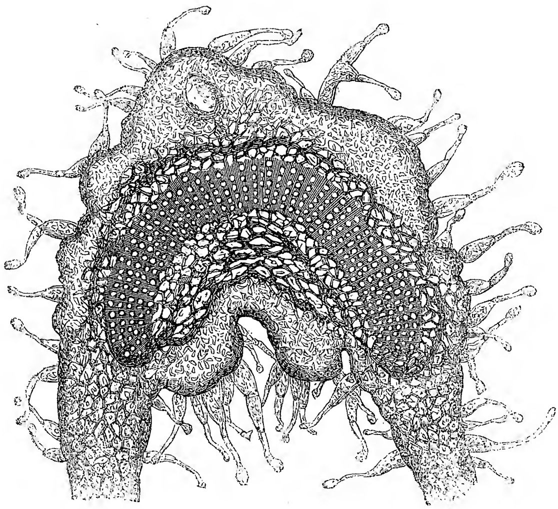
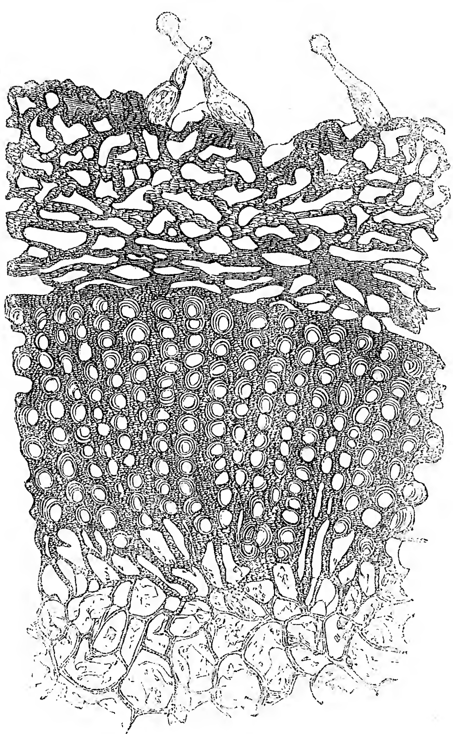


Fig. 148.
PORTION OF TRANSVERSE SECTION OF MID-RIB OF LEAF OF TOBACCO.
(Magnified 90 diameters.)



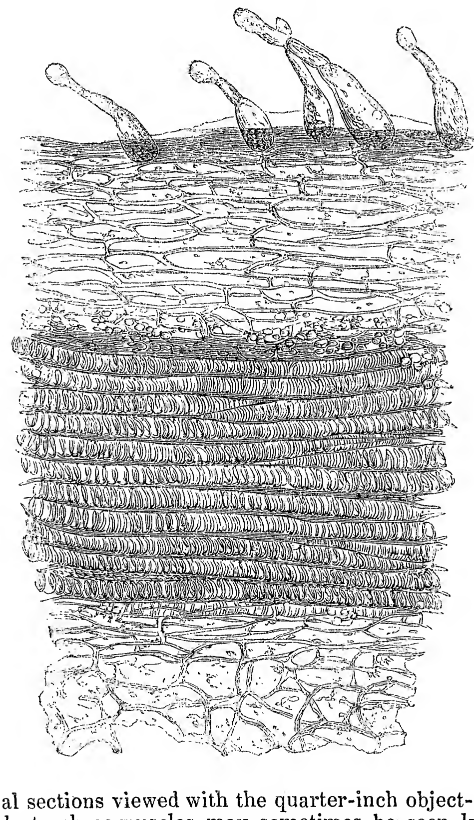
On the outside, running all round the section, *fig.* 147., is a layer of the cellular tissue of which the lamina of the leaf is itself mainly composed, bearing on its outer surface the glandular hairs ; in the centre of the section, the cut extremities of the elongated cells, woody fibre, and dotted ducts, of which the stalks are chiefly made up, are seen, having a somewhat radiated disposition. These structures are more clearly shown in *fig.* 148.

Fig. 149. represents a longitudinal section of one of the smaller mid-ribs, in which the cells, fibres, and vessels are still more clearly shown :—

Fig. 149.

LONGITUDINAL SECTION OF MID-RIB OF LEAF OF TOBACCO.

(Magnified 90 diameters.)



In longitudinal sections viewed with the quarter-inch object-glass, a few small but well-formed starch-corpuscles may sometimes be seen lying in the cells situated just outside the central part of the mid-rib.

In the leaf of tobacco reduced to powder all the above structures may be readily detected, — of course much broken up, — as the hairs, cells of the lamina, stomata, elongated cells, woody fibre, and portions and fragments of the spiral ducts.

The quantity of woody fibre present in the central part of the mid-rib, is by no means very considerable, it being made up to a great extent of the spiral ducts ; the fibres, in general, are more like elongated cells than ordinary woody fibres ; nevertheless, bundles of undoubted woody fibre do occur. The fibres are short, the borders striated, and the extremities truncate — characters which will be represented in the figure of ground tobacco-leaf to be given hereafter. We shall also describe the structure of the principal leaves employed in the adulteration of tobacco, and point out the differences between each of these and the tobacco leaf.

We have now to consider the *composition* and *properties* of tobacco.

The principal analyses of tobacco which have hitherto been made are the following: —

*Vauquelin's Analysis.**

An acrid volatile principle (*nicotina*).
Albumen.
Red matter soluble in alcohol and water.
Acetic acid.
Supermalate of lime.
Chlorophylle.
Nitrate of potash and chloride of potassium.
Sal ammoniac.
Water.

Expressed Juice of Leaves.

The *leaves* contained, in addition to the above, woody fibre, oxalate and phosphate of lime, oxide of iron, and silica. The two latter substances were obtained from the ashes. *Manufactured tobacco* contained the same principles, and in addition carbonate of ammonia and chloride of calcium, perhaps produced by the reaction of sal ammonia and lime, which are added to tobacco to give it pungency.

Posselt and Reinmanns' Analysis.†

Nicotina	0·06
Concrete volatile oil	0·01
Bitter extractive	2·87
Gum with malate of lime	1·74
Chlorophylle	0·267
Albumen and gluten	1·308
Malic acid	0·51
Lignin and a trace of starch	4·969
Salts (sulphate, nitrate, and malate of potash, chloride of potassium, phosphate and malate of lime, and malate of ammonia)	0·734
Silica	0·088
Water	88·280
Fresh leaves of tobacco	100·836

Conwell's Analysis.‡

Gum.
Mucilage soluble in both water and alcohol.
Tannin.
Gallic acid.
Chlorophylle.
Green pulverulent matter, soluble in boiling water.
Yellow oil having the odour, taste, and poisonous properties of tobacco.
Pale yellow resin (large quantity).
Nicotina.
A substance analogous to morphia.
An orange-red colouring matter.
Nicotianin.

Of the several constituents, the presence of which has been revealed by chemical analysis, the most important are nicotina or nicotine, and nicotianin, as upon these the active properties of tobacco mainly depend.

Nicotina exists not only in the leaves, both fresh and fermented, but in the roots, seeds, and even the smoke of tobacco. It is obtained by digesting an aqueous extract of the leaves in rectified spirit; this takes up the nicotina in

* Ann. de Chim., vol. lxxi. p. 139.
† Gmelin's Handb. de Chem. vol. ii. p. 1303.
‡ Silliman's Journal, vol. xvii., p. 369.

combination with acids; the tincture is then to be concentrated, and mixed with solution of potash; this sets free the nicotina, which is again taken up on agitation with ether.

The alkaloid may be purified thus:—Oxalic acid is to be added to the etherial solution; oxalate of nicotina falls to the bottom of the vessel: this precipitate is to be repeatedly shaken up with ether, the nicotina being separated as before by potash and ether. With a view to its still more complete purification the etherial solution is to be distilled in a salt-water bath, transferred to a retort through which a current of dry hydrogen gas is made to circulate, exposed in an oil-bath to a temperature of 284° Fahr., to get completely rid of the water, ether, and ammonia; lastly, the temperature is to be raised to 356° Fahr., at which the nicotina distils over drop by drop. It is stated that from twenty-eight pounds of Virginia tobacco at least four per cent. of the alkaloid can be obtained by this process.

Nicotina is a colourless liquid alkaloid, with an offensive odour, and an acrid, burning taste. It boils and undergoes decomposition at 482°; it becomes brown by exposure to the air, and is readily combustible with the aid of a wick. It is soluble in water, ether, alcohol, and the oils both fixed and volatile; with the acids it forms salts, which are for the most part crystallisable. A solution of nicotina with one of bichloride of mercury gives a white, flocculent precipitate, a double chloride of nicotine and mercury, and a yellow granular precipitate with chloride of platinum.

Schloesing* has given the following process for estimating the amount of nicotina in dried tobacco. Two drachms of tobocco are to be exhausted by ammoniacal ether in a continuous distillatory apparatus, the ammoniacal gas is to be expelled from the nicotina solution by boiling, and after the evaporation of the ether, the amount of nicotina is to be estimated by the quantity of diluted sulphuric acid, of known strength, required to neutralise it.

The following are the amounts of nicotina estimated by this process found in different kinds of tobacco.

100 Parts of Tobacco dried at 212°.	Nicotina.
Virginia	6·87
Kentucky	6·09
Maryland	2·29
Havannah (Cigares primera) less than	2·00
Lot	7·96
Lot-et-Garonne	7·34
Nord	6·58
Ile-et-Vilaine	6·29
Pas de Calais	4·94
Alsace	3·21
Tobacco in powder	2·04

Pure nicotina is an energetic poison almost as active as hydrocyanic acid. It was employed by Count Bocarmé for the murder of his brother-in-law; and his trial at Mons a few years since created a great sensation in the public mind.

NICOTIANIN, *the concrete volatile oil of tobacco*, *tcbacco camphor*, is obtained by distillation. Six pounds of leaves yield only about eleven grains of the oil; it has the odour of tobacco, and a bitter taste; it excites in the tongue and throat a sensation similar to that caused by tobacco smoke; applied to the nose it causes sneezing. Hermbstädt swallowed a grain of it, which produced nausea, giddiness, and inclination to vomit.

Since it is chiefly from TOBACCO SMOKE that we must draw our conclusions as to the effects of tobacco smoking on the system, a knowledge of its composition is of great importance. It has been analysed by several different experimenters.

The constituents of *Tobacco smoke*, according to Raab†, are—

Carbonate of ammonia.
Acetate of ammonia.
Nicotianin.
Empyreumatic oil.

* Chemical Gazeite, vol. v. p. 41.
† Zenker and Schenk, Naturgesch. d. vorzüg. Handelspfl, Bd. ii. S. 75.

Carbonaceous matter.
Moisture, and several gases.

Unverdorben * obtained, by the dry distillation of tobacco, the following products:—

A volatile oil.
An oleaginous acid.
An empyreumatic acid.
Resin.
Traces of a powder insoluble in potash and acids.
Odorin, a small quantity.
A base soluble in water (Nicotin ?).
Fuscin.
Red matter soluble in acids.
Two extractive matters, one forming a soluble, the other an insoluble compound with lime.

More recently Zeise† has made a careful analysis of tobacco smoke, and gives the following as its constituents:—

A peculiar empyreumatic oil.
Butyric acid.
Carbonic acid.
Ammonia.
Paraffine.
Empyreumatic resin.
Water.
Acetic acid, probably.
Carbonic oxide.
Carburetted hydrogen.

Lastly, Melsens‡ has detected nicotina in tobacco smoke. The empyreumatic oil of tobacco is undistinguishable from that of foxglove. It is evident, therefore, that tobacco smoke contains the more active constituents of tobacco, and that it consequently possesses to some extent the properties of the leaf. We shall hereafter enter upon the question of the effects upon the system of the habit of smoking tobacco, but we now confine our remarks to the physiological action and effects of tobacco when administered.

In small doses tobacco produces a sensation of heat in the throat, and sometimes a feeling of warmth in the stomach; it also frequently excites nausea, and a peculiar sensation of giddiness, more allied to incipient intoxication; by repetition, it acts as a diuretic and laxative.

In larger doses it occasions distressing nausea, accompanied with a sensation of sinking at the pit of the stomach, vomiting and purging; occasionally it acts as an anodyne, or more rarely promotes sleep. But the most remarkable symptoms produced by it are langour, feebleness, relaxation of the muscles, trembling of the limbs, great anxiety, and tendency to faint; the pulse is small and weak; respiration somewhat laborious; surface cold and clammy, and, in extreme cases, there are convulsive movements.

In large doses the effects are nearly the same, but more violent in degree; the convulsive movements are followed by paralysis and a kind of torpor terminating in death.

The application of tobacco *to abraded surfaces* is a very dangerous practice. A case has been related which proved fatal in three hours and a half, in which the expressed juice had been applied for the cure of ringworm to the head of a child eight years of age.

Tobacco has also frequently proved fatal in the form of *glyster*. Dr. Copland saw half a drachm in infusion prove fatal.

The operation of tobacco resembles somewhat that of Lobelia inflata, both being anodyne and antispasmodic. In its enfeebling action on the heart it

* Poggendorff's Annalen, viii. 399.
† Annal. d. Chemie u. Pharm., vol. xlvii. p. 212, 1843.
‡ Ann. de Chim. et de Physiq., 3me sér. t. ix. p. 465.

agrees with digitalis, but it is not equal to foxglove in this respect. In its power of causing relaxation of the muscular system it greatly surpasses digitalis. From belladonna, stramonium, and hyoscyamus, it is distinguished by causing contraction of the pupil, both when applied to the eye, and when taken internally in poisonous doses, and also by the absence of delirium and of any affection of the throat. From aconite it is distinguished by not possessing the power of paralysing the sentient nerves.

Tobacco is met with in two states—the "Raw" or "Unmanufactured," and the "Manufactured."

Tobacco in the raw state consists merely of the dried leaves; these, as imported, are sometimes separate, and placed one upon the other, as in Turkey tobacco; at others they are strung on strings, as in German tobacco; but usually they are imported in "heads" or "hands," as they are termed; the different varieties of American tobacco come over in this state.

There are various kinds of dried leaf, or unmanufactured tobacco, distinguished by the name of the country in which it is grown, as well as by differences of colour and quality, arising chiefly from soil and climate.

United States Tobacco.—The principal supplies of tobacco to this country are derived from the United States of America, the several kinds being named after the states in which they are grown—as *Virginian*, *Kentucky*, *Maryland*, *Missouri*, *Ohio*, and other descriptions, all cultivated in, and imported from, the United States.

Virginian Tobacco is the strongest kind of tobacco, and is not, therefore, well suited for cigars; it is best adapted for smoking in pipes and for snuff. The colour of the leaves is deep brown, and they present a mottled appearance; they feel unctious, and are so tough that they may be bent double without breaking, when not over-dried. Since this tobacco will retain more moisture than almost any other kind, and since its strength is much greater, it is extensively used by tobacco manufacturers.

Maryland Tobacco is paler in colour and weaker than the former; the "*pale Cinnamon*" is the best, the "*Scrubs*" the commonest.

Kentucky Tobacco is described as being intermediate in strength between these; it is paler than the Virginia.

Carolina Tobacco is less frequently met with, and is of inferior quality.

Columbian Tobacco is much esteemed for cigars, for which it is more used than any other kind. The leaves are marked with light yellow spots. Other varieties of Columbian tobacco are, *Varinas*, brought over in rolls and heads, a very mild tobacco, and *Cumana*.

Oronoko Tobacco comes over in separate leaves; it is of a yellow colour, and is very mild and delicate.

Cuba Tobacco is also a mild tobacco, and the most esteemed for cigars; that grown near the town of *Havannah* is the finest; the leaves of this are yellowish brown, with a musky or spicy odour. The ordinary tobacco grown on the island is darker than the Havannah. Both kinds are imported in heads, and are remarkable for the light yellow spots on the leaves.

St. Domingo Tobacco comes over in separate leaves, and is of inferior quality.

Brazilian Tobacco.—A very small quantity only of this tobacco is imported from the Brazils.

Dutch or Amersfoort Tobacco is very mild, and deficient in flavour; the darker kind is the strongest, and is much used for snuff; while the mildest is employed for the commonest cigars.

Levant Tobacco includes *Turkey*, *Latakia* (a Syrian tobacco), and *Salonica* tobacco; these are all the produce of *Nicotiana rustica*; they are mild, but valuable tobaccos. *Turkey* tobacco comes over in broad and separate leaves, of a bright-yellow colour.

Persian or *Shiraz Tobacco* is also a Levant tobacco; it is delicate and fragrant, and is the produce of *Nicotiana Persica*.

Another description is East India Tobacco, of which a small quantity only is imported; it is not much esteemed.

Manilla Tobacco, grown near the town of Manilla, in Lucon, one of the

Philippine Islands, is a dark-coloured tobacco, and is extensively used in the manufacture of cheroots.

In the hands of the manufacturer the leaf is converted into manufactured tobacco in the following manner: —

The leaves are unfolded and "stripped"—that is, the mid-ribs or stalks are removed; this is done by a sudden jerk of the stalk by the hand, holding by the leaf. They are then sprinkled with "sauce" or "liquor;" this, properly, should consist of water only, but in some cases it contains salt, and is coloured with treacle or liquorice; but these additions are adulterations. After the sprinkling, by which the leaves imbibe a good deal of the liquor, and therefore become increased in weight, they are put into large, flat, square, iron boxes, and pressed into a solid cake; during the pressure, if too much "liquor" has been used for the sprinkling of the leaves, some escapes, deeply coloured with extractive derived from the tobacco-leaf. This, mixed with the washings of the cloths used in pressing, is sold as "tobacco water," and is used as a sheep-wash, and also by gardeners to destroy worms and other vermin. The cake is then cut into shreds with knife-edged chopping-stamps, the shreds varying in diameter of from sixteen to one hundred to the inch. Lastly, the tobacco in this state is lightly dried or "stoved" in a flat copper or iron tray, heated by sand, and frequently by steam.

The above process of course applies only to CUT or SHAG TOBACCO; in the manufacture of "ROLL TOBACCO" a totally different method is followed: —

The leaves, or rather the half-leaves, are arranged end to end in a line down a long table; this is mostly done by women or boys. One of the leaves, having first been twisted into a kind of thin rope, is attached to an iron hook, which is made to revolve rapidly, by means of a wheel, in a horizontal position on a level with the surface of the table. The "spinner" then, with a small board fixed to the palm of the hand, while the rope is turning, attaches leaf after leaf, rolling and hardening it with the board as the length proceeds. When sufficient is manufactured, the rope is coiled up so as to form a barrel-shaped pile or mass, each layer being well oiled with a brush, to prevent the coils from adhering to each other. The coils being firmly pegged together with wooden nails, the whole pile is then steeped in "liquor," and finally pressed, oiled, and polished with a brush. It is estimated that this kind of tobacco increases in weight in the manufacture from fifteen to twenty-five per cent.

All manufactured tobaccos may be referred to one or other of the four following forms or kinds: —

In the first kind the leaves are cut into shreds; to this all the different varieties of *cut tobacco* belong.

In the second, the leaves are twisted or spun into a kind of rope; this includes the different kinds of *roll*, *spun*, or *twist tobacco.*

In the third, the stripped leaves are folded one over the other, so as to form *cigars* and *cheroots.*

In the fourth form, the leaves are reduced to powder, constituting *snuff.*

We need only describe at present the different varieties of cut and roll tobacco: —

The chief kinds of cut tobacco are *Shag*, *Returns*, and *Bird's-eye;* other less common kinds are *Maryland*, *K'Naster*, *Oronoko*, *Turkey*, *Persian*, and *Varinas.*

Shag is prepared chiefly from Virginia and Kentucky tobacco.

Returns is a light-coloured, mild tobacco. The true derivation of its name is said to be, that formerly the tobacco known as "*short cut*" was with much labour rubbed through a wire sieve; the finer portions and dust, technically called "smalls," passed through, and were supposed to be much the strongest; when no more would go through, that which was left upon the sieve was reckoned to be milder, and of superior quality, and called in the trade "Returns." According to Pereira its name is derived from its being formerly prepared by returning Shag for re-cutting. In the Report on the Tobacco Trade, by the Select Committee of the House of Commons, made in August 1844, it is described as "made up of the small pieces of broken leaves, and the dust and siftings produced in the various processes of manufacture."

Bird's-eye differs from the other varieties in containing the mid-ribs of the leaves, the transverse slices of which have been fancifully compared to the eyes of birds.

The principal kinds of roll tobacco are *Pigtail*, *Bogie*, *Alloa*, *Negro-head*, and *Cavendish*.

The three first are used entirely for chewing, and are distinguished by the difference in the thickness of the ropes, *Alloa* being the thinnest and *Bogie* the thickest.

Negro-head and *Cavendish* are used nearly exclusively for smoking.

Negro-head is manufactured in the form of a thickish rope; it also sometimes consists of two ropes coiled together in short pieces.

Cavendish is made in small square flat cakes, about an inch and a half wide by five inches long.

In that portion of the report published already we have enumerated the different species from which the several varieties of tobacco are obtained, described the cultivation of the tobacco plant in Virginia, gave the minute structure of the leaves, their chemical composition and properties, the processes by which raw or unmanufactured is converted into manufactured tobacco, and, lastly, we described the different varieties of cut and roll tobacco; these particulars were necessary in order that the subject of the adulteration of tobacco might be the more easily and fully comprehended.

On referring to Act 5 & 6 Vict., entitled, "An Act to amend an Act of the fourth year of her present Majesty, to discontinue the Excise survey on tobacco, and to provide other regulations in lieu thereof," (10th August, 1842,) we find the following provisions relating to the adulteration of tobacco: —

By Clause 1. it is enacted, "that no manufacturer of tobacco shall, in manufacturing any tobacco, make use therewith of any other material, or any other liquid substance, or matter, or thing, than water only; or in manufacturing any snuff, make use therewith of any other material, or any other liquid, or substance, or matter, or thing, than water, or water and salt, or alkaline salts only, or lime-water, in snuff known as *Welch* or *Irish* snuff," under a penalty of three hundred pounds.

Clause 2. allows of the use of essential oils for scenting and flavouring snuffs, as also oil in making up spun or roll tobacco.

By Clause 3. it is provided, "that any manufacturer of, dealer in, or retailer of tobacco, who shall receive, or take into, or have in his possession, or shall sell, send out, or deliver, any tobacco or snuff which shall have been manufactured with, or shall have had added thereto, or mixed therewith, any other substance than water, shall forfeit two hundred pounds."

Clause 4. declares all tobacco manufactured otherwise than with water, or the other substances allowed by law, as oil in the making up of roll tobacco, or salt, or alkaline salts, or lime-water, in snuffs, to be forfeited.

By Clause 5. it is enacted, "that no manufacturer of tobacco shall receive, or take into, or have in his possession, any sugar, treacle, molasses, or honey, (except for the necessary and ordinary use of his family,) nor any commings or roots of malt, or any ground or unground roasted grain, ground or unground chicory, lime, sand (not being tobacco-sand), umber, ochre, or other earths, sea-weed, ground wood, moss, or weeds, or any leaves, or any herbs or plants (not being tobacco leaves or plants) respectively, nor any substance, syrup, liquid, or preparation or thing, to be used or capable of being used as a substitute for, or to increase the weight of, tobacco or snuff, on pain of forfeiting the same and two hundred pounds."

Clause 6. provides that manufacturers of tobacco who are also grocers may carry on the two trades or businesses in separate premises. It states, "It shall be lawful for the Commissioners of Excise to authorise and empower such person to carry on the business of a manufacturer of tobacco, without being subject to the same penalty by reason of having such of the said commodities as are usually sold by grocers in his possession, so as his premises for manufacturing tobacco be separated, to the satisfaction of the Commissioners of Excise, from, and all internal communication prevented with, his premises used for carrying on his business of a grocer, and so that such commodity shall be in his possession only, and for the purposes of his business as a grocer, and shall not be found in his premises used for the manufacture of tobacco or snuff."

By Clause 7. it is made "lawful for any officer of Excise, at any time he shall see fit, to take a sample or samples of any tobacco or snuff manufactured, or in the process of manufacture, or manufactures in the stock or possession of any manufacturer of, dealer in, or retailer of, tobacco, paying for the same, if demanded, at the current wholesale price of such tobacco or snuff."

Clause 8. enacts "that every person who shall cut, grind, pound, colour, stain, dye, or manufacture any leaves, or any herb or plant, moss or weed, or any wood, chicory, commings or roots of malt, or any other vegetable matter, so as to imitate or resemble tobacco or snuff, or who shall have in his possession any of the above-mentioned substances, or any syrup, liquid, or preparation to be used in the manufacture of tobacco or snuff, shall forfeit two hundred pounds; and all such leaves, herbs, plants, &c. &c., together with all machines, tools, materials, vessels, and utensils for cutting, grinding, pounding, colouring, staining, dyeing, manufacturing, or preparing the same, shall be forfeited."

By clause 13. it is enacted that no person shall hawk about tobacco or snuff for sale under a penalty; and any officer of excise or customs may arrest the offender and convey him before a justice of the peace, who has the power to inflict the penalty of one hundred pounds, in default of payment of which the offender may be committed to prison, and there kept to hard labour for a period of three calendar months.

Such, then, is the present state of the law with regard to the adulteration of tobacco. Every addition made to cut tobacco in the course of manufacture, excepting water, or water and oil in the making of roll tobacco, is an adulteration, subjecting the manufacturer to the heavy penalty of three hundred pounds.

From the number of substances enumerated in the Act, it would appear that a variety of different articles have been employed in the adulteration of tobacco; and there is reason for believing that tobacco has been extensively adulterated; indeed, convincing proof of this is afforded by the evidence given on the tobacco trade before the parliamentary committee already referred to, as well as by an examination of the Excise returns at different periods, showing the number of prosecutions instituted, and fines inflicted on parties who have been found guilty of adulterating tobacco.

The following are the substances which have either been discovered, or have been stated on good authority to have been employed, in the adulteration of tobacco, either in the form of cut or roll tobacco, cigars, or snuff; they may be divided —

First, into *vegetable substances not tobacco*, as the leaves of the dock, rhubarb, coltsfoot, cabbage, potato, &c.; malt cummings — that is, the roots of germinating malt; peat, which consists chiefly of decayed moss; seaweed, roasted chicory-root, bran, catechu or terra japonica, and oakum.

Secondly, into *saccharine substances*, as cane-sugar, treacle, honey, liquorice, beet-root dregs.

Thirdly, into *salts and earths*, as nitre, common salt, sal ammoniac, or hydrochlorate of ammonia, nitrate of ammonia, carbonate of ammonia, the alkalies, as potash and soda, and lime-water; yellow ochre, umber, fuller's earth, Venetian red, sand, chromate of lead.

The detection of some of the above substances is easy enough, but others present great difficulties. The complete examination of a sample of tobacco, with a view to determine whether it is adulterated or not, involves a very considerable expenditure of time and trouble, as will appear from the following details.

The method of examination to be pursued is as follows: —

A certain quantity of each tobacco (100 grains) is to be weighed immediately after it is purchased, and before it has had time to lose weight by evaporation, and thoroughly dried at a temperature of about 100° Fahr. It is then to be reweighed; the loss or per-centage of water is by this means ascertained.

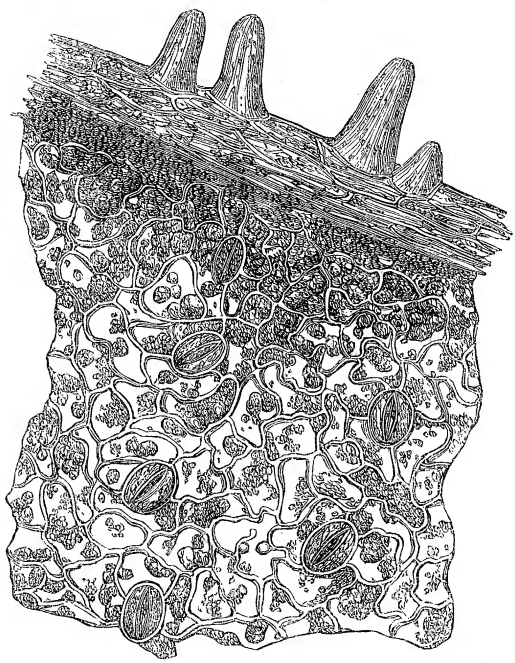
Each sample may next be thoroughly examined by means of the microscope, in order to ascertain whether there be any foreign vegetable substance present;

if it contain any of those enumerated on the preceding page, in ever so fine a state of powder, and even in the smallest quantities, they may be detected with the greatest certainty with the aid of the microscope, since they all present peculiarities of structure by which they may be readily distinguished.

Thus the structure of the leaves of the Common Dock is very characteristic; it is as follows: — The cells of the lamina do not differ materially in size or shape from those of the tobacco-leaf, neither do the stomata present any great peculiarity; like those of tobacco, they occur on both surfaces of the leaves, but of course are most numerous on the under surface; unlike tobacco, however, the cellular part of the lamina is wholly destitute of hairs. *Fig.* 150.

Fig. 150.

PORTION OF UNDER SURFACE OF THE LEAF OF THE DOCK,
Showing the cells and stomata, as also the junction of the cellular part of the leaf with one of the smaller veins. Magnified 220 diameters.



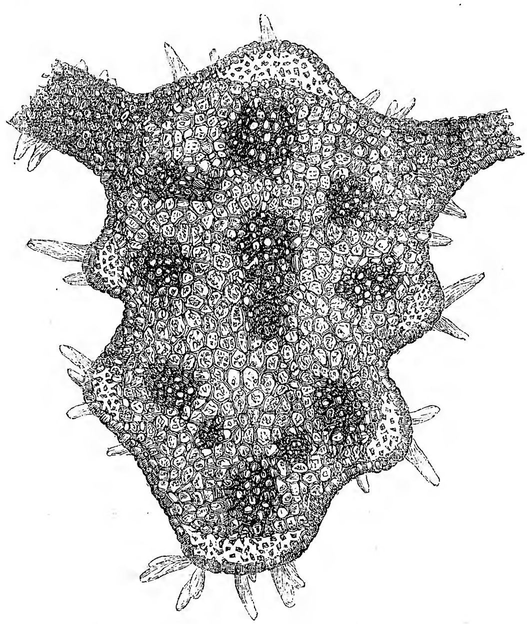
The structure of the mid-rib and veins is very different from that of tobacco; they differ in shape, in the form and nature of the spines or hairs which arise from them, and in the arrangement of the vessels and woody fibre. Transverse sections of the mid-rib are of a somewhat triangular form, the base of the triangle being smaller than the sides; one of these, viewed with an inch object-glass, presents six prominences, indicating the number of ridges by which the mid-rib, in a longitudinal view, is seen to be traversed: of these ridges, one is situated on the upper surface of the mid-rib, (the base of the triangle,) between the origins of the lamina of the leaf; the other five are below, one in the centre large and prominent, forming the lower surface of the mid-rib, (apex of the triangle,) and two on either side.

The hairs, or rather spines, spring from the surface of the mid-ribs and veins, and principally from the ridges; they are thick, short, hollow, striated, of considerable diameter, and terminate in obtuse rounded extremities; it is these spines which impart a feeling of roughness to the finger passed along the mid-rib.

The woody fibre and vessels traverse the mid-rib in bundles; the number of bundles being greatest in sections of the larger mid-ribs; in those of small and medium size there are usually six or eight fasciculi. *Fig.* 151.

Fig. 151.

TRANSVERSE SECTION OF MID-RIB OF LEAF OF DOCK.
(Magnified 40 diameters.)



The cells forming the ridges are very characteristic, being small and angular; those composing the internal part of the mid-rib, and which are traversed by the vascular and woody tissue, are larger and more reticular.

The above structural peculiarities are clearly shown in *figs.* 152. and 153.

Descriptions and figures illustrating the structure of the other leaves and principal vegetable substances which have been detected in adulterated tobacco, will be given hereafter.

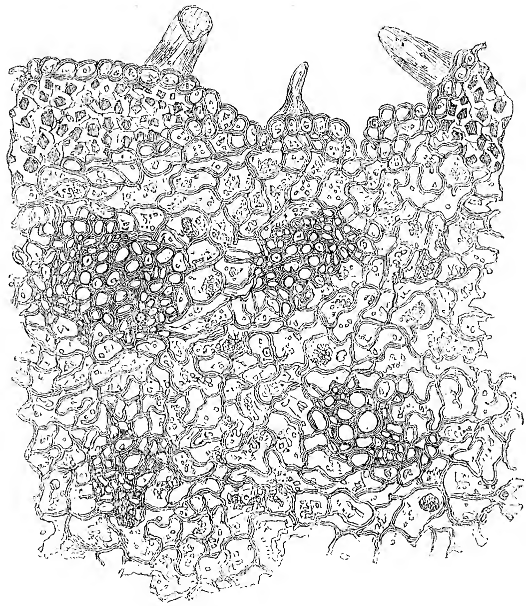
The microscopic examination of the tobacco being completed, 100 grains should be thoroughly dried, and then gently shaken; should it contain any sand or earthy substance, this, which adhered to the tobacco while moist, will now readily fall from it. Having determined these points, the examination must be continued as follows:—

One hundred grains of the tobacco dried previously are to be carefully incinerated, and the ash weighed; the soluble salts are to be separated from those that are insoluble by means of distilled water, and the weight of these determined. If the total ash be at all in excess over that which is common to genuine tobacco, adulteration may be suspected; and the nature of the analysis to be next pursued will depend upon whether the excess be in the insoluble or soluble portion of the ash: if in the former we must look for excess of lime, and perhaps also of alumina; if in the latter, we must search either for nitrate of potash, which by incineration becomes converted into carbonate of potash, or for chloride of sodium.

Fig. 152.

PORTION OF TRANSVERSE SECTION OF MID-RIB OF LEAF OF DOCK.

(Magnified 90 diameters.)



There is one soluble salt with which tobacco might be adulterated that would escape detection by the above process, that is hydrochlorate of ammonia, or sal ammoniac. The presence of this salt may be determined by sublimation, or by estimating the *quantity* of ammonical gas evolved on boiling with liquor potassæ.

From another weighed portion of tobacco, an extract must be obtained in the following manner: — On 200 grains of the dried tobacco, about four ounces of distilled water should be poured; this should be raised to a temperature of nearly 170° Fahr., and kept up to that point for about forty minutes. The infusion is then allowed to become cold, and is set aside to macerate for twelve hours. Lastly, it must be strained, evaporated at a temperature of about 100°, the extract dried until it ceases to lose weight, and then weighed.

The extract may be divided into two equal parts: of one, a quantitative analysis, by Fehling's process, is to be made for glucose or grape sugar, which is the sweet principle of treacle, beetroot dregs, liquorice, and honey; the other portion is to be incinerated, the weight of the ash determined, and, if in excess, analysed.

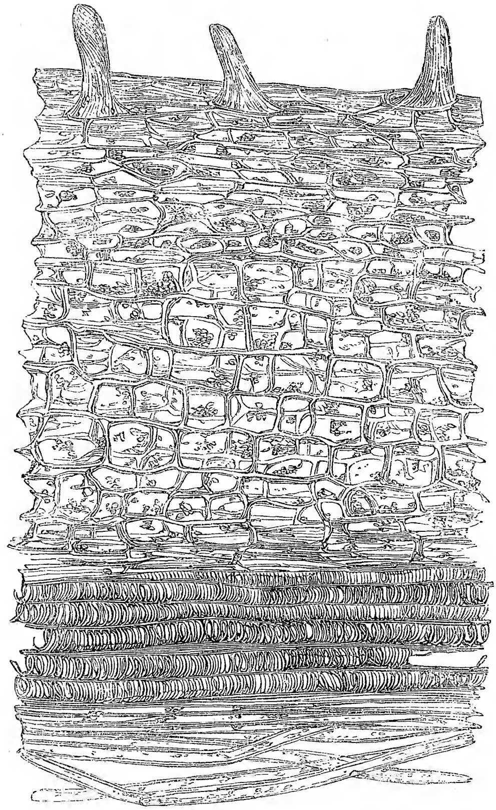
If it be suspected that cane-sugar is present, instead of adopting Fehling's process we must employ the fermentation test, and estimate either the quantity of carbonic acid gas evolved, or the amount of alcohol generated. Excepting that the results obtained by the copper test are more accurate than the fermentation test, it would save time to employ the latter in all cases for the determination of the presence of saccharine matter, whether in the form of glucose or cane-sugar.

The test liquor used may be prepared as follows:—Dissolve 69 grains of pure crystallised sulphate of copper in 276 grains of distilled water; to this add 276 grains of a saturated solution of tartrate of potash, then add 80 grains of hydrate of soda, previously dissolved in one ounce of distilled water, shake all well together, and introduce the liquor into a vessel capable of holding 2000

Fig. 153.

LONGITUDINAL SECTION OF MID-RIB OF LEAF OF DOCK.

(Magnified 90 diameters.)



grains, graduated into 1000 equal parts, and fill up with distilled water. Every 200 grains, or 100 parts, of this test liquor are sufficient to decompose one grain of glucose. It is better, however, to add excess of the solution, and to weigh the red oxide thrown down.

The fermentation test is used in the following manner:—1000 grains of tobacco are to be placed in a vessel, and a pint or so of water, at a temperature of about 100° Fahr., poured upon it; the infusion is then to be strained, and 250 grains of dried yeast added; the mixture is next to be set aside for forty-eight hours to ferment, at a temperature of about 60°; lastly, the liquor must be introduced into a retort, the alcohol distilled over, and its amount estimated, or the carbonic acid may be collected, and the amount of sugar calculated therefrom.

It will be evident from the above particulars, that a complete analysis of tobacco, with the view to determine whether it be adulterated or not, is a task of no ordinary difficulty; so difficult indeed is it that some chemists have entertained the opinion that it is possible to adulterate tobacco in such a manner as to defy detection by any means; and this is no doubt the case.

We learn from the Report by the Select Committee of the House of Commons on the tobacco trade, more than once referred to, that so convinced were the manufacturers of London of the inability of the Excise officers to detect adulterations in tobacco, that they "proposed to the secretary to the Excise Board to send specimens of pure and of adulterated tobacco, that the Excise officers might convince the manufacturers of the power they had of detecting adulteration. That proposal appears to have been fair and well meant, but the offer was declined by the Board of Excise. The manufacturers then resolved to give the samples to a chemist in Oxford-street, and to request him to analyse them, and to report on their purity. Mr. Rogers, tobacconist, stated to the Committee the course taken; and Mr. Garden, chemist, to whom such samples of adulterated tobacco were submitted, has stated to the Committee that he found it very difficult to analyse them; and further, that he considered it a doubtful test on which to convict any man, and that at the best it is extremely uncertain and very difficult to detect, unless a very large per-centage of adulteration has been used."

"Under the authority of that evidence, your Committee resolved to prepare twelve samples of tobacco, to be mixed with different matters in the course of the manufacture, and then submitted to the Board of Excise, to be examined by them, and to be reported upon."

"*Particulars of Six Samples of Tobacco prepared by* Mr. W. E. Heathfield, *Chemist, in the presence of* Sir Chas. Douglas, M. P., *and* Mr. Ewart, M. P., *Members of the Committee, on the* 13*th of May*, 1844.	"*Report of the Analysis of the first Series of Six Samples by* Richard Phillips, Thomas Graham, *and* Geo. Phillips, 7*th June*, 1844.
No. 1., marked X.	No. 1., marked X.
9 lbs. 8 oz. of tobacco, with 1 lb. 8 oz. of garden rhubarb leaves. About 16 per cent., or $12\frac{1}{2}$ per cent. in 100 parts.	Adulterated with the leaves of garden rhubarb; the amount of the adulteration is estimated at 3·3 per cent.
No. 2., marked K.	No. 2., marked K.
9 lbs. 6 oz. of tobacco, with 1 lb. of foxglove leaves. About 10 per cent. added, or $9\frac{52}{100}$ in 100 parts.	Adulterated by a green leaf, not tobacco, but which appears to belong to a plant of the same natural family, possibly the potato; the amount of the adulteration is estimated at 3·9 per cent.
No. 3., marked N.	No. 3., marked N.
11 lbs. 11 oz. of tobacco, with 8 oz. of brown paper, soaked in decoction of sarsaparilla; $10\frac{1}{2}$ oz. of syrup of sugar, containing solid sugar, 7 or 8 dwts., 1 oz. of saltpetre, and $\frac{1}{2}$ oz. of alum; in all, $18\frac{1}{2}$ oz. About 8 per cent. added, or $7\frac{54}{100}$ in 100 parts.	Adulterated with brown paper or mill-board, and also with sugar; the amount of the first adulteration is estimated at 6 per cent.; of the second, 1·5 or 2 per cent.
No. 4., marked F.	No. 4., marked F.
11 lbs. 14 oz. of tobacco, mixed with chicory root, dried and powdered; Irish moss glutenised, carbonate of potash, sulphate of potash, carbonate of magnesia, and carbonate of lime; about 9 oz., or About $5\frac{1}{4}$ per cent., or 4 in 100 parts.	Adulterated with a vegetable matter, not tobacco, the nature of which we are not agreed upon; the amount of this adulteration is estimated at 1·2 per cent.; there is reason to suspect the addition to this tobacco of both sand and sugar, in small quantity.
No. 5., marked O.	No. 5., marked O.
13 lbs. 9 oz. of tobacco, mixed with 12 oz. of ground tobacco stalks.	Adulterated with sand and sugar; the amount of the first adulteration is estimated at 2 per cent.; of the second, at 3 per cent.

No. 6., marked R.

11 lbs. 4 oz.

No adulteration.

No. 6., marked R.

Genuine, but with a proportion of sand unusually high.

" *Particulars of Six Samples of Tobacco, mixed and sealed up at* Messrs. Rogers, 392. *Oxford-street, in the presence of* Sir Charles Douglas *and* Mr. Ewart, *as above, 24th May, by* Edward Solly, jun., Esq.

No. 1., marked C.

Adulterated with sugar of milk	5
Terra Japonica	1
Nitrate of potash	1
Alum	1
Total per cent.	8

No. 2., marked L.

Adulterated with refined sugar	3
Terra Japonica	1
Carbonate of potash	1
Common salt	1
Total per cent.	6

No. 3., marked Q.

Adulterated with refined sugar	2
Crude nitrate of ammonia	4
Common salt	1
Muriate of potash	0·5
Nitrate of potash	0·5
Alum	1
	9

No. 4., marked P.

Adulterated with sugar of milk	5
Refined sugar	3
Common salt	1
Carbonate of potash	1
	10

No. 5., marked B.

Not adulterated at all.

No. 6., marked M.

Not adulterated at all.

" *Second Series of Six Samples, signed* Rogers & Son, *marked as under; analysed by* Richard *and* George Phillips, *and* Thomas Graham.

No. 1., marked C.

Adulterated with sugar; the adulteration estimated at 1 per cent.

No. 2., marked L.

Adulterated with sugar; the adulteration estimated at 3 per cent.

No. 3., marked Q.

Adulterated with sugar; estimated at 2 per cent.

No. 4., marked P.

Adulterated with sugar; the adulteration is estimated at 4 per cent.

No. 5., marked B.

Genuine; grains of cane-sugar were, however, found in it, and picked out, but the quantity so small that we allow their introduction to be accidental.

No. 6., marked M.

Adulterated with loaf bread, which has been cut up in the same manner as the tobacco; the amount of this adulteration was not estimated, but it is small; the sample contains also a little sugar.

The Committee, not feeling satisfied with the results of these analyses, submitted seven of the twelve samples sent to the Excise to Dr. Andrew Ure, for his examination and analysis, and they state that after having been employed nearly twenty days, the evidence by Dr. Ure is also not satisfactory.

Mr. Graham and the Messrs. Phillips would appear not to have subjected the samples sent to them to a sufficiently close or rigorous examination. The foreign leaves introduced into the samples were simply picked out by the hand, and the only substance searched for chemically was sugar; and here even these gentlemen do not seem to have been aware that genuine tobacco frequently contains a small quantity of sugar and other matters convertible by fermentation into alcohol.

Every one of the following substances introduced into the samples sent for analysis was overlooked: — Sulphate of alumina, or alum; carbonate, sulphate, nitrate, and muriate of potash; carbonate of magnesia; carbonate of lime; common salt; nitrate of ammonia; and terra japonica or catechu.

One cause of the above very imperfect results was, that these chemists did not make any complete analysis of genuine tobacco before instituting their examination, in order to ascertain the proportions of extractive and saccharine matter, and the various salts which genuine tobacco contains. Mr. George Phillips, who by his evidence showed that he was most conversant with the method that should be pursued in order to determine whether a sample of tobacco be adulterated or not, did certainly so far analyse genuine tobacco as to ascertain the relative proportions of extractive and woody fibre obtainable from different varieties of tobacco. In these experiments the extractive was procured in the following manner: —

One hundred grains of tobacco, previously dried, were placed in two pints and a half of distilled water; the temperature of this was raised to 176° Fahr., and maintained at that heat for fifty minutes; at the end of that time the infusion was strained, and the insoluble portion retained by the strainer or filtering paper, redried until it ceased to lose weight; it was then weighed. The loss sustained showed the quantity of soluble matter or extractive. The results obtained by Mr. Phillips were as follow: —

Per-centage of Extractive and Ligneous Matter in different kinds of Tobacco.

	Extractive.	Ligneous Matter.
Virginia, Hand - - -	54·	46·
,, ,, - - -	54·	46·
,, Stripped - - -	51·	49·
,, ,, - - -	53·	47·
Kentucky, Hand - - -	50·	50·
,, ,, - - -	44·2	55·8
,, Stripped - -	45·2	54·8
,, ,, - - -	46·7	53·3
Maryland, Leaf - - -	43·1	56·9
,, ,, - - -	42·3	57·7
Turkey - - - -	53·2	46·8
Porto Rico - - -	30·	70·
Columbian - - -	38·5	61·5
,, - - -	39 2	60·8
Virginia, Stalks - - -	51·5	48·5
Kentucky, ,, - - -	35·9	64·1
,, ,, - - -	33·6	66·4

Mr. George Phillips states, that he has experimented with between five and six hundred samples of tobacco, and that he never found any to give a higher amount of extractive than fifty-five per cent.; also that he found it made no difference whether he experimented with the leaf, or with the cut and manufactured tobacco.

The only other analyses of tobacco which have been made, and which are at all calculated to be of service in determining the question of the adulteration of tobacco, are the following, by Messrs. Brande and Cooper, made in 1845.*

* Brande's Manuel of Chemistry, p. 1623, 1848.

Tobaccos, dried at 212°.	Per Cent. of Extract, &c., soluble in Water.	Per Cent. of Woody Fibre, &c., insoluble in Water.	Per Cent. of Ash after treating with Carbonate of Ammonia.	Per Cent. of Matter soluble in Water in the Ash.	Per Cent. of Matter soluble in Hydrochloric Acid in the Ash.	Per Cent. of Insoluble Matter, as Silica, &c., in the Ash.	Per Cent. of Alcohol obtained from fermented Infusion.	Per Cent. of Saccharine Matter deduced from the obtained Alcohol.
1. Light Missouri, leaf and stalk	49·	54·9	20·97 white	2·17	11·73	5·9		
2. Light Missouri, leaf only	50·	47·7	19·7 white	1·77	12·83	5·1	0·75	1·50
3. Dark Missouri, leaf and stalk	50·	52·4	16·47 white	4·2	10·14	2·13		
4. Dark Missouri, leaf only	51·	50·6	13·8 white	2·17	8·73	2·9	0·35	0·71
5. Light Virginia, leaf and stalk	51·5	53·1	16·4 gray-white	2·53	8·54	5·33		
6. Light Virginia, leaf only	54·	46·1	11·97 green-gray	2·0	6·86	3·11	1·045	2·09
7. Dark Virginia, leaf and stalk	48·5	51·8	14·7 gray	4·8	8·40	1·5		
8. Dark Virginia, leaf only	52·	49·8	12·53 gray	2·63	8·20	1·7	1·46	2·93

1. The samples were dried, and the extract and woody fibre were also dried at 212°. The watery infusions of all contained ammoniacal salts. The salts from the ash, which were soluble in water, consisted of sulphates, carbonates, phosphates, and chlorides, the bases being potassa and lime. The solution by hydrochloric acid contained lime, alumina, phosphate of lime, and oxide of iron.
3. Contained oxide of manganese in small quantity. Sulphates in watery solution of ash abundant. Hydrochloric solution contained an abundance of lime.
4. A trace of manganese; a trace only of phosphoric acid in watery solution.
5. Contained abundance of oxide of manganese.
6. Abundance of oxide of manganese.
7. A mere trace of oxide of manganese, and a trace of oxide of iron; only a trace of alumina.
8. A trace of oxide of manganese; quantity of oxide of iron very great; only a trace of alumina.

Without a full and an accurate knowledge of the structure and chemical composition of the several varieties of tobacco in its different states, unmanufactured and manufactured, it is impossible to attempt, with anything like a chance of success, to enter upon the detection of adulteration in tobacco. It is on this account that we have described so fully the organisation of the tobacco-leaf, and have given the various analyses of tobacco which have as yet been made.

The analyses of tobacco hitherto published are all of them, however, more or less defective, and we have therefore instituted some original analyses of the more important kinds of tobacco. These will be found to be of much value in the determination of the question of the adulteration of tobacco.

One hundred grains of each of the tobaccos were treated as follows:—They were dried for twenty-four hours in a water-bath, and then re-weighed; the loss showed the amount of hygrometric moisture which the samples contained.

They were then macerated for twenty-four hours in cold, distilled water, by which means the extractive was obtained. They were next boiled for an hour, by which they lost starch. The residue was ligneous matter, which yielded from three to ten per cent. of ash, composed chiefly of silica, with earthy carbonates and phosphates. The Table marked A represents the results obtained by the above processes.

One hundred grains of each tobacco were next submitted (according to the process of M. Schloesing) to the action of ammoniated ether. The ether was distilled off, and the residue neutralised with dilute sulphuric acid of known saturating power; by this means the proportions of nicotine, chlorophyle, and fat were determined. The Table marked B represents the results obtained by this process.

TABLE A,

Showing the general Composition of Six Samples of Leaf-Tobacco, as imported.

	Havannah.	Virginia.	Maryland.	Kentucky.	Turkey.	German.
Hygrometric moisture	12·0	11·4	13·4	13 2	12·4	10·8
Extractive soluble in cold water	43·2	40·8	60·0	48·4	58·6	49·0
Extractive soluble in boiling water	4·0	2·6	4·4	2·4	2·0	3 0
Ligneous matter and insoluble salts	40·8	45·2	22·2	36·0	27·0	37·2
	100·0	100·0	100·0	100·0	100·0	100·0

TABLE B,

Showing the general Composition of the Extractive taken up by Ammoniacal Ether.

	Havannah.	Virginia.	Maryland.	Kentucky.	Turkey.	German.
Hygrometric moisture	12·0	11·4	13·4	13·2	12·4	10·8
Chlorophyle and fat	5·7	2·2	2·7	1·1	2 0	3·6
Nicotine	1·5	3·2	2·1	2·7	1·2	2·0
Total (per cent.) soluble in ether	19·2	16·8	18·2	17·0	15·6	16·4

The extractive obtained by the first operation was treated as follows : —

It was dissolved in distilled water, and the solution treated with basic acetate of lead and filtered. The filtered liquid and the precipitate were both decomposed by sulphuretted hydrogen, and evaporated to dryness : one was treated with a modification of Trommer's or the copper-test for sugar ; and the other with dilute alcohol for malic acid and gum. The table marked C represents the results obtained by the above process.

TABLE C,

Showing the Composition of the Cold and Hot Aqueous Extractive.

	Havannah.	Virginia.	Maryland.	Kentucky.	Turkey.	German.
Sugar	0·1	0·03	0·4	traces	3·6	none
Gum	7·6	8·82	10·1	7·6	7·4	7·8
Acids, chiefly malic, with little colouring matter	4·4	6·58	11·9	3·4	3·4	2·2
Starch	4·0	2·60	4·4	2·4	2 0	3·0
Colouring matter, &c.	31·1	25·37	37·6	37·4	44·2	39·0
	47·2	43·40	64·4	50·8	60·6	52·0

Lastly, 100 grains of each tobacco were incinerated, and a per-centage analysis of the ash carefully performed. Table D represents the results obtained.

TABLE D,

Showing the Composition of the Ash in 100 parts.

	Havannah.	Virginia.	Maryland.	Kentucky.	Turkey.	German.
Carbonate of potash	0·5	2·0	4·9	4·25	3·0	4·1
Chloride of potassium, and a little soda	3·0	0·6	0·4	0·25	0·1	0·6
Sulphate of potash	2·7	2·0	1·1	1·50	0 9	1·3
Carbonate of lime	7·4	5·2	5·8	4·40	3·0	7·0
Carbonate of magnesia	2·9	2·5	2·6	1·60	1·0	3·3
Phosphate of lime	1·6	1·9	2·1	2·40	1·8	2·9
Phosphate of iron and alumina	traces	traces	traces	traces	traces	traces
Silica, chiefly sand	0 5	7·4	2·3	0 60	0·8	3·4
Per cent. amount of ash	18·6	21·6	19·2	15·00	10·6	22·6

It is evident, from the preceding analyses, that the composition of tobacco is subject to very great variations. Reviewing these analyses, we find the variations to extend — first to all the organic products and compounds, as the gum, sugar, starch, chlorophyle, fat, the organic acids, nicotine, and colouring matter; and secondly, to all the inorganic substances and salts, including a variety of soluble and insoluble carbonates, sulphates, chlorides, and phosphates.

We are now in a position to form some idea of the extreme difficulty in determining, in many cases, the question of the adulteration of tobacco. It is also now evident that it is quite possible to adulterate tobacco to a large extent in a particular manner, and with certain substances, without the possibility of detection by any means at present known to science.

It will be observed that the ash furnished by the tobacco-leaf is very great, amounting frequently to considerably over twenty per cent. This character has led to the supposition that it is possible to detect the adulteration of tobacco with leaves other than those of the tobacco plant, by means of the quantity of ash furnished on incineration. It is obvious, however, that no certain reliance can be placed upon this test, since the tobacco-ash itself varies very greatly in weight, as is shown even by the above analyses, in which there is a variation of 10·06 to 22·6 per cent.

The following elaborate table has even been constructed, in the hope that it would furnish some useful data in determining adulteration of tobacco: —

" TABLE *showing the Composition of the Ashes of various Plants likely to be employed in Adulterating Tobacco.*

NAME OF PLANT.	Ash per cent.	Per cent. Composition of Ash.								
		Alkalies.	Lime.	Magnesia.	Alum.	Oxide of Iron.	Silica.	Sulphuric Acid.	Phosphuric Acid.	Chlorine
Lime leaves	8 to 9	21·7	53·6	6·3	0·6	2·0	3·2	1·1	8·5	2·8
Birch "	5 — 6	38·9	29·3	6·8	0·8	0·9	12·6	0·5	2·6	5·6
Oak "	5 — 6	14·1	63·1	3·9	0·7	0·2	13·1	0·6	3·0	0·3
Ash "	6 — 7	28·3	50·3	6·4	0·2	0·1	2·5	5·7	6·6	3·9
Elm "	11 — 12	14·6	25·1	3·6	—	0·2	47·3	1·5	5·9	1·8
Sycamore "	11 — 12	13·1	38·9	5·2	0·1	0·3	18·8	6·0	3·3	2·5
Beech "	7 — 8	37·2	34·5	4·2	0·7	0·5	13·5	1·3	1·4	6·4
Poplar "	9 — 10	10·2	60·2	5·5	—	0·3	11·5	3·7	6·2	1·7
Alder "	6 — 7	21·5	47·2	7·4	1·1	3·6	9·7	3·2	4·1	1·5
Willow "	8 — 9	27·4	46·9	3·1	0·3	0·2	1·9	12·6	4·0	3·9
Cabbage "	12 — 13	30·8	34·3	3·2	0·1	0·9	7·1	7·1	5·4	4·8
Plaintain "	2 — 3	42·0	23·1	1·3	1·9	0·7	16·5	6·2	3·5	3·6
Beet "	15 — 16	56·3	15·0	5·4	0·8	0·3	2·7	6·3	4·5	6·8
Tobacco "	11 — 27	13·0	26·7	7·8	—	—	6·8	5·4	2·0	1·0"

The only safe and certain means for the determination of the adulteration of tobacco with foreign leaves is by the microscope, by the aid of which any one of the above-enumerated leaves, if present, may be at once readily discovered.

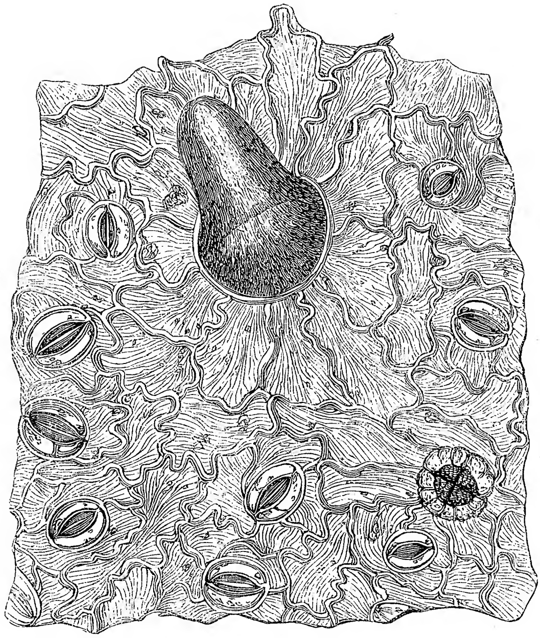
We have already seen how very distinct the structure of the dock leaf is from that of tobacco; we will now show that the organisation of the rhubarb leaf is equally distinctive and characteristic.

In the stomata, and in the form and size of the cells of the rhubarb leaf, slight differences only are observable; but the walls of the cells are finely striated, as shown in the wood-engraving; and this is a character by which rhubarb leaf may be at once known from tobacco. Other differences are found in the characters of the short spines or hairs which clothe the leaf, in the form of the mid-rib and veins, and in the presence of gland-like bodies scattered throughout the lamina of the leaf.

The hairs or spines are short, thick, hollow, striated, and terminate in obtuse, rounded extremities. They resemble closely in form those of the dock, but differ in being several times larger; in the character and fineness of the striæ with which they are marked, and by their distribution; for while in the dock the spines spring only from the mid-rid and veins, in the rhubarb leaf they arise from all parts of the leaf, the lamina as well as the mid-rib and veins.

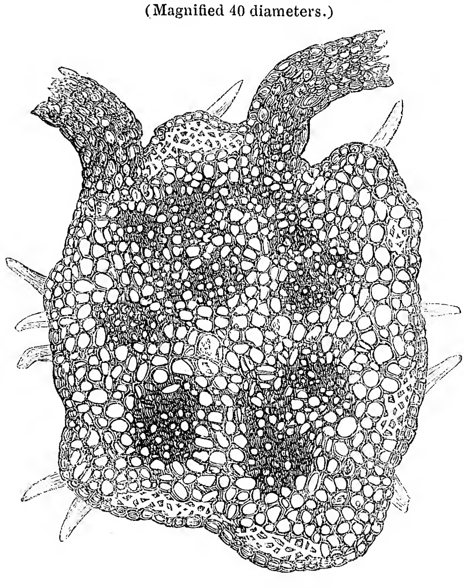
The mid-rib and veins, as in dock, consist on the outside of small, angular cells, succeeded by large, reticular cells, which are traversed by bundles of woody fibre and spiral vessels; the differences between the mid-ribs of the

Fig. 154.
PORTION OF UNDER SURFACE OF RHUBARB LEAF,
Showing the situation of the cells, one of the short spines or hairs, and also one of the gland-like bodies. Magnified 220 diameters.



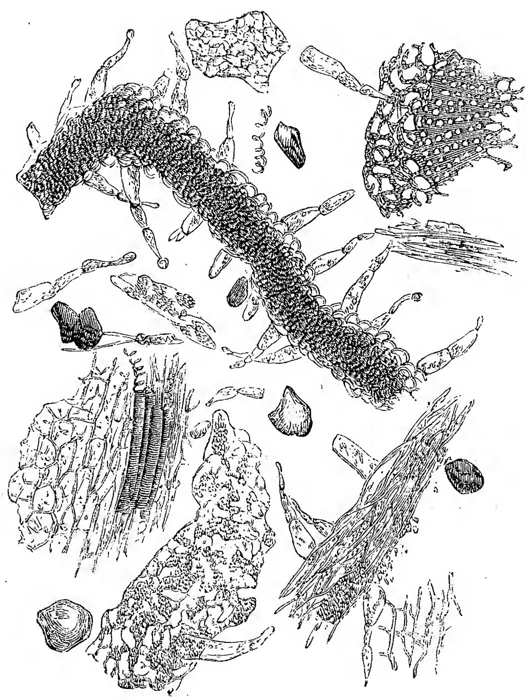
leaves of the two plants being in form, and in the absence of distinct ridges on the mid-rib of the rhubarb leaf. *Fig.* 155.

Fig. 155.
TRANSVERSE SECTION OF MID-RIB OF RHUBARD LEAF.
(Magnified 40 diameters.)



In examining a sample of tobacco, in order to determine whether it contain any other leaf, it is in most cases sufficient to employ an object-glass of one inch focal distance. If the specimen be genuine, the sections or narrow slips of the leaf, including also occasional transverse sections of the veins, will be seen, clothed with the glandular hairs which are so characteristic of the tobacco leaf. *Fig.* 156.

Fig. 156.
GENUINE CUT TOBACCO.
(Magnified 40 diameters.)



For the samples of unmanufactured leaf tobacco, full analyses of which have been given in the preceding pages, we are indebted to the courtesy of Mr. J. Rogers, tobacco manufacturer, 392. Oxford-street.

In previous parts of this Report we described and also showed by numerous illustrations, the peculiarities of structure presented by the leaves of Tobacco, Dock, and Rhubarb. We now proceed to describe the minute organisation of the Coltsfoot or Tussilage leaf, which has been stated to have been sometimes employed in the adulteration of tobacco.

The cells which form the upper surface of the leaf of coltsfoot are of small size, angular, and faintly striated, there are but few stomata, and no hairs, except on the mid-ribs and principal veins. *Fig.* 157.

The structure of the under surface of the leaf differs entirely from that of the upper. The cells are also of small size, but their margins are waved, and the walls are not striated, the stomata are exceedingly numerous, and the whole of this surface is clothed with delicate filamentous hairs, which impart the downy character to the leaf; intermixed with these are other hairs of much larger size, and which, being jointed, bear some resemblance to those of tobacco, but they want the distinct glandular terminations. *Fig.* 158.

Fig. 157.

PORTION OF UPPER SURFACE OF LEAF OF COLTSFOOT.
(Magnified 220 diameters.)

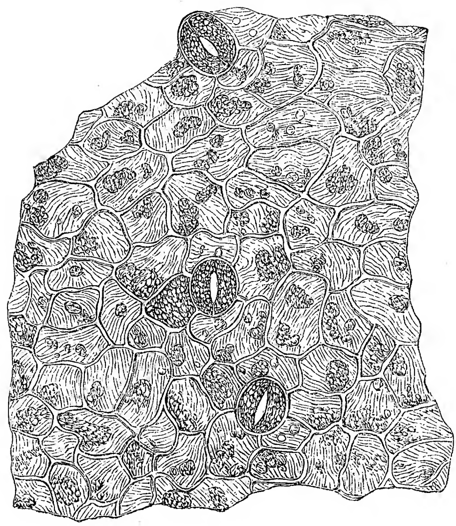
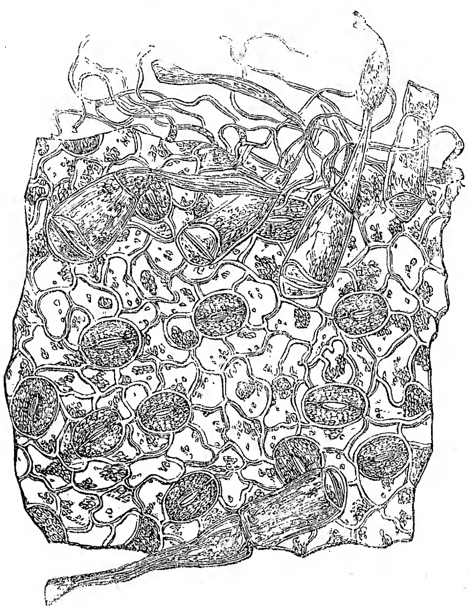


Fig. 158.

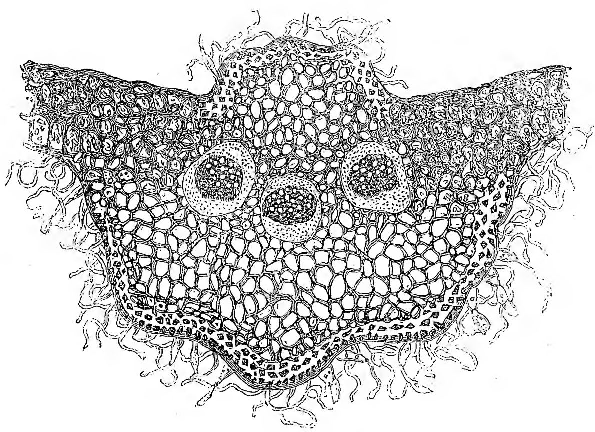
PORTION OF UNDER SURFACE OF LEAF OF COLTSFOOT,
Showing the numerous stomata, as also the two kinds of hairs with which this surface of the leaf is invested.



Transverse sections of the leaf-stalk present the following structure:—Externally, there is a well-defined border of distinctly angular cells; from the outside of these spring the two kinds of hairs described above. The central portion of the section is made up of loose cellular tissue similar to that of the mid-ribs of many other leaves, and it is traversed by from about six to eight bundles of woody and vascular tissue, the number usually varying with the size. The large *leaf-stalks* of the coltsfoot would hardly, however, be used in any case for the adulteration of cut tobacco.

Sections of the *veins* present a nearly similar conformation; the principal difference is in the number of the bundles which traverse them, there being almost invariably but three such bundles. By this character the veins of the leaf of coltsfoot are at once distinguished from those of the other leaves we have described. *Fig.* 159.

Fig. 159.
TRANSVERSE SECTION OF ONE OF THE VEINS OF LEAF OF COLTSFOOT.
(Magnified 40 diameters.)



The following is an outline of the method adopted in the analysis and examination of the different samples of tobacco:—

100 grains were carefully dried at a temperature of 100° Fahr. until they ceased to lose weight, and the amount of moisture determined.

100 grains of each tobacco thus dried were infused in eight ounces of distilled water; the water was poured cold upon the tobacco; the temperature was raised to 170° Fahr., and maintained at that point for forty minutes; the infusion was then allowed to become cold and to stand for twelve hours, when it was strained and evaporated at a temperature of 100°, until it ceased to lose weight; the extract was then weighed and subsequently tested for sugar or glucose.

100 grains of each tobacco, dried as before, were incinerated, the ash weighed, and the insoluble separated from the soluble portion, the amount of each being ascertained.

Lastly, each tobacco was examined with the microscope for leaves other than tobacco, and also for other solid extraneous substances.

The amount of extract obtained from any tobacco varies somewhat even in different portions of the same leaf treated in precisely the same manner, but when different methods of extraction are followed the results differ still more considerably; the quantity of distilled water used, the temperature to which it is raised, and the length of time during which the infusion is kept hot and maceration allowed to continue, will affect the results; when therefore we are desirous of obtaining comparative results, the same method of extraction should in all cases be carefully pursued. In procuring the extracts of the six samples of unmanufactured tobacco, the analyses of which have already been given, a method of extraction different from that described above was followed, and hence a considerable variation in the amount of the extracts obtained.

With regard to the method of proceeding for the detection of grape-sugar or glucose in tobacco, we would remark that we find it necessary to add a considerable excess of Fehling's test liquor, in order to precipitate all the sugar, and hence the quantity of glucose present cannot be accurately determined by the amount of test liquor used. One of the best modes of proceeding for the quantitative determination of glucose is as follows: —

Take a solution of the extract of 100 grains of tobacco and strain it through muslin; precipitate with a slight excess of basic acetate of lead, and filter; pass sulphuretted hydrogen through the filtered liquid, re-filter, and evaporate nearly to dryness; dissolve the residue in about one ounce of liquor potassæ, dilute with one ounce of distilled water, and filter again to remove the salts of lime; then add half an ounce of Fehling's solution; put the mixture into a large test-tube or flask, boil for a few minutes, and observe whether any yellow streaks of reduced oxide of copper make their appearance. Should that be the case, set the solution aside at rest for two hours, and collect the precipitate; weigh and calculate the quantity of glucose to which it is equivalent. One grain of the red oxide of copper is nearly equal to half a grain of grape-sugar or glucose.

The following is a more simple method, and in the case of tobacco affords results which are for the most part sufficiently accurate Take 1000 grains of a solution of tobacco, containing two grains of the dried extract to one ounce of water; add four drachms of liquor potassæ; boil, filter, and then add about 400 grains of Fehling's test liquid, and heat to boiling; if any glucose be present, the red oxide of copper will be thrown down; collect and thoroughly wash the precipitate in order to free it from any albumen that may be present; weigh and calculate as before.

Results of the Microscopical and Chemical Examination of Fifty-six Samples of Unmanufactured and Manufactured Tobacco as procured from Various Manufacturers and Dealers in London.

UNMANUFACTURED OR LEAF TOBACCO.

1*st Sample.*—Virginia *Leaf.*—Hygrometric moisture, 12·36; watery extract, 51·20; soluble ash, 3·80; insoluble ash, 13·16; total ash, 16·96; grape sugar or *glucose*, 0·08 per cent.

Virginia *Leaf-Stalk.*—Moisture, 16·60; watery extract, 39·85; soluble ash, 6·15; insoluble ash, 17·80; total ash, 23·95. Traces only of *glucose.*

2*nd Sample.*—Kentucky *Leaf.*—Hygrometric moisture, 14·70; watery extract, 37·96; soluble ash, 4·92; insoluble ash, 13·20; total ash, 18·12. Traces of *glucose.*

Kentucky *Leaf-Stalk.*—Moisture, 14·28; watery extract, 29·40; soluble ash, 8·00; insoluble ash, 15·56; total ash, 23·56. Evident traces of *glocuse.*

3*rd Sample.*—Missouri *Leaf.*—Hygrometric moisture, 14·00; watery extract, 48·44; soluble ash, 3·60; insoluble ash, 15·36; total ash, 18·96; *glucose*, 0·50 per cent.

Missouri *Leaf-Stalk.*—Hygrometric moisture, 18·16; watery extract, 39·20; soluble ash, 11·44; insoluble ash, 16·80; total ash, 28·24; *glucose*, 4·70 per cent.

4*th Sample.*—Columbia *Leaf.*—Hygrometric moisture, 14·20; watery extract, 27·64; soluble ash, 7·16; insoluble ash, 11·28; total ash, 18·44; traces only of *glucose.*

Columbia *Leaf-Stalk.*—Hygrometric moisture, 12·40; watery extract, 23·20; soluble ash, 5·60; insoluble ash, 14·40; total ash, 20·00; traces only of *glucose.*

5*th Sample.*—Maryland *Leaf.*—Hygrometric moisture, 11·76; watery extract, 23·88; soluble ash, 3·24; insoluble ash, 10·36; total ash, 13·60; traces of *glucose.*

Maryland *Leaf-Stalk.*—Hygrometric moisture, 16·00; watery extract, 21·04; soluble ash, 10·88; insoluble ash, 9·60; total ash, 20·48; no *glucose.*

6*th Sample.*—Havannah *Leaf.*—Hygrometric moisture, 14·30; watery extract, 30·84; soluble ash, 4·52; insoluble ash, 17·20; total ash, 21·72; *glucose*, 0·30; per cent.

Havannah *Leaf-Stalk.*—Hygrometric moisture, 11·60; watery extract, 25·56; soluble ash, 9·12; insoluble ash, 13·96; total ash, 22·08; *glucose*, 0·25 per cent.

7*th Sample.* — German *Leaf.* — Hygrometric moisture, 11·25; watery extract, 28·00; soluble ash, 4·16; insoluble ash, 17·68; total ash, 21·84; no *glucose*.

German *Leaf-Stalk.* — Hygrometric moisture, 16·16; watery extract, 33·33; soluble ash, 7·80; insoluble ash, 14·20; total ash, 22·00; no *glucose*.

8*th Sample.* — Turkey *Leaf.* — Hygrometric moisture, 22·96; watery extract, 44·80; soluble ash, 3·00; insoluble ash, 10·76; total ash, 13·76; amount of *glucose*, 3·60 per cent.

Turkey *Leaf-Stalk.* — Hygrometric moisture, 15·75; watery extract, 34·80; soluble ash, 11·03; insoluble ash, 16·87; total ash, 27·90; *glucose*, 4·91 per cent.

MANUFACTURED TOBACCO — CUT.

Turkey Tobacco.

9*th Sample.* — Purchased of J. Roberts, 126. Whitechapel-road.
Moisture, 11·40; watery extract, 29·40; soluble ash, 4·24; insoluble ash, 14·44; total ash, 18·68; *glucose*, 0·78 per cent. No leaves, other than tobacco, or solid extraneous matter of any kind.

10*th Sample.* — Purchased of H. R. Martin, 107. Bishopsgate-street Within.
Moisture, 12·80; watery extract, 30·80; soluble ash, 4·96; insoluble ash, 14·00; total ash, 18·96; *glucose*, 0·51 per cent. All tobacco leaf.

Orinoko Tobacco.

11*th Sample.* — Purchased of Mr. Pinheiro, 143. Whitechapel-road.
Moisture, 14·30; watery extract, 46·96; soluble ash, 6·40; insoluble ash, 9·20; total ash, 15·60; *glucose*, 3·81 per cent. No solid admixture of any kind.

12*th Sample.* — Purchased of J. Roberts, 126. Whitechapel-road.
Moisture, 15·16; watery extract, 33·60; soluble ash, 7·60; insoluble ash, 12·76; total ash, 20·36; *glucose*, 2·31 per cent. No leaves other than tobacco, or any solid extraneous substance detected.

K'Naster Tobacco.

13*th Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 15·68; watery extract, 37·56; soluble ash, 5·04; insoluble ash, 15·32; total ash, 20·36; *glucose*, 1·36 per cent. All tobacco.

14*th Sample.* — Purchased of Mr. Pinheiro, 143. Whitechapel-road.
Moisture, 65·76; watery extract, 33·16; soluble ash, 4·60; insoluble ash, 11·44; total ash, 16·04; *glocuse*, 0·66 per cent. No solid admixture of any description.

This sample was literally saturated with water.

Returns Tobacco.

15*th Sample.* — Purchased of T. Huxley, 13. Whitechapel-road.
Moisture, 17·20; watery extract, 38·44; soluble ash, 4·08; insoluble ash, 14·00; total ash, 18·08; minute traces only of *glocuse*. No foreign leaves or other solid admixture.

16*th Sample.* — Purchased of J. Glinister, 29. Park-place, Mile-end-road.
Moisture, 18·06; watery extract, 38·64; soluble ash, 4·48; insoluble ash, 13·68; total ash, 18·16; faint traces only of *glucose*. All tobacco.

17*th Sample.* — Purchased of A. Isaacs, 80. Whitechapel-road.
Moisture, 16·32; watery extract, 45·92; soluble ash, 3·84; insoluble ash, 4·16; total ash, 18·00; *glucose*, 0·88 per cent. No leaves other than tobacco, or other solid extraneous substance.

18*th Sample.* — Purchased of J. Roberts, 126. Whitechapel-road.
Moisture, 13·40; watery extract, 30·72; soluble ash, 5·28; insoluble ash, 14·36; total ash, 19·64; minute traces only of *glucose*. No solid admixture of any kind.

19th Sample.—Purchased of T. White, 213. Shoreditch.
Moisture, 15·34; watery extract, 51·48; soluble ash, 3·60; insoluble ash, 14·48; total ash, 18·08; traces of *glucose*. No adulteration detected.

20th Sample.—Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 16·94; watery extract, 34·32; soluble ash, 5·32; insoluble ash, 12·96; total ash, 18·28; evident traces of *glucose*. All tobacco.

Bird's-Eye Tobacco.

21st Sample.—Purchased of J. Glinister, 29. Park-place, Mile-end-road.
Moisture, 18·74; watery extract, 34·08; soluble ash, 4·92; insoluble ash, 14·16; total ash, 19·08; *glucose*, 0·39 per cent. No leaves or stalks other than those of tobacco.

22nd Sample.—Purchased of P. Procter, 197. Bishopsgate-street Without.
Moisture, 20·00; watery extract, 39·16; soluble ash, 8·08; insoluble ash, 11·60; total ash, 19·68; *glucose*, 0·97 per cent. All tobacco leaf.

23rd Sample.—Purchased of T. Huxley, 13. Whitechapel-road.
Moisture, 19·14; watery extract, 34·80; soluble ash, 6·16; insoluble ash, 13·72; total ash, 19·88; slight traces only of *glucose*. No solid extraneous admixture of any kind.

24th Sample.—Purchased of A. Isaacs, 80. Whitechapel-road.
Moisture, 20·60; watery extract, 29·32; soluble ash, 7·12; insoluble ash, 13·56; total ash, 20·68; *glucose*, 0·78 per cent. No foreign leaves or stalks, or other solid extraneous substance.

25th Sample.—Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
Moisture, 18·00; watery extract, 39·72; soluble ash, 6·00; insoluble ash, 13·40; total ash, 19·44; evident traces of *glucose*. No leaves other than tobacco, or any solid extraneous admixture.

26th Sample.—Purchased of Mr. Pinheiro, 143. Whitechapel-road.
Moisture, 19·86; watery extract, 46·52; soluble ash, 7·16; insoluble ash, 10·52; total ash, 17·68; no *glucose*. All tobacco leaf.

27th Sample.—Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 19·48; watery extract, 33·28; soluble ash, 5·72; insoluble extract, 12·64; total ash, 18·36; *glucose*, 0·55 per cent. No solid admixture of any kind detected.

28th Sample.—Purchased of H. Bear, 17. Church-lane, Whitechapel.
Moisture, 27·06; watery extract, 29·72; soluble ash, 5·40; insoluble ash, 13·64; total ash, 19·04; traces only of *glucose*. No solid extraneous substance of any description.

Shag Tobacco.

29th Sample.—Purchased of T. Biggs, 24. Norton Folgate.
Moisture, 21·86; watery extract, 38·64; soluble ash, 7·08; insoluble ash, 13·72; total ash, 20·80; evident traces of *glucose*. No leaves other than tobacco, or solid extraneous substance of any kind.

30th Sample.—Purchased of A. Isaacs, 80. Whitechapel-road.
Moisture, 19·92; watery extract, 33·08; soluble ash, 3·72; insoluble ash, 14·16; total ash, 17·88; *glucose*, 0·88 per cent. All tobacco leaf.

31st Sample.—Purchased of J. Roberts, 126. Whitechapel-road.
Moisture, 22·00; watery extract, 29·88; soluble ash, 4·24; insoluble ash, 13·24; total ash, 17·48; faint traces of *glucose*. No solid extraneous admixture of any kind.

32nd Sample.—Purchased of Glinister, 29. Park-place, Mile-end-road.
Moisture, 22·46; watery extract, 32·80; soluble ash, 3·36; insoluble ash, 14·24; total ash, 17·60; slight traces only of *glucose*. No leaves other than those of tobacco, or other solid extraneous substance.

33rd Sample.—Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
Moisture, 21·46; watery extract, 36·80; soluble ash, 5·28; insoluble ash, 11·88; total ash, 17·16; *glucose*, 1·22 per cent. No extraneous leaves or other admixture.

34th Sample. — Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 20·40; watery extract, 43·84; soluble ash, 4·20; insoluble ash, 12·40; total ash, 16·60; no *glucose*. All tobacco leaf.

35th Sample. — Purchased of H. R. Martin, 107. Bishopsgate-street Within.
Moisture, 21·66; watery extract, 34·56; soluble ash, 3·80; insoluble ash, 14·48; total ash, 18·28; traces only of *glucose*. No solid admixture of any description detected.

36th Sample. — Purchased of T. Huxley, 13. Whitechapel-road.
Moisture, 20·00; watery extract, 33·48; soluble ash, 4·16; insoluble ash, 12·64; total ash, 16·80; minute traces only of *glucose*. No solid extraneous substance of any kind.

37th Sample. — Purchased of R. Lloyd & Sons, 69. Holborn-hill.
Moisture, 20·56; watery extract, 62·20; soluble ash, 4·20; insoluble ash, 12·12; total ash, 16·32; faint traces of *glucose*. No foreign leaves or other solid extraneous mixture.

38th Sample. — Purchased of W. Fryer, 13. Smithfield-bars.
Moisture, 19·40; watery extract, 31·20; soluble ash, 3·84; insoluble ash, 14·56; total ash, 18·40; traces of *glucose*. No leaves other than tobacco.

39th Sample. — Purchased of J. Mullens, 24. Fore-street, Cripplegate.
Moisture, 20·16; watery extract, 40·60; soluble ash, 3·44; insoluble ash, 16·24; total ash, 19·68; traces only of *glucose*. No solid extraneous substance of any kind.

40th Sample. — Purchased of J. Clark, 5. Drury-lane.
Moisture, 20·24; watery extract 29·72; soluble ash, 4·60; insoluble ash, 14·96; total ash, 19·56; no *glucose*. No foreign leaves or other solid admixture of any description.

MANUFACTURED TOBACCO — ROLL, TWIST, AND SPUN.

Cavendish Tobacco.

41st Sample. — Purchased of R. Allen, 131. Shoreditch.
Moisture, 25·40; watery extract, 46·64; soluble ash, 4·88; insoluble ash, 15·20; total ash, 20·08; evident traces of *glucose*. No leaves other than tobacco, or solid extraneous substance.

42nd Sample. — Purchased of J. Roberts, 126. Whitechapel-road.
Moisture, 24·04; watery extract, 39·60; soluble ash, 5·52; insoluble ash, 13·20; total ash, 18·72; evident traces of *glucose*. No solid extraneous admixture of any description.

43rd Sample. — Purchased of T. Huxley, 13. Whitechapel-road.
Moisture, 31·40; watery extract, 41·60; soluble ash, 3·20; insoluble ash, 14·28; total ash, 17·48; evident traces of *glucose*. All tobacco leaf.

44th Sample. — Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
Moisture, 29·22; watery extract, 36·96; soluble ash, 4·00; insoluble ash, 12·96; total ash, 16·96; traces of *glucose*. No solid admixture of any kind.

Twist Tobacco.

45th Sample. — Purchased of Beynon & Stocken, 10. Gracechurch-street.
Moisture, 22·46; watery extract, 41·08; soluble ash, 3·40; insoluble ash, 15·96; total ash, 19·36; *glucose*, 1·02 per cent. All tobacco leaf, no solid extraneous substance of any description.

46th Sample. — Purchased of H. Bear, 17. Church-lane, Whitechapel.
Moisture, 23·32; watery extract, 32·04; soluble ash, 4·64; insoluble ash, 14·68; total ash, 19·32; no *glucose*. No leaves other than tobacco, or other solid admixture.

47th Sample. — Purchased of S. Huxley, 13. Whitechapel-road.
Moisture, 28·74; watery extract, 45·88; soluble ash, 3·48; insoluble ash, 12·80; total ash, 16·28; *glucose*, 0·74 per cent. No solid extraneous substance of any kind.

48th Sample. — Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 21·46; watery extract, 47·88; soluble ash, 3·88; insoluble ash, 11·28; total ash, 15·16; no *glucose*. No solid admixture of any kind.

NEGRO-HEAD TOBACCO.

49*th Sample.* — Purchased of T. White, 213. Shoreditch.
Moisture, 28·66; watery extract, 40·88; soluble ash, 3·24; insoluble ash, 14·76; total ash, 18·08; *glucose,* 0·46 per cent. No leaves other than tobacco, or other solid extraneous substance.

50*th Sample.*—Purchased of H. Bear, 17. Church-lane, Whitechapel.
Moisture, 24·54; watery extract, 34·48; soluble ash, 4·36; insoluble ash, 15·20; total ash, 19·56; *glucose,* 1·16 per cent. No solid admixture of any kind.

51*st Sample.*—Purchased of M. & E. Cannon, 4. Whitechapel-road.
Moisture, 9·80; watery extract, 44·84; soluble ash, 3·68; insoluble ash, 12·40; total ash, 16·08; but slight traces of *glucose.* All tobacco leaf.

52*nd Sample.* — Purchased of T. Biggs, 29. Norton Folgate.
Moisture, 24·26; watery extract, 44·20; soluble ash, 3·72; insoluble ash, 11·72; total ash, 15·44; *glucose,* 1·27 per cent. No solid extraneous substance of any kind.

53*rd Sample.* — Purchased of J. Wright, 4. Barbican.
Moisture, 23·60; watery extract, 43·20; soluble ash, 3·60; insoluble ash, 11·08; total ash, 14·68; traces of *glucose.* No solid admixture of any kind.

54*th Sample.* — Purchased of S. A. Geller, 9. Newgate-street.
Moisture, 24·40; watery extract, 36·64; soluble ash, 6·28; insoluble ash, 14·12; total ash, 20·40; *glucose,* 0·45 per cent. All tobacco leaf.

55*th Sample.* — Purchased of L. Alexander, 65. High Holborn.
Moisture, 24·40; watery extract, 43·76; soluble ash, 3·32; insoluble ash, 11·48; total ash, 14·80; *glucose,* 3·82 per cent. No solid admixture of any description.

56*th Sample.* — Purchased of S. Phillips, 174. High Holborn.
Moisture, 24·60; watery extract, 44·40; soluble ash, 3·80; insoluble ash, 11·40; total ash, 15·20; *glucose,* 2·55 per cent. No leaves other than tobacco, or solid extraneous substance of any kind.

From a full consideration of the whole of the results contained, not only in the following Table of Analyses, but also in the analyses given in a previous portion of this report on Tobacco, we arrive at the following conclusions: —

1st. That the *Tobacco-leaf* itself presents certain peculiarities of structure, by which it may be readily distinguished from the leaves of all other plants said to be employed in the adulteration of tobacco, especially in the form and structure of the hairs, and of the mid-ribs and veins. These peculiarities are so decisive as to enable the observer, by means of the microscope, at once to distinguish tobacco in all the forms of cut and roll tobacco, and even when the leaf is still more minutely divided, as in some kinds of snuffs.

2nd. That the majority of leaves not tobacco which have been detected from time to time in adulterated tobacco also present certain peculiarities in their organisation, by which they may be all distinguished, not only from tobacco, but from each other.

3rd. That while the structure of the tobacco leaf is constant, its composition varies very greatly, particularly as regards the quantity of gum and sugar which it contains, and the amount of ash furnished on incineration: thus we find that in the six samples of unmanufactured *leaf tobacco,* the analyses of which have already been published, the amount of hygrometric moisture varied from 10·8 to 13·4 per cent.; the extract from 40·8 to 60·0 per cent.; the sugar from mere traces to 3·6 per cent.; the gum from 7·4 to 10·1 per cent.; and the ash from 10·6 to 22·6 per cent., it being composed chiefly of chlorides, sulphates, carbonates, and phosphates, combined with much lime. In the eight samples of *leaf-stalk,* the analyses of which are now given, the hygrometric moisture varied from 11·60 to 18·16 per cent.; the extract from 21·04 to 39·85 per cent.; the sugar from traces to 4·91 per cent., and the ash from 20·00 to 28·24, these ashes being remarkable for the large amount of soluble salts which they contained. These differences are evidently so considerable and so varied, as to render it manifest, that by imitating its chemical composition, tobacco may be adulterated to a considerable extent without the possibility of our being able to declare with certainty that it is so adulterated.

Turning now to the analyses of the different kinds of *Manufactured Tobacco*, we notice the following particulars: —

4th. That the amount of moisture in the two *Turkey tobaccos* varied from 11·40 to 12·80 per cent.; the extract from 29·40 to 30·80; the sugar from 0·51 to 0·78; and the ash from 18·68, of which 4·24 was soluble and 14·44 insoluble, to 18·96 per cent., of which 4·96 was soluble and 14·00 insoluble. No adulteration was discoverable with the microscope in either sample.

5th. That in the two samples of *Orinoko tobacco*, the moisture varied from 14·30 to 15·16; the extract from 33·60 to 46·96 per cent.; the ash from 15·60—namely, 6·40 soluble, and 9·20 insoluble—to 20·36, of which 7·60 was soluble and 12·76 insoluble; and the amount of sugar from 2·35 to 3·81 per cent. No adulteration discoverable with the microscope in either sample.

6th. That in the two samples of *K'Naster tobacco* the moisture was respectively 15·68 and 65·76; the extract, 33·16 and 37·56; the ash, 16·04, of which 4·68 was soluble and 11·44 insoluble, and 20·36, of which 5·04 was soluble and 15·32 insoluble; and the *glucose* was 0·66 and 1·36 per cent. No adulteration discoverable with the microscope.

7th. That in the six samples of *Returns tobacco* the amount of moisture varied from 13·40 to 18·06 per cent.; the extract from 30·72 to 51·48 per cent.; the ash from 18·00 to 19·64; and the sugar from faint traces only to 0·88 per cent. No adulteration discoverable with the microscope.

8th. That in the eight samples of *Bird's-Eye tobacco* the moisture varied from 18·00 to 27·06; the extract from 29·32 to 46·52; the ash from 17·68—namely, 7·16 soluble and 10·52 insoluble—to 19·88, of which 6·16 was soluble and 13·72 insoluble; and the *glucose* from faint traces only to 0·97, or nearly one per cent. No adulteration discoverable with the microscope.

9th. That in the twelve samples of *Shag tobacco* the moisture varied from 19·40 to 22·46 per cent.; the extract from 29·72 to 62·20; the ash from 16·32, of which 4·20 was soluble and 12·12 insoluble, to 20·80, of which 7·08 was soluble and 13·72 insoluble; and the *glucose* from faint traces only to 1·22 per cent. No adulteration discoverable with the microscope.

10th. That in the four samples of *Cavendish tobacco* the moisture varied from 24·04 to 29·22; the extract from 36·96 to 46·64; the ash from 16·96, of which 4·00 was soluble and 12·96 insoluble, to 20·08 per cent., of which 4·88 was soluble and 15·20 insoluble; while traces only of glucose were present in any of the samples. No adulteration was discoverable with the microscope.

11th. That in the four samples of *Twist tobacco* the moisture varied from 21·46 to 28·74; the extract from 32·04 to 47·88; the ash from 15·16, of which 3·88 was soluble and 11·28 insoluble, to 19·36, of which 3·40 was soluble and 15·96 insoluble; and the glucose from traces only to 1·02 per cent. No adulteration discoverable with the microscope.

12th. That in the eight samples of *Negrohead tobacco* the moisture varied from 9·80 to 28·66; the extract from 34·48 to 44·84; the ash from 14·68, of which 3·60 was soluble and 11·08 insoluble, to 20·40, of which 6·28 was soluble and 14·12 insoluble; and the amount of glucose varied from slight traces only to 3·82, or nearly four per cent. No adulteration discoverable with the microscope.

Taking, then, the whole of the above results into consideration, we find: —

13th. That in the *Unmanufactured Tobaccos*, including stalk,
The hygrometric moisture varied from 11·25 to 22·96 per cent.
The extract, from 23·20 to 51·20.
The soluble ash, from 3·00 to 11·44.
The insoluble ash, from 9·60 to 17·80.
The total ash, from 13·60 to 27·90.
The sugar, from traces to 4·91.

TABLE SHOWING THE PER-CENTAGE OF MOISTURE, EXTRACT, SOLUBLE, INSOLUBLE, AND TOTAL ASH, AND GLUCOSE, IN FIFTY-SIX SAMPLES OF UNMANUFACTURED AND MANUFACTURED TOBACCO.

No. of Sample.	Name.		Hygrometric Moisture.	Watery Extract.	Soluble Ash.	Insoluble Ash.	Total Ash.	Grape Sugar, or Glucose.	No. of Sample.
	UNMANUFACTURED TOBACCO.								
1	Virginia	leaf	12·36	51·20	3·80	13·16	16·96	0·08	1
	Ditto	leaf-stalk	16·60	39·85	6·15	17·80	23·95	traces	
2	Kentucky	leaf	14·70	37·96	4·92	13·20	18·12	traces	2
	Ditto	leaf-stalk	14·28	29·40	8·00	15·56	23·56	evident traces	
3	Missouri	leaf	14·00	48·44	3·60	15·36	18·96	0·50	3
	Ditto	leaf-stalk	18·16	39·20	11·44	16·80	28·24	0·60	
4	Columbia	leaf	14·20	27·64	7·16	11·28	18·44	traces	4
	Ditto	leaf-stalk	12·40	23·20	5·60	14·40	20·00	traces	
5	Maryland	leaf	11·76	23·88	3·24	10·36	13·60	traces	5
	Ditto	leaf-stalk	16·00	21·04	10·88	9·60	20·48	none	
6	Havannah	leaf	14·30	30·84	4·52	17·20	21·72	0·30	6
	Ditto	leaf-stalk	11·60	25·56	9·12	13·96	22·08	1·25	
7	German	leaf	11·25	28·00	4·16	17·68	21·84	none	7
	Ditto	leaf-stalk	16·16	33·33	7·80	14·20	22·00	none	
8	Turkey	leaf	22·96	44·80	3·00	10·76	13·76	3·60	8
	Ditto	leaf-stalk	15·75	34·80	11·03	16·87	27·90	4·91	
	MANUFACTURED TOBACCO (CUT).								
9	*Turkey*	J. Roberts	11·40	29·40	4·24	14·44	18·68	0·78	9
10	,,	H. R. Martin	12·80	30·80	4·96	14·00	18·96	0·51	10
11	*Orinoko*	Pinheiro	14·30	46·96	6·40	9·20	15·60	3·81	11
12	,,	J. Roberts	15·16	33·60	7·60	12·76	20·36	2·31	12
13	*K'Naster*	M. Cannon	15·68	37·56	5·04	15·32	20·36	1·36	13
14	,,	Pinheiro	65·76	33·16	4·60	11·44	16·04	0·66	14
15	*Returns*	T. Huxley	17·20	38·44	4·08	14·00	18·08	2·35	15
16	,,	J. Glinister	18·06	38·64	4·48	13·68	18·16	faint traces	16
17	,,	A. Isaacs	16·32	45·92	3·84	14·16	18·00	0·88	17
18	,,	J. Roberts	13·40	30·72	5·28	14·36	19·64	faint traces	18
19	,,	T. White	15·34	51·48	3·60	14·48	18·08	traces	19
20	,,	M. Cannon	16·94	34·32	5·32	12·96	18·28	evident traces	20
21	*Bird's-eye*	J. Glinister	18·74	34·08	4·92	14·16	19·08	0·39	21
22	,,	P. Procter	20·00	39·16	8·08	11·60	19·68	0·97	22
23	,,	T. Huxley	19·14	34·80	6·16	13·72	19·88	slight traces	23
24	,,	A. Isaacs	20·60	29·32	7·12	13·56	20·68	0·78	24
25	,,	R. Bready	18·00	39·72	6·04	13·40	19·44	evident traces	25
26	,,	Pinheiro	19·86	46·52	7·16	10·52	17·68	none	26
27	,,	M. Cannon	19·48	33·28	5·72	12·64	18·36	0·55	27
28	,,	H. Bear	27·06	29·72	5·40	13·64	19·04	traces	28
29	*Shag*	T. Biggs	21·86	38·64	7·08	13·72	20·80	evident traces	29
30	,,	A. Isaacs	19·92	33·08	3·72	14·16	17·88	0·88	30
31	,,	J. Roberts	22·00	29·88	4·24	13·24	17·48	faint traces	31
32	,,	J. Glinister	22·46	32·80	3·36	14·24	17·60	faint traces	32
33	,,	R. Bready	21·46	36·80	5·28	11·88	17·16	1·22	33
34	,,	M. Cannon	20·40	43·84	4·20	12·40	16·60	none	34
35	,,	H. R. Martin	21·66	34·56	3·80	14·48	18·28	traces	35
36	,,	T. Huxley	20·00	33·48	4·16	12·64	16·80	faint traces	36
37	,,	R. Lloyd	20·56	62·20	4·20	12·12	16·32	faint traces	37
38	,,	W. Fryer	19·40	31·20	3·84	14·56	18·40	traces	38
39	,,	J. Mullens	20·16	40·60	3·44	16·24	19·68	traces	39
40	,,	J. Clark	20·24	29·72	4·60	14·96	19·56	none	40
	MANUFACTURED TOBACCO (ROLL, TWIST, OR SPUN).								
41	*Cavendish*	R. Allen	25·40	46·64	4·88	15·20	20·08	evident traces	41
42	,,	J. Roberts	24·04	39·60	5·52	13·20	18·72	evident traces	42
43	,,	T. Huxley	31·40	41·60	3·20	14·28	17·48	evident traces	43
44	,,	R. Bready	29·22	36·96	4·00	12·96	16·96	traces	44
45	*Twist*	Beynon and Stocken.	22·46	41·08	3·40	15·96	19·36	1·02	45
46	,,	H. Bear	23·32	32·04	4·64	14·68	19·32	none	46
47	,,	T. Huxley	28·74	45·88	3·48	12·80	16·28	0·74	47
48	,,	M. Cannon	21·46	47·88	3·88	11·28	15·16	none	48
49	*Negrohead*	T. White	28·66	40·88	3·24	14·76	18·00	0·46	49
50	,,	H. Bear	24·54	34·48	4·36	15·20	19·56	1·16	50
51	,,	M. Cannon	9·80	44·84	3·68	12·40	16·08	slight traces	51
52	,,	T. Biggs	24·26	44·20	3·72	11·72	15·44	1·27	52
53	,,	J. Wright	23·60	43·20	3·60	11·08	14·68	traces	53
54	,,	S. A. Geller	24·40	36·64	6·28	14·12	20·40	0·45	54
55	,,	J. Alexander	24·40	43·76	3·32	11·48	14·80	3·82	55
56	,,	S. Phillips	24·60	44·40	3·80	11·40	15·20	2·55	56

14th. That in the *Manufactured Tobaccos*—
The hygrometric moisture varied from 9·80 to 65·76.
The extract, from 29·32 to 62·20.
The soluble ash, from 3·24 to 7·60.
The insoluble ash, from 9·20 to 16·24.
The total ash, from 14·68 to 20·80.
The sugar, from traces to 3·82.

15th. That in the *Bird's-Eye Tobaccos* the soluble ash was very high, in consequence of the large quantity of mid-ribs which these tobaccos contain.

16th. That the extract from the *Negroheads and Twists* was in some cases unusually high, as was also the quantity of glucose; these large extracts were probably, in part, due to the oil employed in the manufacture of these kinds of tobacco, but principally to the use of some saccharine solution.

17th. That not one of the *Forty Samples* of manufactured cut tobacco was adulterated with any foreign leaf, or with any insoluble or organic extraneous substance of any description other than with sugar or some other saccharine matter, which there is good reason to believe was present in several instances. The more common adulterations of tobacco consist in the addition of water, sugar, and salts. The presence of these, in amount sufficient to constitute adulteration, can only be declared with certainty, however, when they are in considerable excess, or by a comparison of the unmanufactured and manufactured leaf.

These results are assuredly very different from those which might have been anticipated, taking into consideration the notions which prevail generally amongst the public with respect to the adulteration of tobacco, and also the high duty to which this article is subject. The absence of any very great or extensive adulteration is to be explained, we apprehend, by the constant supervision exercised over the manufacture of tobacco on the part of the excise.

Although taking a limited number of samples of tobacco, we do not find adulteration to be by any means common, yet we must not conclude from this that tobacco is never adulterated with foreign leaves and other solid and insoluble substances. The excise returns show that it occasionally is so, the officers of excise making from time to time, in the warehouses, &c., of tobacco manufacturers, seizures of dock, rhubarb, coltsfoot, and other leaves, as well as of a variety of other vegetable and mineral substances.

We have before us the particulars of numerous seizures of adulterated tobacco, cigars, and snuff, made by the Excise for the years ended January, 1851 and 1852. To these we shall again have occasion to refer more in detail at the conclusion of the Reports on Cigars and Snuff.

In any future analyses of tobacco which may be made, we would recommend that the sugar be estimated both by the copper and fermentation tests, as by the former test any cane sugar which might be present would not be detected. When treacle is employed, it is almost impossible to ascertain the exact amount used, as this consists not only of glucose, but also of albumen, colouring matter, and other extractive and feculent matters.

The duty on Tobacco is,—

	s.	*d.*	
Unmanufactured - - - - -	3	$1\frac{8}{10}$	per lb.
Manufactured and Cigars - - -	9	$5\frac{4}{10}$	,,
Snuff - - - - - - -	6	$3\frac{6}{10}$	,,

The quantities entered for home consumption were, in

1852	Stemmed - - - - - -	18,787,812 lbs.
	Unstemmed - - - - -	9,571,097 ,,
	Manufactured foreign snuff, and foreign cigars included - - -	199,845 ,,
1853	Stemmed - - - - - -	18,439,637 ,,
	Unstemmed - - - - -	11,081,412 ,,
	Manufactured and foreign snuff, and foreign cigars - - - -	216,512 ,,

First six months of 1854.	Stemmed - - - -	8,369,479 lbs.
	Unstemmed - - - -	6,708,942 ,,
	Manufactured and foreign snuff, and foreign cigars - - -	113,446 ,,

ADULTERATION OF TOBACCO.

At the Wandsworth police-court, a short time since, a Mr. Piddie was summoned by the Excise authorities for keeping and selling tobacco adulterated with saccharine matter, and from the conclusive evidence adduced, was pronounced guilty, and mulcted in the usual penalty for such an offence.

The samples were given to Dr. R. D. Thomson, Lecturer on Chemistry at St. Thomas's Hospital, for analysis, who, to detect the adulteration, employed the fermentation test, distilling off the alcohol from the fermented infusion of the tobacco. It was thus proved, from several experiments conducted on a large scale, that no less than $9\frac{1}{2}$ per cent. of sugar had been added to the tobacco in question.

As confirmatory proof that the tobacco had been adulterated, the Excise officers contrived to procure samples of the same leaf of which the tobacco had been manufactured. This was also submitted to analysis by the fermentation test, and traces only of saccharine matter were detected. So decisive were the results obtained by these comparative analyses of both the manufactured tobacco and the leaf from which it was made, that the magistrates had not much difficulty in arriving at the conclusion that the sample in question was adulterated with sugar. It is in all cases necessary, unless the per-centage of sugar be very great indeed, to obtain a portion of the original leaf for the sake of comparison, and this can rarely be procured unless by the Excise officers, who have the power of entering upon the premises of parties suspected.

Another and more recent seizure of adulterated tobacco has been effected by the excise officers, and information laid before the magistrates. The following are the details:—

The case was been heard at Bow-street police-court, against Ellen Secker and John M'Culloch, carrying on the business of a tobacco manufacturer at Goodman-street, Islington, and who had been summoned at the instance of the Board of Inland Revenue, to answer the charges of being engaged in the adulteration of tobacco, and of having the fraudulent materials in their possession.

It appears that from certain information received, the officers of excise paid a visit to the factory so early as six o'clock in the morning, but could not obtain admission until the men came to work. As soon as entry was gained, the search was commenced, and a large quantity of tobacco was found in the presses in process of manufacture, from which a suspicious looking fluid was dropping; on tasting this, it was found to be sweet; a sample of it was taken, and the search continued. In a large trough, in which the tobacco leaf had evidently been steeped, a considerable quantity more of this liquid or syrup was found, and on going to an out-house used as a kitchen, they discovered a full-sized copper set in brick-work; and on the floor several pans and vessels, all of which contained a good deal more of the syrup, together with some lime. Samples of each of these were taken, as well as of the manufactured leaf, and of the cut tobacco; these were submitted to analysis by the excise chemist, who found the whole of them to contain crystallisable sugar and lime.

During the time search was being made, one of the defendants, M'Culloch, having been sent for by one of the workmen, came into the factory; he was very indignant, and became much excited, demanding to know who had dared to enter his premises. On finding that they were excise officers, he immediately upset the contents of the vessels on to the floor, and ordered one of his men to throw down water to wash the fluid away; but the officers informed him that it was useless, as they had already possessed themselves of samples which were quite sufficient to convict him of the offence. The plea set up by the female defendant was, that although she was proprietess of the business, still, not understanding the manufacture of tobacco, she had left it in the hands of the workmen. M'Culloch pleaded that he could not be liable as he was only an agent. The court thought otherwise, and found both guilty, Secker being fined 300*l.*, and M'Culloch 200*l.* Of course the whole of the utensils and machinery used in the factory were condemned and removed from the premises.

It appears that M'Culloch formerly held a responsible situation in the customs, and being an intelligent man, had at one time been selected to commence a course of study to qualify him as an examiner and chemist to the excise; he thus perhaps imagined that he knew the way by which he could more easily defraud the revenue without risk.

CIGARS, AND THEIR ADULTERATIONS.

The second form in which manufactured tobacco is consumed is that in which the leaves are rolled up into cigars and cheroots. The use of tobacco in this form has been rapidly advancing within the last few years, the cheaper penny cigars taking the place, to a great extent, of cut tobacco, although the consumption of both, from the growing taste of the public for tobacco-smoking, has been for some time, and still is, on the increase.

The process employed for making cigars and cheroots in England is precisely the same as that adopted in other countries. It is as follows:—

The leaves are first slightly moistened with water; they are then "stripped," that is, the midribs are removed in the same manner as described in a former report on the Manufacture of Cut Tobacco, by which means each leaf is separated into two parts; the half-leaves are next smoothed out by the hand, and put under a slight pressure, to remove any creases which may have occurred in the packing. This first process is generally the work of a woman or boy, who, seated near the cigar-maker, hands up the half-leaves as fast as they are required.

The "cigar-maker" is seated in front of a stout wooden bench, made somewhat like a butler's tray, it being furnished with raised edges on three of its sides, but open on that next the workman. He takes one of the half-leaves, and by means of a very sharp knife cuts it into the form of a section of the rind of an orange; upon this a sufficient quantity of fragments and cuttings of leaf are placed, and the "maker" proceeds to roll them up, and fashion them into the well-known form of a cigar or cheroot; over this, again, a long narrow strip of tobacco-leaf, of rather a better quality and appearance, termed the "wrapper," is spirally rolled; this is twisted at the smaller end into a kind of knot, to prevent its becoming loosened. The cigar is next placed against a gauge made of iron, and cut from its thick end to the required length. Great dexterity is requisite in the making of cigars, and the work proceeds with the utmost rapidity, a few seconds only being employed in the manufacture of each. After the cigars are removed from the makers' hands, they are placed on open trays in a room artificially heated, in order to thoroughly dry them; they are then weighed, and packed in boxes of various sizes for sale.

Cigars and cheroots are known in the trade by a variety of different names, taken either from the name of the country from whence they are imported, or the kinds of leaf from which they are made, while in other cases the name of the maker or the caprice of the manufacturer determines the name. Thus we have Havannah, St. Lucia, Cuba, and Dutch Cigars, and Chinsura and Manilla Cheroots; Columbia and Amersfoort Cigars; Cabana, Silva, and Lopez Cigars, and the innumerable fanciful names that have at various times been given them, as Principes, Fragancias, Panetellas, Kings, Queens, Imperials, and a host of other names, the only distinguishing characters being their size, colour, make, and form. The above names all relate to foreign cigars and cheroots.

British cigars and cheroots are most frequently made in imitation of the most famous and saleable varieties of the above, and take their names from them. It should be mentioned, however, that nearly all the cigars sold as Cubas are of British manufacture. Vast numbers also of cheroots peculiar to the English markets are manufactured here; one sort is termed "Bengal," and are sold usually at $1\frac{1}{2}d.$ or $2d.$; the other, "Pickwicks," the price of which is $1d.$ each.

Although it is commonly believed and stated that cigars are very generally adulterated, and that they often consist of anything rather than tobacco, we do not find any precise observations recorded respecting the adulterations alleged to be practised.

The cigars and cheroots were examined in the following manner:—Very thin transverse sections were made from different parts of the whole cigar, so as to include all its contents; these were afterwards examined under the microscope with an object-glass of one inch focus, and the second eye-piece; each cigar was then unrolled carefully, and every leaf or fragment of leaf also subjected to microscopic examination. In this way but little difficulty was experienced in determining whether the cigar consisted of tobacco or not, the structure of the leaf, and especially of the glandular hairs, being so peculiar as to allow of ready identification.

In addition to microscopic examination, the Manilla cheroots, which are commonly reported to contain opium, were subjected to chemical analysis with a view to the discovery of the presence of that drug.

Results of the Microscopical and Chemical Examination of Fifty-eight Samples of Cigars and Cheroots, purchased of different Manufacturers and Dealers resident in the Metropolis.

CIGARS.

Havannah Cigars.

1*st Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.
No adulteration.

2*nd Sample.* — Purchased of J. De Sola & Co., 120. High-street, Whitechapel.
Made up in the centre with sweepings, probably of the warehouse. It contains dust, dirt, fragments of mortar, pieces of apple-paring, and much broken and refuse tobacco-leaf.

3*rd Sample.* — Purchased of T. Huxley, 13. Whitechapel-road.
No adulteration.

4*th Sample.* — Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
No adulteration.

5*th Sample.* — Purchased of W. Frankford, 61. Whitechapel-road.
No adulteration.

6*th Sample.* — Purchased of J. Mullens, 24. Fore-street, Cripplegate.
No adulteration.

7*th Sample.* — Purchased of Messrs. Woodhead & Brunt, 12. Hackney-road-crescent.
No adulteration.

Cuba Cigars.

8*th Sample.* — Purchased of H. Bear, 1. Church-lane, Whitechapel.
No adulteration.

9*th Sample.* — Purchased of J. Glinister, 29. Park-place, Mile-end-road.
No adulteration.

10*th Sample.* — Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
No adulteration.

11*th Sample.* — Purchased of M. Pinheiro, 143. Whitechapel-road.
No adulteration.

12*th Sample.* — Purchased of A. Isaacs, 80. Whitechapel-road.
No adulteration.

13*th Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.
No adulteration.

14*th Sample.* — Purchased of W. Frankford, 61. Whitechapel-road.
No adulteration.

15*th Sample.* — Purchased of Messrs. Beynon & Stocken, 10. Gracechurch-street.
No adulteration.
16*th Sample.* — Purchased of H. R. Martin, 107. Bishopsgate-street Within.
No adulteration.
17*th Sample.* — Purchased of J. Wright, 4. Barbican.
No adulteration.
18*th Sample.* — Purchased of T. Smith, 132. Aldersgate-street.
No adulteration.
19*th Sample.* — Purchased of W. Fryer, 13. Smithfield-bars.
No adulteration.
20*th Sample.* — Purchased of R. Lloyd & Sons, 69. Holborn-hill.
No adulteration.

Principe Cigars.

21*st Sample.* — Purchased of H. Bear, 1. Church-lane, Whitechapel.
No adulteration.
22*nd Sample.* — Purchased of G. F. Chance, 163. Fenchurch-street.
No adulteration.
23*rd Sample.* — Purchased of H. Benjamin, 16. High-street, Aldgate.
No adulteration.

CHEROOTS.

Bengal Cheroots.

24*th Sample.* — Purchased of J. Glinister, 29. Park-place, Mile-end-road.
No adulteration.
25*th Sample.* — Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
No adulteration.
26*th Sample.* — Purchased of A. Isaacs, 80. Whitechapel-road.
No adulteration.
27*th Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.
No adulteration.
28*th Sample.* — Purchased of W. Frankford, 61. Whitechapel-road.
No adulteration.
29*th Sample.* — Purchased of T. Huxley, 13. Whitechapel-road.
No adulteration.

Cheroots.

30*th Sample.* — Purchased of J. Glinister, 29. Park-place, Mile-end-road.
No adulteration.
31*st Sample.* — Purchased of H. Bear, 1. Church-lane, Whitechapel.
No adulteration.
32*nd Sample.* — Purchased of A. Isaacs, 80. Whitechapel-road.
No adulteration.
33*rd Sample.* — Purchased of J. De Sola & Co., 120. High-street, Whitechapel.
No adulteration.
34*th Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.
No adulteration.
35*th Sample.* — Purchased of M. Pinheiro, 143. Whitechapel-road.
No adulteration.
36*th Sample.* — Purchased of W. Frankford, 61. Whitechapel-road.
No adulteration.
37*th Sample.* — Purchased of W. Fryer, 13. Smithfield-bars.
No adulteration.
38*th Sample.* — Purchased of J. Mullens, 24. Fore-street, Cripplegate.
No adulteration.
39*th Sample.* — Purchased of J. Wright, 4. Barbican.
No adulteration.
40*th Sample.* — Purchased of T. Smith, 132. Aldersgate-street.
No adulteration.

41*st Sample.*—Purchased of F. Ryder, 28. Chiswell-street, St. Luke's.
No adulteration.
42*nd Sample.*—Purchased of L. Alexander, 65. High Holborn.
No adulteration.
43*rd Sample.*—Purchased of S. Phillips, 174. High Holborn.
No adulteration.
44*th Sample.*—Purchased of Messrs. Bush & Co., 289. High Holborn.
No adulteration.
45*th Sample.*—Purchased of J. Johnson, 38. Little Queen-street, Holborn.
No adulteration.
46*th Sample.*—Purchased of J. Clark, 5. Drury-lane.
No adulteration.
47*th Sample.*—Purchased of H. Arnett, 10. High Holborn.
No adulteration.

MANILLA CHEROOTS.

48*th Sample.*—Purchased of M. Pinheiro, 143. Whitechapel-road.
Leaf all tobacco.
49*th Sample.*—Purchased of M. & E. Cannon, 4. Whitechapel-road.
The same as the above.
50*th Sample.*—Purchased of T. Huxley, 13. Whitechapel-road.
The same as the above.
51*st Sample.*—Purchased of F. Pontet, 60. Charing-cross.
Same as the above.
52*nd Sample.*—Purchased of H. J. Skinner, 3. St. Martin's-court, Leicester-square.
Same as the above.
53*rd Sample.*—Purchased of Messrs. Wishart & Lloyd, 21. Coventry-street, Haymarket.
Same as the above.
54*th Sample.*—Purchased of M. Loftus, 63. Haymarket.
Same as the above.
55*th Sample.*—Purchased of J. H. Harrison, 15. St. James's-street.
Same as the above.
56*th Sample.*—Purchased of W. Simmonds, 62. Piccadilly.
Same as the above.
57*th Sample.*—Purchased of a Hawker, in Whitechapel-road.
These cheroots were made up of two twisted wrappers or layers of thin *paper* tinted of a bistre colour, while the interior consisted entirely of *hay*, not a particle of tobacco entering into their composition.

It appears that about the neighbourhood of Whitechapel, the sale of spurious cheroots of this kind constitutes a regular business. Men dressed as sailors, and appearing as though they had just returned from a long voyage, are constantly on the look out for young gentlemen who are supposed to have a little money in their pockets, and to be somewhat inexperienced; to such these fellows address the inquiry in a mysterious manner, as though they feared being overheard by the police — "Do you want to buy a box of real Manillas? I have got a few boxes '*on the cross;*' just come with me down this passage, and I will show you them and let you taste them," at the same time handing out a genuine Manilla cheroot, as if taken from the box, for the young gentleman to try, who, being satisfied with the quality and flavour, closes the bargain, and walks off home with a box of brown paper and hay under his arm, congratulating himself on his purchase, and anticipating the pleasure in store for him from smoking his acquisition!

58*th Sample.*—Purchased at a Review in Hyde-park.
Consists externally of tobacco-leaf, but made up internally of *hay.*
These cigars are often hawked about, and sold on race-courses and other gatherings of a like nature.

It thus appears that cigars and cheroots are subject to but little adulteration; the cheap penny ones even consisting, in the majority of cases, entirely of tobacco, though there is no doubt but that it is tobacco of very inferior quality.

This is again quite contrary to what might have been anticipated from the general belief entertained; and it is no doubt due to the constant supervision of the excise officers, as well as to the great difficulty of finding, or using, any article that could be substituted for the tobacco-leaf.

In consequence of the high duty of 9*s*. 6*d*. per pound, cigars, like tobacco, are often smuggled into this country, as is shown by the evidence of several witnesses who were examined before the select Committee of the House of Commons, on the tobacco trade, in August, 1844.

The following extract will serve to show the manner as well as the scale upon which the smuggling of cigars and cheroots was sometimes carried out: —

"Will you state what was the date of your first transaction? — The first transaction with regard to cheroots took place in January, 1842.

"What happened then? — A person called upon me that I had seen many times before, and occasionally had bought cheroots of.

"An Englishman or a foreigner? — A foreigner.

"Do you know his name? — I do not, because he has many assumed names. This man I had occasionally bought cheroots from in small quantities. Manilla cheroots generally come in boxes of 1000 each, weighing seven pounds and a quarter. This man had occasionally called upon me with a box of cheroots under his arm, which I purchased of him.

"You had bought them as contraband? — Of course, because they were sold to me at a low price.

"What price? — Probably twelve shillings a pound; I cannot exactly say.

"What is the usual price? — About sixteen shillings. I had bought them of him five or six times. I had bought 6000 or 7000 of him before this. He called upon me in 1842, and said, 'Give me 200*l*., and I will bring you home six cases of cheroots from the London Docks, in the same packages as they lie there in.'

"What are the weights of these? — Each case of cheroots contains 20,000 (twenty times seven pounds and a quarter).

"What was the value of the cheroots, duty paid? — 690*l*.

"His offer was to bring you six cases for 200*l*., the duty alone being 420*l*.? — Yes.

"You were to lose the cheroots if they were seized? — Yes.

"But not pay the 200*l*.? — Certainly not.

"If they were delivered to you safely, you would get 220*l*. by the transaction? — Yes, and he would get 200*l*.; but I did not agree to this offer. He said, 'If this does not answer your purpose, give me 240*l*., and I will guarantee you the safe delivery of the cheroots; and to ease your mind against any loss, I will deposit in your hands 300*l*. of $3\frac{1}{2}$ per cent. stock, to hold as collateral security.' He had 300*l*. in the funds; for those he had some slips of paper — three slips of 100*l*. each — and those I took to a solicitor, and asked him, 'Is this all right as a collateral security?' and he said, 'Yes, it is.' Those he placed in my hands to secure me from loss. I took them, and it was agreed that I should give him 240*l*. when the goods were all delivered safe into my premises. I gave him the warrants of the Dock Company. In about four or five days afterwards he called upon me in the morning, and said, 'I have those cheroots all right; will you have them brought here in the chests just as they are?' and I said, 'Oh, yes, of course,' and ten minutes after that he drove a cart up to the door with the six chests of cheroots, which had never been broken open from the time they left the dock.

"Which you received? — Yes.

"Did he tell you how he landed them? — He did not at the time. I have asked him many times since, when I had transactions with him, how it was done; he never told me at the time, but gave me sufficient information to enable me to understand how it was done. He shipped those goods for exportation. I believed the first parcel was shipped for Honduras for export, and some boxes similar to the chests which contained the cheroots, which they call dummies, were made up and put on board the ship. The goods were carried from the London Dock to the ship that was lying in the river in a lighter. During the transit from the docks to the ship, the changes were rung, and the dummies were put on board the ship instead of the cheroots.

"And the cheroots were landed in the lighter? — Yes; the way it is done is this: there are two lighters; as soon as the goods go out of dock in the lighter, there is another lighter waiting for them with the dummies, and those boats go alongside, and immediately the officer who is in charge of the cheroots is transferred from one boat to the other, and the dummies go on board ship, and the cheroots to the nearest wharf.

"In every case of this kind must the officer be bribed? — I believe it is necessary that there should be an officer bribed.

"Is the officer bribed who allows the change of the chests for the dummies? — The officer is bribed to go from one lighter to the other; the dummies go alongside and are regularly shipped, and after that no man whatever can take them."

Another very common practice is to sell British-made cigars and cheroots as foreign ones; this deception is carried into effect by making, branding, and labelling boxes in exact imitation of the different foreign boxes in which cigars are imported. This practice prevails extensively with English-made Havannah cigars and Manilla cheroots; although in the case of Manilla cheroots the fraud is easily detected since it is scarcely possible to imitate these cheroots so closely as not to allow of the discrimination between the British and foreign-made article. So generally is this practised, that probably not one-third of the cigars sold in boxes are what they profess to be — namely, foreign-made cigars.

There is a kind of cheroot called *Chinsurah;* this was commonly sold in the shops for some years, although it was known that but two or three cases had been entered at the Custom House, and paid duty, during the whole time. In one year alone, twenty thousand pounds weight of these cheroots found their way into the market, in addition to from eighteen thousand to twenty thousand pounds of Manilla cheroots, without having paid duty.

The cheroots known as *Bengal*, notwithstanding their East Indian name, are all British-made, having originally been prepared in imitation of Chinsurah cheroots. Thus we see, what with smuggling and the passing off inferior English-made cigars as foreign, by the imitation of the form, manufacture, branding, and labelling the boxes, &c., there still remains a wide scope for fraud and adulteration in the articles of cigars and cheroots.

Great difficulty is experienced in the detection of opium in cheroots, and when the examination is limited to a single cigar it is almost impossible to pronounce upon the presence of that drug with absolute certainty. Although from the results of the analyses made there is much reason for believing that several of the cheroots did really contain a proportion of opium, yet the reactions obtained were not sufficiently marked to warrant a definite conclusion. We therefore repeated the analyses of Manilla cheroots for opium, operating on a large scale. The results, together with the method of examination pursued, are given below.

OPIUM IN MANILLA CHEROOTS.

In the preceding Report on Cigars and their Adulterations we referred to the suspected presence of opium in Manilla cheroots, and we stated generally the results of certain analyses. These results were of an indecisive character, but appeared to favour the belief generally entertained, that opium is sometimes contained in this kind of cheroots, so much esteemed by smokers; this result was mainly attributable to the fact that tobacco itself contains a principle, probably nicotine, which gives nearly the same reactions with nitric acid as morphia. It was therefore necessary to make out a property of morphia or narcotine that could not be confounded with anything present in tobacco. This was found in the action of concentrated sulphuric acid and per-oxide of manganese on morphia, a characteristic *violet* tint being produced.

The question whether Manilla cheroots do really contain opium or not being one of considerable importance to tobacco smokers, we resolved to institute other analyses, and to operate on a larger quantity of cheroots. The results of these analyses are given below. The process adopted for the detection of opium was as follows: —

Four cheroots from each sample were cut up and infused for twelve hours in about ten ounces of cold water, which had been slightly acidified by the addition of a few drops of acetic acid. The liquid was then filtered off, and partially precipitated with basic acetate of lead, by which means a considerable proportion of colouring matter was thrown down. The solution was next refiltered, treated with three drachms of animal charcoal, and allowed to digest for twenty-four hours, frequently agitating it; by this means it became further decolorised, and lost its bitter taste. The charcoal was then collected on a filter, and boiled with two portions of rectified spirit, each of about the same bulk as the liquid originally employed. The spirit, which had acquired a slight greenish-yellow tint, was submitted to distillation, so that it should not be wasted, and it left behind an extract of a yellowish colour, having a bitter taste; this was purified by washing on a filter with weak liquor ammoniæ, then with ether, and lastly, with rectified spirit; this was now evaporated, and the residue treated on a white porcelain plate, with a little per-oxide of manganese, and a drop of concentrated sulphuric acid; and if morphia had been present, even in only very small quantity, the residue would have assumed a rich violet tint, similar to that which occurs with strychnia when treated in a similar way.

1*st Sample.*— Purchased of M. & E. Cannon, 4. Whitechapel-road.
Does not contain *opium.*

2*nd Sample.*—Purchased of T. Huxley, 14. Whitechapel-road.
No *opium.*

3*rd Sample.*— Purchased of M. Pinheiro, Whitechapel-road.
No *opium.*

4*th Sample.*— Purchased of T. Bewley, 49. Strand.
No *opium.*

5*th Sample.*—Purchased of H. J. Skinner, 3. St. Martin's-court.
No *opium.*

6*th Sample.* — Purchased of F. Pontet, 60. Charing-cross.
No *opium.*

7*th Sample.*—Purchased of Messrs. Wishart & Lloyd, Coventry-street.
No *opium.*

8*th Sample.* —Purchased of Messrs. Fribourg & Pontet, 121. Pall-mall.
No *opium.*

9*th Sample.*—Purchased of M. Loftus, 63. Haymarket.
No *opium.*

10*th Sample.*— Purchased of Messrs. Fribourg & Treyer, 34. Haymarket.
No *opium.*

11*th Sample.* — Purchased of J. N. Harrison, 15. St. James's-street.
No *opium.*

12*th Sample.* — Purchased of W. Simmonds, 62. Piccadilly.
No *opium.*

It does not appear, therefore, after a most careful analysis of numerous samples, and notwithstanding the generally received opinion, that Manilla cheroots usually contain opium. The difficulties attending an organic analysis of this kind are very great, but the results obtained appear to be of a character to be fully relied upon, since, by the process above given, so little as one quarter of a grain of crude opium may be satisfactorily detected in a single cheroot to which that drug has been purposely added.

SNUFF, AND ITS ADULTERATIONS.

The third and last form in which the tobacco-leaf is employed is in the state of a more or less finely-reduced powder, constituting snuff.

Snuff is made principally from the stalks or "*strippings*" of the leaf which are rejected in the processes of manufacturing cut tobacco and cigars; some snuffs, however, contain a proportion of leaf as well as stalk.

Snuff is met with in commerce in two states—namely, the dry and the moist. Of each of these there are several varieties, the characters which distinguish them depending, in most cases, upon differences in the processes of manufacture, in the relative proportion of the stalk and leaf, in the degree of moisture, in the flavour or pungency, and in the scenting.

The dry snuffs are in general much more finely ground than the moist: the different kinds of Scotch, Irish, and Welsh are comprised under this head.

The moist snuffs, of which there are a great many varieties, are known in the trade under the following names: Brown and Black Rappee, John Bull, Hardham's 37, Princeza, French and Dutch Carrotte, Masulapatam, Prince's Mixture, Grand Cairo, and a great many others, which derive their names either from the fancy of the maker or the fashion of the day.

In the manufacture of the different varieties of snuff, the process adopted depends upon the kind required to be made. Scotch snuff, which is said to be the purest of all, is made almost entirely from the stalks of tobacco; and this being a dry snuff, as little moisture as possible is added—merely sufficient to prevent the finer particles from escaping and being lost in the act of powdering or grinding, which would otherwise occur. The stalks, cut up into small pieces, are introduced into a kind of iron mortar or "*mull*," as it is termed. This is furnished with a pestle, heavily weighted, the handle of which is connected with a set of jointed arms or levers, so adjusted as to give it a peculiar rotary and grinding motion, this being the best calculated to effect the reduction of the stalks to powder. A series of twenty or thirty, or more, of these mortars or "mulls" are arranged and fixed on a strong oak table, with similar machinery attached to the pestles of each, and all of which are capable of being worked at the same time by means of a steam-engine and connecting shafts and wheels. After the snuff has been reduced to the requisite degree of fineness, it is removed from the "mulls," and dried and flavoured according to a process peculiar to the different manufacturers.

Irish and Welsh snuffs are also dry snuffs; but before the stalks are reduced to powder, they are subjected to a roasting process in closed cylinders, which assists in imparting the peculiar smell by which these snuffs are characterised. These two varieties of dry snuff are ground in mills of a similar description to those employed in the powdering of Scotch snuff: lime-water, and even powdered lime, frequently enter into the composition both of Welsh and Irish snuff. Indeed the addition of the former is allowed by the Excise laws. The most celebrated of the Irish snuffs is that manufactured by the firm of Lundy Foot and Co., of Dublin, and from which it takes its name.

On account of the high duty, over 6*s*. per pound, to which foreign manufactured snuff is subject, but a very small quantity is ever imported and passed through the Custom House, as it can be made in England quite equal in quality to the foreign, and for less than half the duty charged upon the latter. Indeed, preference is in general given to English-made snuffs.

The different varieties of the rappees or moist snuffs are likewise made chiefly from stalks, but a small proportion of the leaf is also introduced, as well as the finer parts and siftings of cut tobacco called "*smalls*," which are too fine to be conveniently smoked in a pipe.

The process followed in the manufacture of moist snuffs differs somewhat from that just described. The stalks cut into fragments, pieces of leaf, and smalls, are well moistened, and ground in a mill of the following construction:—A pair of very heavy cylindrical stones (in form like the common grindstone), six or eight feet in diameter, and a foot or eighteen inches thick, are set up on edge, parallel to each other, and a few inches apart, on a wooden slab or bed slightly hollowed out. These stones have a twofold motion given to them—a rotary one on their own horizontal axis, and a traversing rotary motion round the surface of the bed, similar to the two wheels of a carriage going round in a small circle; this motion is communicated to them by means of an upright shaft driven by machinery. The ingredients for the snuff are placed upon the bed, and the broad edge of the massive stones passing repeatedly over them, combined with their rotary, grinding motion, soon reduces them to powder. The construction and working of this kind of snuff-mill is the same as that used in making gunpowder, or for crushing the apples in the manufacture of cyder. After the snuff has been reduced to the required degree of fineness, it is heaped up in a trough, and again moistened thoroughly, or "sauced," as it is termed, and allowed to remain a considerable time, by which means a certain degree of fermentation is induced; it is turned with a shovel from time to time, and re-liquored as the moisture evaporates. The flavour of the snuff depends much upon the extent to which the fermentation is allowed to proceed; this fermentive process also adds greatly to its depth of colour. After the snuff is thus far manufactured, the salts, or alkaline salts, allowed by the excise regulations, are added. The salt is said to be chiefly employed to ensure the preservation of the snuff from mouldiness, and to retain its moisture; while the alkaline salts are used to increase its pungency; at the same time they add considerably to the weight of the snuff.

In the scenting of snuffs, the perfumes used — either the essential oil of bergamot, or otto of roses, and in some cases powdered orris-root — are added after the snuffs are manufactured. The process adopted is as follows: — The snuff is spread out upon large skins or sheets of parchment, and the oils sprinkled over it from a bottle with slits cut in the cork; the snuff is frequently turned over; and lastly it is rubbed with the hand through a wire sieve. The only snuffs that are ever scented are brown and black rappee, Grand Cairo, and prince's mixture, amongst the moist snuffs, and Scotch amongst the dry snuffs.

The greater part of the snuff consumed in London is ground in snuff-mills, situated near Mitcham, in Surrey, in consequence of the facility afforded for working the mills by means of the river Wandle, which runs through the town. There are several of these establishments to which the London manufacturers send their snuff after having undergone a certain stage of preparation. Beyond the preparatory drying and grinding, it is said that nothing further is done to the snuff in the snuff-mills; the proprietor not only prepares it before sending it to the mill, but in most cases passes it through some finishing operations after it is brought from the mill. Many of the London manufacturers have, however, small mills in their own establishments for grinding small quantities of snuff, or for passing the various kinds of fancy snuffs through any particular process; but there are very few establishments in London where the main bulk of the snuff is ground.

The method adopted in the examination of the forty-three samples of the different kinds of snuffs was as follows: — A portion of each was spread out upon a slip of glass and thoroughly wetted with water; all the larger particles were then picked out with a needle-point and removed to another slip; these were carefully pulled to pieces and scrutinised with the microscope, the dust or finer portion was also thoroughly examined under this instrument; and this process was repeated two or three times with each sample.

100 grains of each of the snuffs were incinerated, the weight of the ash ascertained, and then analysed quantitatively for chloride of sodium or salt, for alkaline and earthy carbonates, sulphates and phosphates, for iron and alumina, chromate of lead, oxide of lead, bichromate of potash, and for silica.

For the detection of lead, the snuff, after being moistened with a solution of carbonate of soda, is to be incinerated, the ash drenched with a little water, and the residue treated with a few drops of nitric acid, and tested with the usual re-agents. The quantity may be determined from the sulphuret or sulphate of lead formed.

The following is a good method of proceeding, and by it we ascertain whether the metal is in the state of chromate or oxide: —

The soluble portion of the ash having been removed, the remainder should be fused with a mixture of nitre and bisulphate of potash, the residue well washed with water, the solution filtered, evaporated, treated with hydrochloric acid, and, while at a boiling heat, with alcohol. If no green colour be produced, the absence of chromic acid may be inferred; if the colour does appear, the oxide of chromium must be precipitated by ammonia.

The residue left after the first washing is to be treated with a solution of ammoniacal tartrate of ammonia, by which means the sulphate of lead is taken up. This is precipitated with sulphuretted hydrogen, collected, dried, and weighed.

On treating the sulphuret with nitric acid, and evaporating to dryness, an insoluble sulphate of lead is again obtained, and, on fusing this with carbonate of soda, and treating the insoluble residue with acetic acid, acetate of lead is formed, the solution of which gives a yellow precipitate with iodide of potassium, yellow with bichromate of potash, and white with dilute sulphuric acid.

If, on following the above methods of analyses, the green colour is produced on the addition of alcohol, but no lead formed, then we may infer that chromate or bichromate of potash has been employed.

Results of the Microscopical and Chemical Analysis of Forty-three Samples of various kinds of Snuff, as purchased of different Manufacturers, Dealers, and Retailers in the Metropolis.

The differences in the results furnished by the chemical examination of the ash of the several varieties of snuff will be most easily comprehended when contrasted with the following analyses of the ashes of the leaf and stalk of genuine tobacco:—

Table,

Showing the Composition of the Ash of 100 *parts of Tobacco-leaf.*

	Havannah.	Virginia.	Missouri.	Kentucky.	Turkey.	German.
Carbonate of potash - - - -	0·5	2 0	4·9	4.25	3·0	4·1
Chloride of potassium and a little soda -	3·0	0·6	0·4	0·25	0·1	0·6
Sulphate of potash - - - -	2·7	2·0	1·1	1·50	0·9	1·3
Carbonate of lime - - - - -	7·4	5·2	5·8	4·40	3 0	7·0
Carbonate of magnesia - - -	2·9	2·5	2·6	1·60	1·0	3·3
Phosphate of lime - - - - -	1·6	1·9	2·1	2·40	1·8	2·9
Phosphate of iron and alumina - -	traces	traces	traces	traces	traces	traces
Silica, chiefly sand - - - -	0·5	7·4	2·3	0·60	0·8	3·4
Per cent. of ash - - - -	18·6	21·6	19 2	15·00	10·6	22·6

Table,

Showing the Composition of the Ash of Tobacco-stalks in 100 *parts.*

	Havannah.	Virginia.
Carbonate of potash - - - -	5·2	4·9
Chloride of potassium - - - -	0·5	1·5
Sulphate of potash - - - -	0·6	0·8
Earthy carbonates - - - -	7·0	8·4
Alkaline phosphates - - - -	2·6	2·3
Earthy ditto - - - - -	2·1	1·4
Iron and alumina - - - -	traces	traces
Silica - - - - - -	0·8	0·4
Per cent. of ash - - -	18·8	19·7

DRY SNUFFS.

Scotch Snuff.

1*st Sample.* — Purchased of M. & E. Cannon, 4. Whitechapel-road.

Vegetable tissue all tobacco; ash, dull rusty brown, amounting to 26·52 per cent., of which 26·2 grains were submitted to quantitative analysis, and found to be composed of *chloride of sodium*, 6·0; *alkaline carbonates*, 0·3; *earthy carbonates*, 5·0; *alkaline phosphates*, 1·9; *earthy phosphates*, 3·4; *alkaline sulphates*, 1·4; *oxide of iron and alumina*, 3·2; *chrome yellow or chromate of lead*, 1·0; and *silica*, 4·0 grains.

2*nd Sample.* — Purchased of A. Isaacs, 80. Whitechapel-road.

Vegetable tissue consisting entirely of tobacco; ash, blackish-brown, amounting to 30·54 per cent., 29·6 of which was composed of *chloride of sodium*, 11·0; *alkaline carbonates*, 0·3; *earthy carbonates*, 4·6; *alkaline phosphates*, 0·3; *earthy phosphates*, 2·2; *alkaline sulphates*, 2·0; *oxide of iron and alumina*, 3·8; and *silica*, 5·4 grains.

3rd Sample. — Purchased of J. Roberts, 126. Whitechapel-road.
Vegetable tissue all tobacco; ash, dull brown, intermixed with yellow, amounting to 30·40 per cent., 30·8 of which consisted of *chloride of sodium*, 7·0; *alkaline carbonates*, 0·4; *earthy carbonates*, 5·8; *alkaline phosphates*, 1·0; *earthy phosphates*, 1·8; *alkaline sulphates*, 0·8; *oxide of iron and alumina*, 1·2; *chromate of lead*, 4·4; and *silica*, 8·4 grains.

4th Sample. — Purchased of G. F. Chance, 163. Fenchurch-street.
No vegetable tissue other than tobacco; ash, dark yellowish-brown, amounting to 20·18 per cent., 18·6 of which was composed of *chloride of sodium*, 4·2; *alkaline carbonates*, 2·1; *earthy carbonates*, 3·8; *alkaline phosphates*, 0·9; *earthy phosphates*, 2·0; *alkaline sulphates*, 1·2; *oxide of iron and alumina*, 1·4; *chromate of lead*, 1·2; and *silica*, 1·8 grains.

5th Sample.—Purchased of T. Ryder, 28. Chiswell-street, St. Luke's.
Vegetable tissue entirely tobacco; ash, dull reddish-brown, amounting to 28·02 per cent., 26·8 of which was composed of *chloride of sodium*, 6·0; *earthy carbonates*, 5·0; *alkaline phosphates*, 1·6; *earthy phosphates*, 3·4; *alkaline sulphates*, 3·0; *oxide of iron and alumina*, 1·8; *chromate of lead*, 3·2; and *silica*, 2·8 grains.

6th Sample. — Purchased of S. Phillips, 174. High Holborn.
Vegetable tissue all tobacco; ash dark-reddish brown intermixed with yellowish brown, amounting to 35·54 per cent., 32·6 of which consisted of *chloride of sodium*, 2·0; *alkaline carbonates*, 2·9; *earthy carbonates*, 5·4; *alkaline phosphates*, 1·1; *earthy phosphates*, 2·6; *alkaline sulphates*, 5·4; *oxide of iron and alumina*, 2·0; *bichromate of potash*, 6·2; and *silica*, 5·0 grains.

7th Sample. — Purchased of P. Proctor, 197. Bishopsgate-street Without.
Vegetable tissue entirely tobacco; ash, blackish-brown, fused into a mass, amounting to 26·52 per cent., 26·6 of which consisted of *chloride of sodium*, 7·0; *alkaline carbonates*, 2·1; *earthy carbonates*, 5·6; *alkaline phosphates*, 5·5; *earthy phosphates*, 2·0; *alkaline sulphates*, 1·2; *oxide of iron and alumina*, 1·8; and *silica*, 1·4 grains.

Scented Scotch.

8th Sample. — Purchased of M. Pinheiro, 143. Whitechapel-road.
Vegetable tissue entirely tobacco; ash, dull yellowish-brown, amounting to 22·60 per cent., 21·0 of which was composed of *chloride of sodium*, 1·4; *alkaline carbonates*, 0·8; *earthy carbonates*, 5·4; *alkaline phosphates*, 0·4; *earthy phosphates*, 2·7; *alkaline sulphates*, 2·2; *oxide of iron and alumina*, 0·8; *bichromate of potash*, 5·9; and *silica*, 1·4 grains.

9th Sample.—Purchased of M. & E. Cannon, 4. Whitechapel-road.
No vegetable tissue other than tobacco; ash, deep rusty brown, amounting to 26·24 per cent., of which 23·8 was composed of *chloride of sodium*, 5·6; *earthy carbonates*, 2·8; *alkaline phosphates*, 6·6; *earthy phosphates*, 1·8; *alkaline sulphates*, 1·0; *chromate of lead*, 2·8; and *silica*, 3·2 grains.

Welsh Snuffs.

10th Sample.—Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.
Vegetable tissue all tobacco; ash, blackish-gray, partly fused, amounting to 28·66 per cent., of which 22·8 was composed of *chloride of sodium*, 5·6; *alkaline carbonates*, 3·2; *earthy carbonates*, 5·2; *alkaline phosphates*, 1·8; *earthy phosphates*, 3·6; *alkaline sulphates*, 1·0; and *silica* 0·6 grains.

11th Sample. — Purchased of J. Glinister, 29. Park-place, Mile-end-road.
Vegetable tissue all tobacco; ash, blackish-grey, amounting to 20·00 per cent., 18·00 of which was composed of *chloride of sodium*, 0·6; *alkaline carbonates*, 3·4; *earthy carbonates*, 5·4; *alkaline phosphates*, 4·6; *earthy phosphates*, 2·4; *alkaline sulphates*, 0·8; and *silica*, 0·8 grains.

12th Sample. — Purchased of J. Roberts, 126. Whitechapel-road.
Vegetable tissue entirely tobacco; ash, dark grey, amounting to 18·26 per cent., of which 15·8 was composed of *chloride of sodium*, 1·0; *alkaline car-*

bonates, 1·7 ; *earthy carbonates*, 4·6 ; *alkaline phosphates*, 3·5 ; *earthy phosphates*, 2·6 ; *alkaline sulphates*, 1·6 ; and *silica*, 0·8 grains.

13*th Sample.* — Purchased of J. Sykes, 157. Bishopsgate-street Without.

Vegetable tissue all tobacco; ash, yellowish-grey, amounting to 29·94 per cent., 28·0 of which was composed of *chloride of sodium*, 1·4 ; *alkaline carbonates*, 2·4 ; *earthy carbonates*, 6·7 ; *alkaline phosphates*, 5·4 ; *earthy phosphates*, 3·8 ; *alkaline sulphates*, 2·8 ; *chromate of lead*, 4·6 ; and *silica*, 0·9 grains.

Irish Snuff.

14*th Sample.* — Purchased of M. Pinheiro, 143. Whitechapel-road.

Vegetable tissue all tobacco ; ash of a light greyish-fawn colour, amounting to 28·72 per cent., of which 28·0 was composed of *chloride of sodium*, 6·4 ; *alkaline carbonates*, 0·9 ; *earthy carbonates*, 10·8 ; *alkaline phosphates*, 2·5 ; *earthy phosphates*, 4·8 ; *alkaline sulphates*, 0·8 ; *chromate of lead*, 1·2 ; and *silica*, 0·6 grains.

15*th Sample.* — Purchased of J. Sykes, 157. Bishopsgate-street Without.

Vegetable tissue all tobacco; ash, pale grey, amounting to 21·20 per cent., of which 19·2 was composed of *chloride of sodium*, 1·4 ; *alkaline carbonates*, 3·6 ; *earthy carbonates*, 5·8 ; *alkaline phosphates*, 3·4 ; *earthy phosphates*, 3·2 ; *alkaline sulphates*, 0·8 ; and *silica*, 1·0 grains.

16*th Sample.* — Purchased of R. Bready, 43. Cannon-street-road, Commercial-road.

Vegetable tissue all tobacco; ash, grey, partly fused, amounting to 20·12 per cent., 18·6 of which was composed of *chloride of sodium*, 1·0 ; *alkaline carbonates*, 2·7 ; *earthy carbonates*, 5·4 ; *alkaline phosphates*, 4·1 ; *earthy phosphates*, 3·4 ; *alkaline sulphates*, 1·0 ; and *silica*, 1·0 grains.

MOIST SNUFFS.

Brown Rappee.

17*th Sample.* — Purchased of W. Fryer, 13. Smithfield-bars.

Vegetable tissue entirely tobacco ; ash, dark reddish-brown, amounting to 19·32 per cent., 17·4 of which consisted of *chloride of sodium*, 6·8 ; *alkaline carbonates*, 0·5 ; *earthy carbonates*, 4·4 ; *alkaline phosphates*, 1·5 ; *earthy phosphates*, 1·2 ; *alkaline sulphates*, 1·2 ; *oxide of iron and alumina*, 1·4 ; *silica*, 0·4 grains.

18*th Sample.* — Purchased of A. Isaacs, 88. Whitechapel-road.

Vegetable tissue all tobacco ; ash, dark reddish-brown, amounting to 23·24 per cent., of which 21·6 was composed of *chloride of sodium*, 8·2 ; *alkaline carbonates*, 0·9 ; *earthy carbonates*, 4·4 ; *alkaline phosphates*, 2·3 ; *earthy phosphates*, 1·4 ; *alkaline sulphates*, 1·6 ; *oxide of iron and alumina*, 0·8 ; *chromate of lead*, traces ; and *silica*, 2·0 grains.

19*th Sample.* — Purchased of J. Roberts, 126. Whitechapel-road.

Vegetable tissue entirely tobacco; ash, light dull brown, amounting to 21·08 per cent., of which 19·6 consisted of *chloride of sodium*, 6·8 ; *earthy carbonates*, 5·2 ; *alkaline phosphates*, 1·6 ; *earthy phosphates*, 1·4 ; *alkaline sulphates*, 1·4 ; *oxide of iron and alumina*, 1·0 ; and *silica*, 2·2 grains.

20*th Sample.* — Purchased of Messrs. Beynon & Stocken, 10. Gracechurch-street.

Vegetable tissue all tobacco ; ash, light ochry-fawn, amounting to 24·52 per cent., 23·6 of which was composed of *chloride of sodium*, 7·6 ; *earthy carbonates*, 5·8 ; *alkaline phosphates*, 2·0 ; *earthy phosphates*, 1·6 ; *alkaline sulphates*, 2·0 ; *oxide of iron and alumina*, 1·2 ; *chromate of lead*, traces ; and *silica*, 3·4 grains.

21*th Sample.* — Purchased of T. Huxley, 13. Whitechapel-road.

Vegetable tissue all tobacco ; ash, dirty reddish-brown, amounting to 21·24 per cent., 19·2 of which consisted of *chloride of sodium*, 7·8 ; *earthy carbonates*, 4·2 ; *alkaline phosphates*, 3·0 ; *earthy phosphates*, 1·2 ; *alklaine sulphates*, 1·4 ; *oxide of iron and alumina*, 1·0 ; and *silica*, 0·6 grains.

Scented Rappee.

22*nd Sample.* — Purchased of H. Benjamin, 16. High-street, Aldgate.

Vegetable tissue all tobacco; ash, reddish-brown, amounting to 27·22 per cent., 26·2 of which consisted of *chloride of sodium*, 6·8; *alkaline carbonates*, 0·1; *earthy carbonates*, 5·8; *alkaline phosphates*, 0·3; *earthy phosphates*, 2·6; *alkaline sulphates*, 2·2; *oxide of iron and alumina*, 4·0; and *silica*, 4·4 grains.

This sample was found to contain a proportion of *powdered orris-root;* it is probable that it was not used as an adulteration, but merely for the purpose of communicating a scent to the snuff.

23*rd Sample.* — Purchased of H. Bear, 1. Church-lane, Whitechapel.

Vegetable tissue entirely tobacco; ash, deep, reddish-brown, amounting to 28·26 per cent., 28·0 of which consisted of *chloride of sodium*, 6·0; *alkaline carbonates*, 0·3; *earthy carbonates*, 3·0; *alkaline phosphates*, 2·5; *earthy phosphates*, 1·0; *alkaline sulphates*, 2·0; *oxide of iron and alumina*, 5·0; *oxide of lead*, traces; and *silica*, 8·2 grains.

This sample also contained a small quantity of *powdered orris-root.*

24*th Sample.* — Purchased of H. R. Martin, 107. Bishopsgate-street Within.

Vegetable tissue all tobacco; ash, deep greyish-brown, amounting to 22·74 per cent., of which 22·0 was composed of *chloride of sodium*, 7·4; *alkaline carbonates*, 0·9; *earthy carbonates*, 2·6; *alkaline phosphates*, 3·9; *earthy phosphates*, 0·6; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 2·8; *oxide of lead*, traces; and *silica*, 2·0 grains.

Black Rappee.

25*th Sample.* — Purchased of J. Glinister, 29. Park-place, Mile-end-road.

Vegetable tissue consisting entirely of tobacco; ash, blackish-brown, amounting to 23·52 per cent., 23·6 of which was composed of *chloride of sodium*, 4·2; *earthy carbonates*, 4·0; *alkaline phosphates*, 7·0; *earthy phosphates*, 2·4; *alkaline sulphates*, 1·2; *oxide of iron and alumina*, 1·4; and *silica*, 3·4 grains.

26*th Sample.* — Purchased of T. Huxley, 13. Whitechapel-road.

Vegetable tissue all tobacco; ash, light-brown, amounting to 24·75 per cent., of which 20·8 consisted of *chloride of sodium*, 5·4; *earthy carbonates*, 4·4; *alkaline phosphates*, 0·5; *earthy phosphates*, 2·0; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 1·0; *bichromate of potash*, 3·7; and *silica*, 2·0 grains.

27*th Sample.* — Purchased of R. Gifford, 121. Holborn-hill.

Vegetable tissue all tobacco; ash, dark-brown, intermixed with yellowish-brown amounting to 24·04 per cent., 22·0 of which consisted of *chloride of sodium*, 9·0; *alkaline carbonates*, 0·3; *earthy carbonates*, 5·2; *alkaline phosphates*, 1·3; *earthy phosphates*, 1·6; *alkaline sulphates*, 1·4; *oxide of iron and alumina*, 0·8; and *silica*, 2·4 grains.

28*th Sample.*—Purchased of H. Bear, 1. Church-lane, Whitechapel.

Vegetable tissue all tobacco; ash, greyish-brown, amounting to 22·28 per cent., 21·0 of which was composed of *chloride of sodium*, 6·4; *alkaline carbonates*, 0·3; *earthy carbonates*, 5·4; *alkaline phosphates*, 1·1; *earthy phosphates*, 1·4; *alkaline sulphates*, 1·0; *oxide of iron and alumina*, 0·8; and *silica*, 4·6 grains.

29*th Sample.*—Purchased of J. Harman, 4. St. John-street, Smithfield.

Vegetable tissue all tobacco; ash of a deep umber-brown, amounting to 28·24 per cent, 26·0 of which consisted of *chloride of sodium*, 6·4; *earthy carbonates*, 7·6; *alkaline phosphates*, 3·2; *earthy phosphates*, 4·6; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 1·8; and *silica*, 0·6 grains.

30*th Sample.*—Purchased of J. Johnson, 38. Little Queen-street, Holborn.

Vegetable tissue all tobacco; ash, dark brownish-grey, amounting to 22·26 per cent., of which 21·0 consisted of *chloride of sodium*, 6·0; *alkaline carbonates*, 0·4; *earthy carbonates*, 6·0; *alkaline phosphates*, 0·6; *earthy phosphates*, 2·0; *alkaline sulphates*, 1·2; *oxide of iron and alumina*, 1·2; and *silica*, 3·8 grains.

31*st Sample.*— Purchased of H. Arnett, 10. High Holborn.

Vegetable tissue entirely tobacco; ash, light brownish-fawn, amounting to 25·84 per cent., 24·8 of which consisted of *chloride of sodium*, 8·8; *alkaline car-*

bonates, 0·2; *earthy carbonates*, 5·8; *alkaline phosphates*, 2·0; *earthy phosphates*, 1·8; *alkaline sulphates*, 2·4; *oxide of iron and alumina*, 1·2; and *silica*, 2·6 grains.

Hardham's No. 37.

32*nd Sample.*—Purchased of M. Pinheiro, 143. Whitechapel-road.

No vegetable tissue other than tobacco; ash, dark-brown, nearly black, amounting to 25·52 per cent., of which 19·6 was composed of *chloride of sodium*, 8·0; *alkaline carbonates*, 1·2; *earthy carbonates*, 2·0; *alkaline phosphates*, 3·2; *earthy phosphates*, 1·6; *alkaline sulphates*, 1·4; *oxide of iron and alumina*, 0·6; and *silica*, 1·6 grains.

33*rd Sample.*—Purchased of H. Benjamin, 16. High-street, Aldgate.

Vegetable tissue all tobacco; ash, rather light brown, amounting to 26·44 per cent., 25·6 of which was composed of *chloride of sodium*, 5·8; *alkaline carbonates*, 1·6; *earthy carbonates*, 3·8; *alkaline phosphates*, 2·2; *earthy phosphates*, 2·4; *alkaline sulphates*, 2·0; *oxide of iron and alumina*, 1·4; *oxide of lead*, 3·0; and *silica*, 3·4 grains.

34*th Sample.*—Purchased of J. Sykes, 157. Bishopsgate-street Without.

Vegetable tissue entirely tobacco; ash, greyish-brown, amounting to 22·92 per cent., of which 22·0 was composed of *chloride of sodium*, 7·0; *earthy carbonates*, 4·2; *alkaline phosphates*, 2·6; *earthy phosphates*, 1·6; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 1·0; and *silica*, 3·8 grains.

French Carrotte.

35*th Sample.*—Purchased of P. Proctor, 197. Bishopsgate-street Without.

Vegetable tissue all tobacco, amounting to 19·96 per cent., of which 19·6 consisted of *chloride of sodium*, 7·0; *earthy carbonates*, 4·2; *alkaline phosphates*, 2·8; *earthy phosphates*, 2·4; *alkaline sulphates*, 1·4; *oxide of iron and alumina*, 0·6; and *silica*, 1·2 grains.

36*th Sample*.—Purchased of G. F. Chance, 163. Fenchurch-street.

Vegetable tissue entirely tobacco; ash, light brownish-grey, amounting to 23·94 per cent., 20·6 of which was composed of *chloride of sodium*, 6·4; *earthy carbonates*, 4·6; *alkaline phosphates*, 1·4; *earthy phosphates*, 2·4; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 0·4; and *silica*, 3·6 grains.

Prince's Mixture.

37*th Sample.*—Purchased of J. Glinister, 29. Park-place, Mile-end-road.

Vegetable tissue all tobacco; ash, dark-grey, almost black, amounting to 21·32 per cent., 20·4 of which consisted of *chloride of sodium*, 7·8; *alkaline carbonates*, 0·4; *earthy carbonates*, 5·4; *alkaline phosphates*, 0·6; *earthy phosphates*, 1·4; *alkaline sulphates*, 1·8; *oxide of iron and alumina*, 1·0; and *silica*, 2·0 grains.

38*th Sample.*—Purchased of M. & E. Cannon, 4. Whitechapel-road.

Vegetable tissue entirely tobacco; ash, dull-brown, amounting to 21·26 per cent., of which 20·2 consisted of *chloride of sodium*, 7·2; *alkaline carbonates*, 0·2; *earthy carbonates*, 5·2; *alkaline phosphates*, 2·2; *earthy phosphates*, 1·6; *alkaline sulphates*, 1·0; *oxide of iron and alumina*, 1·0; and *silica*, 1·8 grains.

39*th Sample.*—Purchased of J. Roberts, 126. Whitechapel-road.

Vegetable tissue all tobacco; ash, dark greyish-brown, amounting to 18·72 per cent., 17·6 of which consisted of *chloride of sodium*, 7·2; *alkaline carbonates*, 0·1; *earthy carbonates*, 4·4; *alkaline phosphates*, 0·1; *earthy phosphates*, 1·2; *alkaline sulphates*, 0·8; *oxide of iron and alumina*, 0·8; and *silica*, 3·0 grains.

40*th Sample.*—Purchased of R. Allen, 131. Shoreditch High-street.

Vegetable tissue entirely tobacco; ash, dark greyish-brown, amounting to 22·08 per cent., of which 20·0 consisted of *chloride of sodium*, 8·0; *alkaline carbonates*. 0·8; *earthy carbonates*, 4·8; *alkaline phosphates*, 0·6; *earthy phosphates*, 1·6; *alkaline sulphates*, 1·2; *oxide of iron and alumina*, 1·2; and *silica*, 1·8 grains.

41*st Sample.*—Purchased of H. R. Martin, 107. Bishopsgate-street Within.

Vegetable tissue no other than that of tobacco; ash, blackish-grey, amounting to 22·64 per cent, of which 20·8 was found to consist of *chloride of sodium*, 8·0; *alkaline carbonates*, 0·6; *earthy carbonates*, 5·0; *alkaline phosphates*, 0·8; *earthy phosphates*, 2·0; *alkaline sulphates*, 1·6; *oxide of iron and alumina*, 1·2; and *silica*, 1·6 grains.

CEPHALIC SNUFF.

42*nd Sample.*— Purchased of Messrs. Hannay & Dietrichsen, 63. Oxford-street. This snuff, on examination, was found to consist almost entirely of tobacco-stalks ground to a very fine powder, and disguised by being flavoured or scented with some essential oil or oils, most probably that of lavender. 100 grains furnished 21·6 grains of ash, of a dirty-brown colour, which was composed of *chloride of sodium*, 2·0; *alkaline carbonates*, 3·9; *earthy carbonates*, 4·0; *alkaline phosphates*, 5·2; *earthy phosphates*, 2·1; *alkaline sulphates*, 0·9; *oxide of iron and alumina*, 1·9; and *silica*, 1·6 grains.

This snuff is sold in tin canisters having a government stamp attached; the following is a copy of the bill or advertisement, with directions for use, which accompanies it: —

"THE VIRTUES AND USE
OF THE
CORDIAL
CEPHALIC SNUFF,

Which, by experience of more than Half a Century, has been found an Effectual Remedy for most Disorders of the Head, especially the Common Headache, to which it hardly ever fails giving Immediate Ease, and by Frequent Use prevents its Return.

"It admirably opens and purges the Head; strengthens the Nerves, revives the Spirits, and has a most grateful aromatic Smell.

"It removes Drowsiness, Sleepiness, Giddiness, and Vapours; relieves Dimness of the Eyes; is excellent in curing recent Deafness; and has been of great service in Hysteric and Paralytic Complaints, and in restoring the Memory when impaired by Disorders of the Head.

"It is also extremely proper for all persons who visit the sick, or go into unwholesome rooms or unhealthy places, and hot climates, as it fortifies the Head against Noxious Exhalations and Infectious Air.

"A pinch or two may be taken at any time, and indeed several in a day; but for a Cold or Stoppage in the Head, a pinch or two should be taken just before going to bed.

"Those who are in the habit of taking much of the common Snuffs (thereby injuring both the Head and Stomach) are desired to mix some of the CEPHALIC SNUFF with them, and their bad effects will, in a great measure be prevented."

Were this snuff not composed, as it is, entirely of tobacco, but admixed with British herbs or plants, we apprehend that it would be an illegal preparation, being contrary to the provisions of the Tobocco Act, which prohibits the mixture with manufactured tobacco of any leaves or vegetable substances other than tobacco.

GRIMSTONE'S EYE SNUFF.

43*rd Sample.*—Purchased of W. Grimstone, 52. High-street, St. Giles's. A prolonged examination of this article by the microscope shows that it is made up of several distinct vegetable substances. Amongst these, after considerable trouble, we have succeeded in identifying the following: *powdered orris-root*, *savory*, *rosemary*, and *lavender*. There are probably one or two other vegetable substances, the names of which we have not as yet ascertained; but it does not contain any hellebore, assarabacca, nor tobacco. 100 grains, on being incinerated, afforded 30 grains of ash, of a light reddish-brown colour, composed of *chloride of sodium*, 12·8; *alkaline carbonates*, 3·8; *alkaline phosphates*, 4·6; *earthy phosphates*, 2·8; *alkaline sulphates*, 0·8; and *silica*, 5·2 grains.

From an examination of the above extensive series of analyses of Snuff, we arrive at the following conclusions: —

1st. That *chloride of sodium*, or *salt*, is added in large and very variable quantities to all descriptions of snuff, the proportions ranging from 1·0 to as much as 12·8 per cent. Where the amount of chloride is less than 1·0 per cent., it is probable that it is derived from the tobacco itself, as well as the water used to moisten it.

2nd. That the *alkaline and earthy carbonates*, chiefly the *carbonates of potash and lime*, are likewise added to snuff, sometimes in considerable quantity, but usually to a less extent than chloride of sodium. One of the samples yielded 3·9 per cent. of carbonate of potash, and another no less than 10·8 per cent. of carbonate of lime. On looking over the table of analyses, it will be seen that the amount of earthy carbonates varies considerably in the different samples, as was the case with the chloride of sodium, the lime being present in somewhat larger proportion in the dry snuffs, as the Scotch, Irish, and Welsh—to these snuffs the law allows the addition of lime-water. When at the same time carbonate of potash is added, decomposition takes place, part of the carbonic acid of the carbonate of potash unites with the lime, and so forms carbonate of lime. This renders it difficult to state exactly the relative proportions of lime and potash employed.

3rd. It would appear also that in some cases the *alkaline and earthy phosphates* are in excess in snuff, as much as seven per cent. of the former having been detected in one of the samples, and 4·8 per cent. of the latter in another. The stalks of tobacco contain a very large and variable quantity of phosphates, especially the alkaline phosphates, and it is probable that they are very rarely added to snuff for the purpose of adulteration.

4th. That the *alkaline sulphates* are likewise slightly in excess, amounting in one sample to 5·4 per cent.; in this case the addition may have been intentional.

5th. That *oxide of iron* derived from different descriptions of coloured ferruginous earth, as *red ochre*, *yellow ochre*, and some of the brown earths, as *umber*, was present in upwards of two-thirds of the samples, amounting in one case to no less than five per cent. It is especially to be observed, that while all the Scotch snuffs contained iron, the oxide of that metal was not present in any one of the samples of Welsh and Irish snuffs submitted to analysis. The presence of ferruginous earths, as well as of some other colouring matters, is frequently indicated by the colour of the ash. Genuine tobacco invariably yields an ash which is more or less grey, while the ashes of snuffs containing iron, lead, and some other mineral colouring matters, are always to a greater or less extent coloured; when decidedly so, we may safely declare that some substance has been employed to colour the snuff. In unadulterated tobacco, the iron present amounts only to traces; nearly all therefore of the different kinds of snuff examined, excepting the Welsh and Irish, were adulterated with coloured ferruginous earths, especially the Scotch rappees, and scented rappees, in one of which the iron and alumina amounted to 5 per cent. *The presence of coloured ferruginous earths in snuff is an adulteration.*

6th. That *chromate of lead* was detected in *nine* of the samples, amounting in one instance to 4·6 per cent. It occurred in five out of the nine samples of Scotch snuff examined, in one of the four samples of Welsh, and in one of the three samples of Irish snuff submitted to analysis. The *presence of this metallic compound in snuff constitutes an adulteration.*

7th. That *oxide of lead*, probably in the form of *red lead*, was discovered in three cases, as much as 3 per cent. being found in one of the samples of Hardham's 37. *The presence of this metallic oxide is also an adulteration and an infraction of the Tobacco Act.*

8th. That *bichromate of potash* was present in three of the samples; in two of the cases it was found in the Scotch snuff, amounting in one sample to 6·2 per cent. *The presence of this salt likewise constitutes an adulteration.*

9th. That many of the samples contained considerable quantities of *silica*, amounting in one instance to no less than 8·4 per cent. *In some of the samples the addition was unquestionably intentional.* Genuine tobacco rarely contains more than 3·4 per cent., and usually much less. In most of the siliceous rasidues of the ashes *shining particles* were observed, which under the microscope presented all the appearance of powdered glass; but since earth contains similar particles in large quantities we are not able to state whether in any case powdered glass had been added; to the majority of the samples, however, it was manifest from the weight and appearance of the residues that no such addition had been made. The ashes of the rappees all furnish a siliceous residue, which, after the action of the acids, in its gelatinous character resembles the silica derived from such a silicate as glass.

10th. That *powdered orris-root* was detected in two of the samples. *The presence of this in snuff is likewise an adulteration.*

11th. That the *total weight of ash* furnished by the incineration of the greater number of the snuffs examined, although many of them were very moist, much exceeded that of genuine tobacco after being dried. While the ashes of samples *of the latter have been found to vary in weight from* 10·6 *to* 22·6, those of the snuffs which were not dried, and many of which contained very large per centages of water, were in no case under 18·26 per cent., while in one instance it amounted to 35·54 per cent. Had the snuffs been dried before analysis, as was the tobacco, the difference in the weight of the ashes would have been much more evident. The average proportion of water in the moist snuffs is about 25 per cent.

Looking, then, at the whole of the results contained in this report, we would say that *the article snuff is subject to a very large amount of adulteration, and that of a kind which is not only detrimental to the revenue, but exceedingly injurious to health.*

Such striking and even startling results were hardly to have been anticipated; for when we consider the enormous revenue derived from tobacco, as well as the costly machinery employed to suppress adulteration, especially in this, and also in other exciseable articles, it might have been expected that the results would have been very different.

The Excise authorities are numerous and powerful; they possess a staff of analysts, and they have the liberty of entering upon any premises, and of seizing all suspected goods. It is clear, therefore, from the results contained in this report, as well as those of several previous ones, that these authorities, including the analysts employed by them, are by no means up to their work. We say it without boasting, but certainly with some degree of satisfaction, that, aided only by science, and supported by a firm resolution, we have done more to discover and check adulteration than the whole body of excise authorities, the maintenance of which costs the country some hundreds of thousands of pounds annually. In those cases in which the excise officers have prosecuted parties for the adulteration of snuff, they have rarely done so on purely scientific grounds, from the results of chemical and microscopical examination; but their proceedings usually have been based upon the seizure of the articles employed for adulteration on the premises of the manufacturer.

That foreign leaves or other vegetable substances should not have been found in the samples of snuff examined, excepting powdered orris-root for scenting, is not surprising, when we consider the latitude which the law itself affords for adulteration with substances not vegetable, the Tobacco Act permitting, without limitation as to quantity, the addition of water, salt, and alkaline salts, and in the case of Irish and Welsh snuffs, lime-water.

The disclosures made in this report clearly show that this Act should be extensively altered; that some limit should be assigned to the use of the substances just named, and that the prohibition should be extended to many articles not specially referred to in the Act.

It appears, then, as one great result of our examination of snuff, that the majority of the samples are adulterated, and this in such a manner as is in direct violation of the excise laws, the parties being liable to very heavy penalties and imprisonment. Of the injurious character of some of the adulterations detected, not a doubt can be entertained. Chromate of lead, red lead, and bichromate of potash, are all highly poisonous, and when applied to soft mucous surfaces, such as those of the nose, they are readily absorbed into the system.

Since Government allows of the admixture of water, salt, alkaline salts, and lime-water, without any limit as to the amount, it is extremely difficult to draw the line, and to say where adulteration with these substances begins. The following extract from an Act passed in the year 1842, to amend the excise survey, shows the facilities afforded for adulterating snuff:—"It is enacted, That no manufacturer of tobacco shall, in manufacturing any tobacco, make use there-

RESULTS OF THE CHEMICAL ANALYSIS OF

Arranged in a

No. of Sample.	NAME.	Chloride of Sodium.	Alkaline Carbonates.	Earthy Carbonates.	Alkaline Phosphates.	Earthy Phosphates.	Alkaline Sulphates.	Oxide of Iron and Alumina.	Chromate of Lead.	Oxide of Lead.
	SCOTCH.									
1	M. and E. Cannon.	6·0	0·3	5·0	1·9	3·4	1·4	3·2	1·0	- -
2	A. Isaacs.	11·0	0·3	4·6	0·3	2·2	2·0	3·8	- -	- -
3	J. Roberts.	7·0	0·4	5·8	1·0	1·8	0·8	1·2	4·4	- -
4	G. F. Chance.	4·2	2·1	3·8	0·9	2·0	1·2	1·4	1·2	- -
5	T. Ryder.	6·0	- -	5·0	1·6	3·4	3·0	1·8	3·2	- -
6	S. Phillips.	2·0	2·9	5·4	1·1	2·6	5·4	2·0	- -	- -
7	P. Procter.	7·0	2·1	5·6	5·5	2·0	1·2	1·8	- -	- -
	SCENTED SCOTCH.									
8	M. Pinheiro.	1·4	0·8	5·4	0·4	2·7	2·2	0·8	- -	- -
9	M. and E. Cannon.	5·6	- -	2·8	6·6	1·8	1·0	- -	2·8	- -
	WELSH.									
10	R. Bready.	5·4	3·2	5·2	3·8	3·6	1·0	- -	- -	- -
11	J. Glinister.	0·6	3·4	5·4	4·6	2·4	0·8	- -	- -	- -
12	J. Roberts.	1·0	1·7	4·6	3·5	2·6	1·6	- -	- -	- -
13	J. Sykes.	1·4	2·4	6·7	5·4	3·8	2·8	- -	4·6	- -
	IRISH.									
14	M. Pinheiro.	6·4	0·9	10·8	2·5	4·8	0·8	- -	1·2	- -
15	J. Sykes.	1·4	3·6	5·8	3·4	3·2	0·8	- -	- -	- -
16	R. Bready.	1·0	2·7	5·4	4·1	3·4	1·0	- -	- -	- -
	BROWN RAPPEE.									
17	W. Fryer.	6·8	0·5	4·4	1·5	1·2	1·2	1·4	- -	- -
18	A. Isaacs.	8·2	0·9	4·4	2·3	1·4	1·6	0·8	traces	- -
19	J. Roberts.	6·8	- -	5·2	1·6	1·4	1·4	1·0	- -	- -
20	Beynon & Stocken.	7·6	- -	5·8	2·0	1·6	2·0	1·2	traces	- -
21	T. Huxley.	7·8	- -	4·2	3·0	1·2	1·4	1·0	- -	- -
	SCENTED RAPPEE.									
22	H. Benjamin.	6·8	0·1	5·8	0·3	2·6	2·2	4·0	- -	- -
23	H. Bear.	6·0	0·3	3·0	2·5	1·0	2 0	5·0	- -	traces
24	H. R. Martin.	7·4	0·9	2·6	3·9	0·6	1·8	2·8	- -	traces
	BLACK RÁPPEE.									
25	J. Glinister.	4·2	- -	4·0	7·0	2·4	1·2	1·4	- -	- -
26	T. Huxley.	5·4	- -	4·4	0·5	2·0	1·8	1·0	- -	- -
27	R. Gifford.	9·0	0·3	5·2	1·3	1·6	1·4	0·8	- -	- -
28	H. Bear.	6·4	0·3	5·4	1·1	1·4	1·0	0·8	- -	- -
29	J. Harman.	6·4	- -	7·6	3·2	4·6	1·8	1·8	- -	- -
30	J. Johnson.	6·0	0·4	6·0	0·6	2·0	1·2	1·0	- -	- -
31	H. Arnett.	8·8	0·2	5·8	2·0	1·8	2·4	1·2	- -	- -
	HARDHAM'S No. 37.									
32	M. Pinheiro.	8·0	1·2	2·0	3·2	1·6	1·4	0·6	- -	- -
33	H. Benjamin.	5·8	1·6	3·8	2·2	2·4	2·0	1 4	- -	3·0
34	J. Sykes.	7·0	- -	4·2	2·6	1·6	1·8	1·0	- -	- -
	FRENCH CARROTTE.									
35	P. Proctor.	7·0	- -	4·2	2·8	2·4	1·4	0·6	- -	- -
36	G. F. Chance.	6 4	- -	4·6	1·4	2·4	1·8	0·4	- -	- -
	PRINCE'S MIXTURE.									
37	J. Glinister.	7·8	0·4	5·4	0·6	1·4	1·8	1·0	- -	- -
38	M. and E. Cannon.	7·2	0·2	5·2	2·2	1·6	1·0	1·0	- -	- -
39	J. Roberts.	7·2	0·1	4·4	0·1	1·2	0·8	0·8	- -	- -
40	R. Allen.	8·0	0·8	4·8	0 6	1·6	1·2	1 2	- -	- -
41	H. R. Martin.	8·0	0·6	5·0	0·8	2·0	1·6	1·2	- -	- -
42	Cephalic.	2·0	3·9	4·0	5·2	2·1	0·9	1·9	- -	- -
43	Grimstone's Eye.	12·8	3·8	- -	4·6	2·8	0·8	- -	- -	- -

FORTY-THREE SAMPLES OF VARIOUS SNUFFS,

Tabular Form.

Bichromate of Potash.	Silica.	Ash analysed.	Total Ash per cent.	Colour of Ash.	Effervescence of Carbonic Acid Gas liberated from Cold Infusion on the addition of Hydrochloric Acid.	No. of Sample.
- -	4·0	26·2	26·52	Dull rusty brown.	Slight.	1
- -	5·4	29·6	30·54	Blackish-brown.	Very considerable.	2
- -	8·4	30·8	30·40	Dull brown intermixed with yellow.	Traces only.	3
- -	1·8	18·6	20·18	Dark yellowish-brown.	Slight.	4
- -	2·8	26·8	28·02	Dull reddish-brown.	Very considerable.	5
6·2	5·0	32·6	35·54	Dark reddish-brown, intermixed with yellowish-brown.	Considerable.	6
- -	1·4	26·6	26·52	Blackish-brown, fused into a mass.	Slight traces.	7
5·9	1·4	21·0	22·60	Dull yellowish-brown.	Slight.	8
- -	3·2	23·8	26·34	Deep rusty brown.	Ditto.	9
- -	0·6	22·8	28·66	Blackish-grey, partly fused.	Rather much.	10
- -	0·8	18·0	20·00	Ditto ditto.	None.	11
- -	0·8	15·8	18·26	Dark grey, partly fused.	Traces only.	12
- -	0·9	28·0	29·94	Yellowish-grey, ditto.	Considerable.	13
- -	0·6	28·0	28·72	Light greyish-fawn colour.	Immense.	14
- -	1·0	19·2	21·20	Pale grey.	Very slight.	15
- -	1·0	18·6	20·12	Grey, partly fused.	None.	16
- -	0·4	17·4	19·32	Dark reddish-brown.	Slight.	17
- -	2·0	21·6	23·24	Ditto ditto.	Rather much.	18
- -	2·2	19·6	21·08	Light dull brown.	Ditto.	19
- -	3·4	23·6	24·52	Light ochry-fawn.	Slight.	20
- -	0·6	19·2	21·24	Dirty reddish-brown.	Very considerable.	21
- -	4·4	26·2	27·22	Reddish-brown.	Rather much.	22
- -	8·2	28·0	28·26	Deep reddish-brown.	Slight.	23
- -	2·0	22·0	22·74	Deep greyish-brown.	Very considerable.	24
- -	3·4	23·6	23·52	Blackish-brown.	None.	25
3·7	2·0	20·8	24·75	Light brown.	Ditto.	26
- -	2·4	22·0	24·04	Dark brown, intermixed with yellowish-brown.	Rather much.	27
- -	4·6	21·0	22·28	Greyish-brown.	Very slight.	28
- -	0·6	26·0	28·24	Deep umber-brown.	Immense.	29
- -	3·8	21·0	22·26	Dark brownish-grey.	Very slight.	30
- -	2·6	24·8	25·84	Light brownish-fawn.	Rather much.	31
- -	1·6	19·6	25·52	Dark brown, nearly black.	Mere trace.	32
- -	3·4	25·6	26·44	Rather light brown.	Immense.	33
- -	3·8	22·0	22·92	Greyish-brown.	Considerable.	34
- -	1·2	19·6	19·96	Dirty reddish-brown.	None.	35
- -	3·6	20·6	23·94	Light brownish grey.	Ditto.	36
- -	2·0	20·4	21·32	Dark grey, nearly black.	Slight traces.	37
- -	1·8	20·2	21·26	Dull brown.	Rather much.	38
- -	3·0	17·6	18·72	Dark greyish-brown.	Traces only.	39
- -	1·8	20·0	22·08	Ditto ditto.	Rather much	40
- -	1·6	20·8	22·64	Blackish-grey.	Very considerable.	41
- -	1·6	21·6	- -	Light brown.	Slight.	42
- -	5·2	30·0	- -	Light reddish-brown.	None.	43

with of any other material, or any other liquid, or substance, or matter, or thing than water only, or in manufacturing any snuff, make use therewith of any other material, or any other liquid, or substance, or matter, or thing, than water, or water and salt, or alkaline salts only, or lime-water in snuff known as *Welsh* or *Irish* snuff;" and it also enacts, "That every manufacturer of tobacco who shall make use of, or shall add to, or mix with, or put into or amongst, or permit to be added to, or mixed with, any other material, liquid, substance, matter, or thing, than as respects tobacco, water only, and as respects snuff, water or salt, or water and salt, or alkaline salts only, or lime-water in snuff known as Welsh or Irish snuff, shall forfeit 300*l.*"

By the next clause it is provided, "That nothing hereinbefore contained shall subject any manufacturer of, dealer in, or retailer of, tobacco to the said penalty of 300*l.*, or to any forfeiture for, or by reason of, his scenting or flavouring any snuffs, so that only the essential oils usually made use of for that purpose shall be used for communicating the scent or flavour."

Besides the addition of water, salts, and the several other substances discovered by us in the course of our analyses, we find that snuff is occasionally further adulterated with various vegetable matters and earthy substances. From an excise return of the seizures made during the two years 1851 and 1852, it appears that fourteen prosecutions were instituted against persons residing in various parts of the United Kingdom, for adulterating snuff with vegetable and earthy matters, or for having the materials for adulteration in their possession. It is worthy of notice, how much more extensively this fraud is practised in the provincial towns than in London, for out of the whole fourteen seizures, three only were effected in the metropolis. On an examination of this return, it appears that the following substances were either detected or seized by the excise authorities in the cases above referred to:— "Powdered Columbo root, yellow ochre, quassia, red ochre, and gentian root, in one case; peat moss and earthy matter, in two cases; earthy matter and ground rhubarb leaves, in one sample; 12·11 per cent. of oxide of iron and sand, in one case; 30 per cent. of vegetable matter not tobacco, and powdered leaves of trees, each in one case; ground fustic-wood, in two cases, one containing 25 per cent., the other 15 per cent.; in one sample wood and earthy matter was found, and in two other cases the materials used in the adulteration were not stated. In the whole of the prosecutions instituted, the parties who were proved guilty of practising the fraud were mulcted in penalties of from 50*l.* to 500*l.*, or suffered imprisonment for periods of from two to three months.

But it is not only with adulteration that the revenue has to contend, but also with *smuggling*. Since 100 lbs. of tobacco-leaf yield but 20 lbs. of stalks, it is evident that the quantity of the latter produced in the manufacture of tobacco and cigars in England is not nearly sufficient to meet the enormous and increased demand for snuff, the annual consumption of which amounts to nearly 3,000,000 lbs., consequently large quantities of the stalks are annually imported from abroad; but the high price which these fetch, ranging between 2*s.* 10*d.* and 3*s.* 4*d.* per lb., led, some years since, to their being extensively smuggled, principally from Holland, which country is itself largely supplied with tobacco-stalks from the United States. The price of the smuggled article has been as low as seven farthings to three-halfpence per pound; a great inducement is thus held out for defrauding the Excise. A few years since, one of the largest tobacco manufacturers in London was convicted and fined for having in his possession a great quantity of tobacco-stalks that had not paid duty.

As we learn, from the evidence of one of the witnesses examined before a Committee of the House of Commons, in 1844, on the tobacco trade, one of the methods adopted for smuggling tobacco-stalks was by having the bottoms of large baskets in which some heavy merchandise was imported made entirely of tobacco-stalks interwoven; these bottoms were very thick, and generally weighed as much as 75 lbs. each; as soon as the goods in the baskets were cleared the Custom-house, the bottoms were taken out and ground up into snuff; the baskets and contents were purposely made exceedingly heavy, affording too much labour and trouble for the excise officers to turn them over to examine the bottoms. In this way large quantities of stalk were from time to time clandestinely imported.

Besides tobacco-stalks large quantities of foreign manufactured snuffs have also at different times found their way into the British market by means of smuggling, some of the devices for the successful accomplishment of which are very ingenious. In the report of the Select Committee of the House of Commons on the tobacco trade, already referred to, it is stated by one of the witnesses, that in 1843, no less than 20,000 lbs. of snuff were smuggled from Holland, made up into the shape of Dutch cheeses, and passed through the Custom House as such without being detected. The duty on this kind of snuff is over 6*s*. per lb.; it will be seen, then, that by this one transaction Government was defrauded to the extent of 6000*l*.

Properties and Effects of Tobacco.

We will in the next place consider the effects of the use of tobacco upon the human frame, whether smoked, chewed, or employed in the form of snuff.

Tobacco owes its chief properties to the presence of two active principles, termed *nicotina* and *nicotianin*. The first of these, *nicotina*, is thus characterised: it is liquid and volatile, devoid of colour, with an acrid, burning taste, and possesses the strong odour of tobacco; to test-paper it shows an alkaline reaction; water, ether, alcohol, and the oils dissolve it. It combines with various organic and inorganic acids to form salts. 1000 grains of tobacco yield, according to the kind used, from 3·86 to 11·28 grains of nicotina. The action of nicotina on the human frame is that of an acrid, narcotic poison, causing giddiness and vomiting, and in doses of a few grains, death.

The properties of the latter, *nicotianin*, are as follow: — It is a concrete oily substance, having the smell of tobacco, and a bitter taste. It is volatile; the dilute acids and water do not dissolve it, but it is soluble in liquor potassæ and ether. In swallowing nicotianin, the same sensation is produced on the tongue and fauces as by tobacco. A grain administered internally, quickly caused giddiness, nausea, and retching. It also produces sneezing when applied to the nose. Six pounds of tobacco leaves furnish about eleven grains of nicotianin. It is also known as "*Concrete Oil of Tobacco*," and "*Tobacco-Camphor*."

Both these active principles and constituents have been shown by chemical analysis to be present in the smoke of tobacco; they are therefore undoubtedly not destroyed by the combustion of the tobacco, whether used in the form of cut tobacco or cigars, but in the act of smoking they are inhaled and thus drawn into the mouth, fauces, lungs, and even the stomach, especially when the saliva, impregnated with the tobacco-smoke, is swallowed. Further, that these active constituents are actually absorbed, and make their way into the system, is proved, from the sickness, giddiness, and death-like faintness, experienced by those who are unaccustomed to smoking; that they are absorbed to some degree if not to the same extent, in the case of habitual smokers of tobacco is unquestionable, the difference in the effects experienced being due to the circumstance of the system becoming more inured to its use, and therefore less susceptible of its influence.

In the case of confirmed smokers, the effect of tobacco-smoke is that of a narcotic. After a very short and almost inappreciable period of excitement, the effect begins, and its tranquillising influence is experienced, pervading the whole system; the frequency and force of the pulse are diminished, as well as the tonicity of the muscles, particularly of the involuntary muscles, as is shown by the readiness with which the bowels act in most cases after smoking tobacco. The action of the skin is also often increased, but there is no evidence to show whether it exerts any sensible effect over other secretions, as those of the liver and kidneys. Bearing in mind the nature of the ordinary and more usual symptoms above referred to, produced by the smoking of tobacco, we are in a position to appreciate the effects of the continued use of tobacco in this form upon the human system.

In persons whose circulation is brisk, and who have an abundance of red blood — in other words, in the sanguine and the plethoric — in whom the functions of digestion and assimilation are active, we should say that this habit would be calculated to be productive of beneficial rather than injurious consequences, by lowering somewhat the tone of the circulation, and by promoting the secretion of the salivary glands and of the skin; also, perhaps, by moderating the activity of digestion. In persons of weak circulation and digestion, in many of whom the habit of tobacco-smoking is attended with great expectoration, there is no question but that the indulgence in this practice is in a high degree prejudicial to health, for it lowers still more the force of the circulation and the powers of digestion; while the great expectoration of saliva, a fluid which contains a large portion of animal matter, acts as an exhausting drain upon the system.

There is another class of persons on whom the practice of tobacco-smoking may possibly exert a beneficial effect—namely, those of nervous and irritable temperament—especially those who are so from the over-excitement of business, rather than from disease: this would apply to a considerable number of residents in large towns and cities.

In those cases in which smoking is attended with great expectoration, it is probable that the constitutional effects of the tobacco are experienced in a far less degree, since very much of the nicotin and nicotianin is ejected with the saliva.

In countries where tobacco is grown, as in America, the pernicious effects of extreme indulgence in smoking are fully known and recognised. In America it is no uncommon circumstance to hear of coroners' inquests on the bodies of smokers, especially youths, the ordinary verdict being, "Died from excessive tobacco-smoking."

But a very large proportion of tobacco-smokers belong to none of the three classes of persons above referred to, being neither plethoric, dyspeptic, nor nervous and irritable, but are in the enjoyment of a good and sound state of health: to such persons we would say that the habit of tobacco-smoking is useless and expensive, and simply panders to that spirit of self-indulgence which leads many to gratify the senses in a variety of ways.

The habit of smoking is often injurious in an indirect manner, by its acting as an inducement to drinking, and thus becoming the source of intemperance and its attendant evils. Indeed, too frequently these practices go together. "Smoking induces drinking, drinking jaundice, and jaundice death."

Many of the above remarks apply with greater force to the practice of tobacco-chewing; in this case, no doubt, a larger quantity of the active principles of the tobacco make their way into the system; and this amount would be very much greater were it not for the fact that all chewers of tobacco expectorate largely and often injure themselves thereby.

The constitutional effects resulting from the use of tobacco in the form of snuff, when this is genuine, are certainly much less than in the case either of smoking or chewing tobacco; indeed, the effects are in most cases chiefly local. The nerves of the Schneiderian membrane are over stimulated; there is determination of blood to the part, and the membrane becomes thickened and insensible; at the same time the brain is roused to increased action. When any of the snuff taken makes its way into the fauces, as it very often does, it produces a certain amount of constitutional derangement, and often gives rise to dyspepsia. On first beginning to take snuff, sickness and faintness are induced in the same way as from tobacco-smoking.

The chief local effects of the long-continued use of snuff are, impairment of the sense of smell, and to a less extent of that of taste; the voice also becomes much altered. These effects are not to be attributed entirely to the tobacco contained in the snuff, but are also due to the irritating action of the alkalies and salts, which enter into the composition of all snuff, as well as to the red and yellow ochre, red lead, chromate of lead, bichromate of potash, and many other injurious substances with which snuff is coloured. The poisonous nature of the chromates of potash, especially the bichromate, has long been suspected from the distressing symptoms produced in workmen engaged in many of the operations of dyeing. This led Mons. Duchatel, of Paris, to institute experiments with the view to investigate and determine the effects which this salt exerts on the animal economy, and the doses in which it proves injurious or poisonous. He found that, even in the small doses of from one twenty-fifth of a grain to one five-hundredth of a grain, it destroyed the lives of animals (dogs) on which he experimented, causing sickness, vomiting, and severe gastritis; and post-mortem examination showed the mucous membrane of the stomach and prima via to be much inflamed and completely softened.

Chromate of lead and red lead, although not poisonous to the same extent, are yet of a very deleterious nature, even in exceeding minute doses. These metallic salts are constantly employed to give colour to variety of articles, especially sugar confectionery; and many instances have been recorded of the fatal consequences to children who have partaken of sweets in which these dangerous substances had been used.

The quantity of chromate of lead and red lead contained in snuff as shown by the analyses is often very considerable, nearly 5 per cent. being sometimes found in it; sufficient, as appears from the following very interesting and highly important case, for the particulars of which we are indebted to Professor Erichsen, to give rise to the different symptoms and effects of poisoning by lead, as cholic, paralysis, &c.

Case of Slow Poisoning by Snuff containing Lead, by Mr. Erichsen.

Whilst on a professional visit in the country last March, I was requested to see a gentleman who had been invited down to a friend's country seat in the hope that change of scene and air would influence favourably an attack of paralysis, which was said to be of a rheumatic character; by which he had been disabled from work for many months past, and of which he despaired of recovering, having relinquished all treatment.

I found the patient in bed, and somewhat exhausted by the journey down—a distance of nearly a hundred miles from his usual residence. He was peculiarly sallow, the complexion having almost an icteric tinge; but the countenance was lively and expressive, and the intellect as bright as usual.

Mr. A. B. could stand and, if supported, could walk, though feebly and with much difficulty. He complained much of pains about the shoulders and the fleshy parts of the thighs and legs, and especially of burning sensations in the soles of his feet. The articulations all appeared healthy, no swelling or looseness was perceptible about any of them.

I was, however, particularly struck with the appearance of the hands and arms, which were lying powerless on the coverlid of the bed. There was marked "wrist-drop" of both arms, the hands hanging flaccid and at right angles with the forearms, without the patient being able to extend or raise them in the slightest degree. There was, however, some slight power of extension left in the fingers, especially in those of the left hand. Though unable to extend the fingers, raise the hand, and scarcely having power to elevate the arm, Mr. A. B. could *flex* the fingers pretty firmly so as to give a tolerably good grasp to whatever was put into his hand. The index finger of the right hand seemed to be the most affected and was permanently flexed.

There was a very marked degree of wasting of the whole mass of the extensor muscles of the forearm, so that a longitudinal hollow corresponding to the interosseous space was perceptible down the whole length of the forearm, and a very deep and marked depression in the interspace between the first and second metacarpal bones. The hands were quite powerless, and the patient was unable to render himself the slightest assistance.

The tongue was pale and flabby; and on examining the gums I found a deep blue-black or leaden-coloured line around the teeth, more marked about the molars.

Digestion was much impaired. Appetite capricious, with much flatulence and occasional attacks of constipation with colicky pains.

On inquiring into the history of the case, I learnt that Mr. A. B., who is much devoted to literary pursuits and habitually led a sedentary life, had for some years previously suffered from pains of a rheumatic or gouty character; that in May, 1853, he had been attacked by constipation and colic whilst lodging for a short time in a newly painted house. In August of the same year he had first begun to lose power in extending his arms, finding a difficulty in raising them to put on his coat; and from this time the paralytic symptoms gradually increased until they had assumed the degree in which I found them, when he had become reduced to a state of complete physical helplessness, though, as I have already observed, his powerful and clear intellect was as perfect as ever.

On examining Mr. A. B. I was at once struck by the very marked "wrist-drop," more complete than I had ever seen before; the limitation of the paralysis to the extensors, which were greatly wasted; the existence of a blue line around the teeth; and the occurrence of occasional attacks of constipation and colic, together with flying pains in the fleshy parts of the body, with absence of all articular inflammation. These symptoms led me to the conclusion that Mr. A. B. was suffering from saturnine paralysis, and that he had been slowly poisoned by lead.

The difficulty was, however, to ascertain how poisoning by lead could have been effected. With this view I made diligent inquiry into the patient's habits, the water he drank, the utensils he used, &c., but could not detect any source to which the presence of the mineral in the system could be traced, except that the first attack of colic and constipation had occurred whilst temporarily lodging in a house which smelt of fresh paint, but as he soon left this I thought it very insufficient to explain his continued and increasing sufferings. In the course of my inquiries, however, I found that he took snuff in considerable quantities. I accordingly emptied his box of its contents, and took them up to town with me with the view to further examination. This snuff was analysed by Professor Williamson, who immediately detected in it a considerable quantity of lead; and another supply, having been procured from the shop at which Mr. A. B. was in the habit of purchasing it, was subjected to analysis by Dr. Garrod, who readily detected large quantities of the metal in it.

Mr. A. B. was now put under treatment for saturnine paralysis. The snuff was left off; the bowels were kept open with the acidulated sulphate of magnesia; iodide of potassium was freely given in conjunction with strychnia, which was applied topically to blistered surfaces as well as administered by the hands; and galvanism was assiduously employed. Under this plan of treatment he gradually improved in all respects; the colicky symptoms rapidly disappeared, the muscular pains subsided, and the paralytic condition of the extensors was gradually removed, until at the end of July he was able to resume and to discharge public duties of a very onerous character with his usual ability and energy.

With the above sketch, we received from Mr. Erichsen a sample of the snuff which was the occasion of all the mischief. On analysis by Dr. Letheby, it was found to contain 1·2 per cent. of red oxide of lead; that is very much less than some of the other samples the analyses of which have already been given.

But the case reported by Mr. Erichsen is by no means a solitary one: we have already been informed of others.

One of these cases was that of Mr. Fosbroke, the surgeon, of Bidford, Alcester. The particulars, as kindly furnished by Mr. Fosbroke himself, are as follow: —

" In the latter part of the year 1852, I suffered from an attack of what was at the time regarded as simple constipation of the bowels, but attended by considerable pain, especially about the umbilicus, of a twisting character. A medical friend who visited me ordered a dose of morphia, followed by an active aperient, which relieved all the symptoms. In the course of a short time my general health began to fail; I constantly experienced a sensation of sinking about the epigastrium; the bowels became irritable, and I invariably passed liquid motions. After spending a short time from home in May 1854, I was suddenly attacked by similar symptoms I had before suffered from, but of a more severe character. The pain was most excruciating, the bowels more obstinate, and were many days before they were relieved, upon which all the symptoms subsided. I now noticed some trembling of the hands, which, however, soon passed off; but from this time every thing I did was by an effort most painful. The appetite failed, I became much thinner, had palpitations of the heart, constant pains in the lower extremities, and was little refreshed by sleep. Matters continued in this state until October 15th, when being engaged in writing late in the night, I was suddenly (in a moment, in fact) surprised to find that I had no command over the ring-finger of the right hand, that it dragged on the paper, and in a few days the other fingers, as well as those of the left hand, became similarly affected. The extensors of the thumbs and wrists escaped. I was then fully impressed with the idea that it must arise from lead, and I consulted Dr. Thomson of Stratford-on-Avon, who has paid much attention to the subject of lead-poisoning. He at once told me there could be no doubt on the subject; the blue line was well marked on the edges of the gums. In the course of the same week I had a third attack, much more severe than either of the preceding ones; the intensity of the pain was indescribable, and I was only comparatively easy when in a bath of almost boiling water. The bowels, as before, did not act, and required various aperients for forty-eight hours before any effect was produced. Castor oil with laudanum, in large doses, and the use of injections of turpentine, at last gave relief to them. I was then for some time tormented by a fixed pain in the small of the back, and extending to the lower extremities, caused possibly by the action of the turpentine on the kidneys. Dr. T. saw me at this time, when paralysis of the upper extremities had gone on so far that I was unable to turn in bed. He most kindly interested himself in my case, and instituted a most minute inquiry as to what I took different from my family, and at once fixed on the article of snuff as the probable source from which the system had been impregnated. Subsequent investigation fully confirmed his view. My health is now perfectly restored, nothing remaining but a trifling weakness of the extensors of the fingers.

"The treatment, in the first instance, was sulphuric acid and alkaline sulphates. Iodide of potassium produced no very marked benefit until galvanism was conjointly tried with it, under which plan I was in a few months fully restored to health."

In the letter which accompanied the sketch of the case above given, Mr. Fosbroke remarks: —

"Perhaps it may be interesting in some degree, in addition to what I stated respecting myself, if I inform you that my father, who is now between 70 and 80 years of age, took the same snuff, and has been incurably paralysed for many years past. No opinion was given by any medical man he consulted as to its origin. He had discontinued the use of snuff for several years previous to my case occurring, and has now much better health, with exception of the powerless condition of the arms."

In a second communication, Mr. Fosbroke furnishes the following further information: "I forgot to say, respecting my father's case, that about four years ago he suffered most dreadfully from sciatica, which confined him to bed for several months, and that Dr. Thomson then visited him, and pointed out that lead had occasioned all the mischief, but that from its insidious introduction into the system from whatever source, and the length of time that had elapsed, little could be done beyond relieving his present sufferings, which fortunately was effected by sulphuric acid. From distaste he gave up snuff-taking, and has had no return of a similar attack.

"A gentleman in this neighbourhood took the same snuff (Bolongaro, from Taddy's, London), and complained of inability to raise the left arm for some time previous to his death."

A sample of the snuff taken by Mr. Fosbroke yielded on analysis distinct evidences of the presence of lead, but not in amount nearly so great as the previous and many other of the snuffs examined.

Another case was referred, about a year since, to Dr. Letheby; it was that of a gentleman who presented all the symptoms of lead-poisoning. An analysis of the snuff, brown rappee, which he took, led to the discovery of the source of the poison.

At the last meeting of the British Association, it was stated, in a discussion on poisoning by snuff, that many persons had been injured by the lead received into the system through the snuff taken. We have thus, in the case of snuff, another striking example of injury to the public health arising out of the practice of adulteration.

But the practices of smoking and chewing tobacco, and of snuff-taking, are objectionable on other grounds than those relating to health. The dwelling and clothes of the smoker are impregnated with the heavy nauseating odour of the tobacco, particularly offensive to those who have a nice sense of smell, and who are not themselves tobacco-smokers. Indeed, the moral and domestic objections to smoking are of the strongest kind.

In the case of the chewing of tobacco the practice is rendered disgusting by the dark, unnatural, and disfiguring stain which an indulgence in this habit imparts to the teeth, and by the character of the liquid which is constantly ejected.

Snuff-taking is an equally dirty habit; for not only are the nostrils constantly filled with the brown and earthy-looking powder, but the fauces as well as the stomach come in for their share of it; the face is often smeared with it, the nails filled with it, and the shirt and clothes also stained and dirtied by its use.

Other views which may be taken of these practices are, the expense and loss of time which they involve. With regard to the expense and loss of time sacrificed in snuff-taking, the following curious estimate has been made by Lord Stanhope: —

"Every professed, inveterate, and incurable snuff-taker, at a moderate computation, takes one pinch in ten minutes. Every pinch, with the agreeable ceremony of blowing and wiping the nose, and other incidental circumstances, consumes a minute and a half. One minute and a half out of every ten, allowing sixteen hours to a snuff-taking day, amounts to two hours and twenty-four minutes out of every natural day, or one day out of every ten. One day out of every ten amounts to thirty-six days and a half in a year. Hence, if we suppose the practice to be persisted in for forty years, two entire years of the snuff-taker's life will be dedicated to tickling his nose, and two more to blowing it." The expense of snuff, snuff-boxes, and handkerchiefs is also alluded to, and it is calculated "that by a proper application of the time and money thus lost to the public a fund might be constituted for the discharge of the national debt."

It should also be remembered that such unclean and disgusting practices, although they may lose much of their offensiveness from repetition to the parties who themselves practise them, yet that in most cases they are most offensive to those who do not participate in them, and who are forced to be spectators of them.

For much interesting and curious detail relating to Tobacco, the reader is referred to "A Dissertation on the Use and Abuse of Tobacco," by Adam Clarke. The remarks occur near its conclusion: — "To those who are not yet incorporated with the fashionable company of tobacco-consumers I would say, Never enter. To those who are entered I would say, Desist. First, for the sake of your health, which must be materially injured, if not destroyed by it. Secondly, for the sake of your property, which, if you are a poor man, must be considerably impaired by it. But, supposing you can afford this extra expense; consider how acceptable the pence (to go no farther) which you spend in this idle and unnecessary employment would be to many who are often destitute of bread, and to whom one penny would sometimes be as an angel of God. Thirdly, for the sake of your time, a large portion of which is irreparably lost, particularly in smoking. Have you any time to dispose of — to murder? Is there no need of prayer, reading, study? Fourthly, for the sake of your friends, who cannot fail to be pained in your company for the reasons before assigned. Fifthly, for the sake of your voice, which a continuance in snuff-taking will infallibly ruin, as the nasal passages are almost entirely obliterated by it. Sixthly, for the sake of your memory, that it may be vigorous and retentive; and for the sake of your judgment, that it may be clear and retentive to the end. Lastly, for the sake of your soul. Do you not think that God will visit you for your loss of time, waste of money, and needless self-indulgence? Have you not seen that the use of tobacco leads to drunkenness? Do you not know that habitual smokers have the drinking-vessel often at hand, and frequently apply to it? Nor is it any wonder; for the great quantity of necessary moisture which is drawn off from the mouth, &c. by these means must be supplied some other way. You tremble at the thought: well you may, for you are in great danger. May God look upon you, and save you before it is too late! It was this view of the subject which led Mr. Sylvester to imagine that the plant derived its name from Bacchus, the heathen god of the drunkards.

> "'Which of their weapons hath the conquest got
> Over their wits; the pipe, or else the pot?
> For even the derivation of the name
> Seems to allude to, and include the same;
> Tobacco, as τω Βακχω one would say;
> To cup-god Bacchus dedicated ay.'

"It is with pain of heart that I am obliged to say, that I have known several who, through their immoderate attachment to the pipe, have become vile sots. There are others who are walking unconcernedly in the same dangerous road. I tremble for them. Should this fall into their hands, may they receive it as a warning from God!"

We may here take occasion to refer to the results of "The Return of Seizures made, and the Prosecutions for Breach of the Laws relating to Tobacco during the years 1851 and 1852," ordered by the House of Commons, and to place before our readers an epitome of the number of seizures made during these two years of *tobacco* and *cigars*, whether adulterated or smuggled, the materials with which the tobacco was adulterated, and the penalties incurred. In the year 1852, we find that in various parts of Great Britain thirty seizures were made, and prosecutions instituted either for adulterating tobacco, for smuggling tobacco and cigars, or for hawking the same without a license; and in Ireland there were twelve prosecutions, in addition to the seizures made of adulterated articles. In the following year the number of prosecutions was seventeen in England and Scotland, and in Ireland nine, making a total of sixty eight; this, with the fourteen convictions for adulterating snuff, gives the whole number of prosecutions as eighty-two. On analysing the returns, we find that during the two years thirty-one convictions were obtained for smuggling tobacco and cigars; fifteen for hawking and selling the same without a license; five for having in their possession tobacco of Irish growth; and eighteen for adulterating tobacco, having it on the premises, or for being in possession of materials used in the adulteration of tobacco. The following are the substances that were seized:— In six cases rhubarb-leaves had been employed to the amount of from 8 to 20 per cent.; in one case, rhubarb-leaves and potatoes together, also nitrate of soda, 3·21 per cent. over and above that contained in the original leaf; leaves of trees in one sample; earthy matter, 31 per cent., and a mixture of rhubarb and coltsfoot leaves, in another sample; malt commings in two cases; British leaves and saw-dust mixed with other leaves, and salt, 6 per cent. each in one case; dock and other leaves, four cases, in which the amount varied from 12 to 46 per cent.; coltsfoot and other weeds, and wood and earthy matter, of each one sample. In some cases the samples taken were not analysed, the defendants admitting their guilt. A few other prosecutions were also commenced, but in these instances the suspected articles were found to be genuine, and restored to their owners.

In some of those cases in which the parties were found guilty, a fine was inflicted varying in amount from 20*s.* to 500*l.*, and the remainder were subjected to imprisonment for different terms,—from five days in the least important, to three months in the more serious offences against the revenue. As in the case of snuff, it appears that adulteration is much more extensively carried on in the country than in London, only one of the seizures having been made in the latter place, and three for either smuggling or hawking tobacco and cigars. According to the excise return quoted above, adulteration and smuggling is confined to the large manufacturing and sea-port towns in Great Britain, such as Manchester, Leeds, York, Sheffield, Nottingham, &c., and Liverpool, Bristol, Hull, Newcastle, Chatham, Rochester, Aberdeen, Glasgow, and many others. In Ireland these frauds are carried on chiefly in Belfast, Cork, Dublin, Limerick, Galway, and Waterford.

It may be of interest now to give the returns of seizures of adulterated tobacco made, and prosecutions instituted, by the Commissioners of the Excise, from the commencement of the year 1842 to 1851 inclusive.

Return to an Order of the Honourable the House of Commons.

	Number of Seizures.	Number of Prosecutions.
Year ending, Jan. 5th, 1842 - -	10	4
,, ,, 1843 - -	45	22
,, ,, 1844 - -	57	26
,, ,, 1845 - -	82	45
,, ,, 1846 - -	103	60
,, ,, 1847 - -	14	5
,, ,, 1848 - -	9	4
,, ,, 1849 - -	19	13
,, ,, 1850 - -	12	11
,, ,, 1851 - -	17	13
Total for ten years - -	368	203

We would undertake to make as many seizures or rather detections of adulterated tobacco in one or other of its forms, in the space of three months, as are recorded in the above Return, which extends over a period of ten years.

POISONOUS COLOURED CONFECTIONERY.

The subject of the present inquiry is at least of as great importance as any of those which have preceded it, for it very closely concerns the public health, as will be made fully evident in the course of the following report. It is, moreover, a subject which has attracted considerable attention at different times both in this country and abroad.

As early as the year 1830 an article appeared in the pages of "The Lancet," by Dr. O'Shaughnessy, entitled "Poisoned Confectionery." This report contains the annexed preliminary observations:—

"In the following observations it is my principal aim to lay before the public and the medical profession a calm, dispassionate statement of the existence of various poisons (gamboge, lead, copper, mercury, and chromate of lead) in several articles of confectionery, the preparation of which, from their peculiar attractions to the younger branches of the community, has grown into a separate and most extensive branch of manufacture. I am fully aware of the hazardous task that individual undertakes who ventures in this country to signalise such abuses. The wrath of the particular trade is, of course, especially excited. The sneers and ridicule of the ignorant are also abundantly provoked, principally through the recollection of the indiscreet and mischievous efforts which over-zealous or designing alarmists have occasionally made to terrify the public mind by topics of this description. I hope, however, by a plain narrative of facts, and by reference to justly-accredited authorities, to avoid at the same time these unpleasant imputations, and to show the real extent of the danger in question."

In that storehouse of facts relating to the adulteration of food, Accum's Treatise, we find under the heads, "Poisonous Confectionery" and "Adulteration of Lozenges," these remarks—

"In the preparation of sugar-plums, comfits, and other kinds of confectionery, especially those sweetmeats of inferior quality frequently exposed for sale in the open streets, for the allurement of children, the grossest abuses are committed.

"The white comfits, called sugar-pease, are chiefly composed of a mixture of sugar, starch, and Cornish clay, a species of very white pipe-clay, and the red drops are usually coloured with the inferior kind of vermilion. This pigment is generally adulterated with red-lead. Other kinds of sweetmeats are sometimes rendered poisonous by being coloured with preparations of copper. The following account by Mr. Miles * may be advanced in proof of this statement.

"'Some time ago, while residing in the house of a confectioner, I noticed the colour of the green fancy sweetmeats being done by dissolving sap-green in brandy. Now, sap-green itself, as prepared from the juice of the buckthorn berries, is no doubt a harmless substance; but the manufacturers of this colour have for many years past produced various tints, some extremely bright, which there can be no doubt are effected by adding preparations of copper.

"'The sweetmeats which accompany these lines you will find exhibit vestiges of being contaminated with copper. The practice of colouring these articles of confectionery should therefore be banished, the proprietors of which are not aware of the deleterious quality of the substances employed by them.'

"The foreign conserves, such as small green limes, citrons, hop-tops, plums, angelica roots, &c., imported into this country, and usually sold in round chip boxes, are frequently impregnated with copper." Under the head Lozenges, Accum writes—

"Lozenges, particularly those into the composition of which substances enter that are not soluble in water, as ginger, cream of tartar, magnesia, &c., are

* Philosophical Magazine, No. 258, vol. liv., 1819, p. 317.

often sophisticated. The adulterating ingredient is usually pipe-clay, of which a liberal portion is substituted for sugar. The following detection of this fraud was lately made by Dr. T. Lloyd.

"'Some ginger lozenges having lately fallen into my hands, I was not a little surprised to observe accidentally that when thrown into a coal-fire they suffered but little change. If one of the lozenges were laid on a shovel, previously made red-hot, it speedily took fire; but instead of burning with a blaze, and becoming converted into charcoal, it took fire, and burnt with a feeble flame for scarcely half a minute, and there remained behind a stony, hard substance, retaining the form of the lozenge. This unexpected result led me to examine these lozenges, which were bought at a respectable chemist's shop in the City; and I soon became convinced that in the preparation of them a considerable quantity of common pipe-clay had been substituted for sugar. On making a complaint about this fraud at the shop where the article was sold, I was informed that there were two kinds of ginger lozenges kept for sale, the one at threepence the ounce, and the other at sixpence per ounce, and that the article furnished to me by mistake was the cheaper commodity: the latter were distinguished by the epithet *verum*, they being composed of sugar and ginger only; but the former were manufactured partly of white Cornish clay, with a portion of sugar only, with ginger and Guinea pepper. I was likewise informed, that of Tolu lozenges, peppermint lozenges, and ginger pearls, two kinds were kept; that the *reduced* articles, as they were called, were manufactured for those very clever persons in their own conceit who are fond of haggling, and insist on buying better bargains than other people, shutting their eyes to the defects of an article, so that they can enjoy the delight of getting it cheap; and secondly, for those persons who, being but bad paymasters, yet, as the manufacturer, for his own credit's sake, cannot charge more than the usual price of the articles, he thinks himself therefore authorised to adulterate it in value, to make up for the risk he runs and the long credit he gives.'—*Literary Gazette*, No. 146.

"The comfits called ginger-pearls are frequently adulterated with clay."

Under the head of "Lozenges and their Adulteration," Mr. Mitchell observes:—

"There are few substances so subject to adulteration as lozenges and similar preparations consumed by children; not only are substances added to them which are cheaper than the sugar in their composition, but others also of a very deleterious character, as preparations of lead, arsenic, copper, &c., for the purpose of colouring.

"The substances employed in the adulteration in bulk are chalk, pipe-clay, plaster of Paris, sand, and starch, all of which bodies can be readily detected and are very often present in such lozenges as are sold in small quantities, and are therefore consumed by children, occasioning severe constipations, and all the diseases arising from such a source; indeed there is little doubt that many children are thus annually sacrificed."

And again, at page 209., Mr. Mitchell continues:—

"I may here add, that all the cheap lozenges I have examined contain starch, and, very nearly all, chalk and plaster of Paris; only a few contain sand, such being a very palpable adulteration. The quantity of chalk and plaster of Paris varied from one to twelve per cent.

"I now have to treat of a far more dangerous adulteration: I allude to the colouring matters used in the manufacture of lozenges, &c., the papers also in which some of these substances are wrapped have also a great tendency to communicate a poisonous character, on account of the presence of salts of arsenic, copper, &c.

"In addition to my own experiments, I shall give the greater portion of a paper on this subject by Dr. O'Shaughnessy, which appeared in the second volume of THE LANCET, 1830-31; and I must also state that I can fully confirm that gentleman's experiments as to the various 'substances used in this most infamous manufacture.'

"Dr. O'Shaughnessy," writes Mr. Mitchell, at page 213., "purchased various lozenges and articles of confectionery, both coloured and colourless, and wrapped in stained papers. I have also purchased such samples at various shops, as have my friends, who have furnished me with them. I have also used Dr. O'Shaughnessy's classification. Of the coloured articles, the greater number (Class 1) were sold expressly for eating; some (Class 2) were cut into small figures, and intended apparently for ornament; but were sold without restriction; and lastly, some (Class 3) were expressly designed for ornament alone. Of the first class, about thirty different kinds were examined, the red being coloured as follow:—

"'*Ten Specimens of Red Comfits, &c.*

1. Minium, or red oxide of lead.
2. Red sulphuret of mercury (vermilion).
1. Mixture of both the former.
1. Of a yellowish or orange tint, chromate of lead, and a vegetable lake of lime.
2. Cochineal alone.
2. Vegetable lakes of alumina and lime.

10'

"In addition to the above samples, I have examined a lozenge of an orange tinge, coloured with chromate of lead and minium (red lead). Dr. O'Shaughnessy states, 'that of the ten specimens he examined, which were expressly designed for eating, six were coloured with mineral poison, and all, with only one exception, were coloured externally.

"'Of the *yellows* (Class 1.) seven specimens of different forms and tints were examined; four were coloured externally with *gamboge;* one coloured throughout with a vegetable lake of lime; one coloured throughout *oxide of lead*, and traces of antimony or Naples yellow. Six of the seven, consequently, contained deleterious substances.'

"Of yellows, I have found some coloured with gamboge, others by some vegetable colouring matter, not gamboge, and some coloured both on the surface and throughout with chromate of lead.

"'Of the *greens* (Class 1.), several specimens were examined: all were coloured by Prussian blue and a vegetable yellow lake of alumina, mixed with sulphate of lime, except one specimen, of which I had only two comfits, and which gave me a mixture of copper and lime.'

"In the greens, I have very often found copper; but in no case have I examined any sample containing Scheele's green or the arsenite of copper, although many such exist, as is fully proved by a case which a gentleman had the kindness to communicate to me. In this instance four children were the sufferers, the youngest of whom was not expected to survive, but ultimately recovered the effects of the poisonous lozenges eaten. Both the lozenges and the contents of the stomach, which had been ejected, were examined, and each contained copper and arsenic in notable quantities, quite sufficient to account for the illness which had occurred.

"'The blues (Class 1.) were chiefly Prussian blues, and contained no hurtful compound.'"

"In the second class, or those apparently intended for ornament, but sold without restriction, and formed into all sorts of fantastic shapes, of eight forms of yellow, three contained chromate of lead, one Naples yellow, one massicot or yellow lead, and three vegetable lakes of alumina and lime. All these were coloured throughout, and contained, moreover, sugar and plaster of Paris, or sulphate of lime.

"The reds in this class were of six specimens: three vegetable lakes of alumina or lime, one chromate of lead, with a red vegetable lake, and two red lead.

"The greens and blues were as described in Class 1.

"In the third class, the composition was precisely the same.

"I may mention that a friend brought me, some little time since, a piece of sugar, 'rock,' (such as is sometimes found in cakes,) from a highly respectable confectioner; and, on examination, it was found that the colour was due to the presence of verdigris, (acetate of copper,) which is an exceedingly poisonous salt.

"The papers were next examined, especially those used for enveloping the sugar drops, called 'kisses.' Without exception the reds were coloured by the *red sulphuret of mercury*, the yellows by the *chromate of lead*, and many of the greens by *verdigris*, or the carbonate of copper." — *Mitchell.*

We will now proceed to give some brief directions, which may prove of assistance to others who may desire to analyse for themselves any suspected samples of coloured confectionery. We shall, however, confine our directions chiefly to the detection of those substances which we have ourselves discovered in the different samples subjected to examination. From the large number of analyses which we have made, and the results of which we shall make known in the course of the present report, the pigments detected will embrace certainly all the most important of those which are ordinarily employed in the coloration of confectionery.

Of the colours used, some are soluble in water, and others insoluble; the former include nearly all the vegetable colours, and the latter most of the mineral colours. In this particular, therefore, there is a broad distinction between vegetable and mineral colouring matters, which will be found very useful in guiding us in our subsequent operations.

In the majority of cases there is but one colouring matter present, and this is usually confined to the surface of the various articles of confectionery, while in other cases different colours are used in the same article. When the colour is confined to the surface, it is readily removed by washing in distilled water, from which, if mineral or insoluble, it will usually be precipitated after standing for some time, and it may then be obtained in an almost unmixed state. When the colour is diffused throughout the whole of the article, the same end can be accomplished by dissolving it in water; the sugar will be removed by the water, and the colouring matter will subside. But should the article contain starch, or any other insoluble substance, it, of course, goes down with the colouring matter. When different colours occur in the same article, they must each be cut out with a knife, and separately washed and tested.

In many cases a shorter method of proceeding than the above may be adopted. The confectionery, when it is supposed to be coloured with a fixed metallic salt, may be incinerated in a capsule, and the ash tested.

Nearly all the pigments used may be referred to one or other of the following colours: *red*, *yellow*, *blue*, *green*, *brown*, and *purple*; other tints occur, which are formed by various combinations of the primary colours.

If the *red* or *pink* colouring matter be of a *vegetable* nature, or indeed if it consist of a solution of *Coccus cacti* or *cochineal*, this may be ascertained by simply immersing small portions of the coloured comfit or lozenge, the one in a solution of caustic potash, and the other in acetic acid; if it be a vegetable colour, or the animal colouring matter cochineal, it will become purplish in the alkaline, and brilliant red in the acid solution. If the colour be not thus affected, then there is reason to suppose that it is a mineral colouring matter, most probably either red lead or vermilion. Inasmuch as many red and pink comfits, &c. are coloured with non-metallic colouring matter, it is as well to try them all in this way in the first instance, and so save ourselves the trouble of analysing each for metallic pigments.

The *lead of the red oxide, or of the chromates of lead*, may be obtained either by washing or by incinerating the comfits; it should be dissolved in a few drops of nitric acid, and the solution be diluted with distilled water previous to testing. If the sugar be adulterated with sulphate of lime the lead may escape detection proceeding in this manner, in consequence of its being converted into a sulphate, in which case the soluble portion of the ash having been removed, the remainder should be fused with a mixture of nitre and bisulphate of potash; the residue, after having been well washed with water, is to be treated with a solution of ammoniacal tartrate of ammonia, by which means the sulphate of lead is taken up, and may be precipitated with sulphuretted hydrogen.

Bisulphuret of mercury or vermilion, after being obtained in as pure a state as possible, must be dissolved in aqua regia, nitro-hydrochloric acid. It is not an uncommon thing to meet with in the same red pigment both lead and mercury, vermilion being very subject to adulteration with red lead.

The *yellows*, like the reds, may be either *vegetable* or *mineral;* but contrary to what was found to be the case with the reds, the yellow colouring matters employed are for the most part mineral, consisting of *lemon-yellow*, *orange-chrome*, both these being *chromates of lead*, *Naples yellow*, and *massicot*. All the yellows therefore should be carefully tested for lead. For this purpose it is sometimes only necessary to touch the surface of the comfit with sulphuret of ammonium, which will turn it of a deep blackish-brown colour if much lead be present. Those articles which are not found to contain lead should be subsequently tested for *gamboge*, which is the next pigment most commonly employed; and if it do not prove to be this, then a portion of the comfit should be immersed in a solution of caustic potash, when, if it become decidedly browned, the colouring matter will be vegetable, and most likely *turmeric*, *saffron*, or *yellow lake*, which is usually formed from the colouring matter of French berries thrown down by alumina or lime, but it may be made from any vegetable yellow: these vegetable yellows are not very frequently employed, probably on account of their liability to alter and fade on exposure to the air and light,—an objection which also applies somewhat to gamboge.

If the pigment be *gamboge*, it will form, with distilled water, a yellowish opaque emulsion, which will not let fall any deposit. This emulsion should be evaporated to dryness, and alcohol added to the residuum; the alcohol will take up the gamboge, and when water is added to the solution, the gamboge will be precipitated. If to the yellow precipitate a drop or two of strong ammonia be now added, it is redissolved, producing a blood-red solution, from which it is precipitated pale yellow by nitric acid. Turmeric gives nearly the same reactions, and therefore much care is requisite to discriminate between the two. Turmeric does not form so decided an emulsion with water as gamboge.

If the pigment contain lead, the colour of the comfit will generally sufficiently inform us of the preparation of lead used, whether it be lemon or orange chrome or massicot. If we are anxious to make certain whether the yellow colour be *Naples yellow*, which contains antimony as well as lead, the antimony may be sublimed in an open tube; it is distinguished from arsenic by not forming a crystalline crust, but a white powdery oxide of antimony, as well as by other tests.

The *blues* may be also either *vegetable* or *mineral:* the former include *litmus* and *indigo;* and the latter, *Prussian blue*, *Antwerp blue*, the two *verditers*, which consist of *carbonate of copper*, the only difference between them being, that the paler verditer is diluted with lime; *cobalt; smalt*, which is a glass of cobalt powdered; and *artificial ultramarine*, which is made in imitation of true ultramarine or lazulite.

The vegetable blue, *litmus*, is sufficiently distinguished by its becoming red on the addition of weak acids. This pigment is manufactured from several species of a lichen (*Rocella*), and, when genuine, is innocuous. In a Report of M. Andral, addressed some years since to the Prefect of Police, it is stated that some manufacturers mix common arsenic and peroxide of mercury with litmus, and M. Andral therefore considers that its use in the colouring of sweet confectionery should be prohibited.

Indigo is sufficiently distinguished by its subliming in dense violet vapours when heated, by forming a blue solution with concentrated sulphuric acid, and by its remaining unchanged in alkalies.

The colour of *ferrocyanide of iron*, or *Prussian blue*, is immediately discharged on the addition of the caustic alkalies, the iron being thrown down in a state of peroxide.

Antwerp blue is Prussian blue, the colour of which is rendered lighter and brighter in consequence of its dilution with some colourless material. Indigo, of course, when burned, leaves no ash, whereas the ashes of Prussian and Antwerp blues are coloured deep brown with oxide of iron.

The *verditers* are distinguished by their containing copper, as shown by ammonia, and ferrocyanide of potassium, or by dissolving in dilute nitric acid, and then precipitating the metal on a polished rod of iron.

The remaining *blue pigments*, *cobalt*, *smalt*, and *ultramarine*, are distinguished by their colour being fixed in the fire, so that the ash of sugar articles coloured with any of these substances is of a bright blue, the tint varying according to the blue used, as well as also in consequence of admixture with uncoloured substances, such as chalk, lime, or pipe-clay. These colours are somewhat expensive, especially the true ultramarine, but they are of such intensity that a little goes a great way; there is, however, a cheap kind of ultramarine, sold in the shops as German or French ultramarine, the price being about sixpence per ounce, and it is this blue pigment which is chiefly employed in the colouring of sugar confectionery. This may be distinguished, when free from admixture with other substances, by adding to it a little hydrochloric acid, and observing the odour of sulphuretted hydrogen or rotten eggs evolved. This method of discrimination is, in the case of coloured sugar confectionery, for the most part inapplicable, since sulphuretted hydrogen is almost invariably thrown off whenever hydrochloric acid is added to the ash left on the incineration of most articles of sugar confectionery.

Of the *greens*, there is but one *vegetable* green used—namely, *sap-green*. This is prepared from the green berries of the buckthorn, *Rhamnus catharticus;* but its use is to be objected to on account of its frequent adulteration with green metallic pigments, containing either copper or arsenic, in order to heighten its colour and render it more permanent.

Of the *metallic greens*, some are simple colours, while others are composed of a blue and a yellow mixed. The *simple greens* are *acetate of copper* or *verdigris*, and *arsenite of copper*, *emerald green* or *Scheele's green*. The first of these colours is known by its containing copper, and its being entirely dissipated by heat, and the latter by its containing both copper and arsenic. The arsenic can be readily obtained in a crystalline state by subliming a minute portion of the colouring matter in a small glass tube open at both ends, and this test is quite conclusive as to the nature of this pigment.

The *compound greens* ordinarily used are those commonly sold as *Brunswick greens;* they are the colours usually employed in making green paint, and are of three different tints, known as pale, middle, and deep Brunswick. They consist of a mixture, in various proportions, of usually *Antwerp blue*, but sometimes *ultramarine*, and *pale chromate of lead*. Where obtained in any quantity from the confectionery, and diffused through water in a shallow dish, the two colours easily separate. Other compound greens are occasionally made by mixing a yellow pigment, usually the *pale chrome*, with one or other of the verditers. The true Brunswick greens are *oxi-chlorides of copper*, but these being very expensive, are seldom employed.

The *browns* which we have met with consist of *Vandyke brown* and *burnt umber;* these are both *ferruginous earths*.

The *purple colour* sometimes met with in sugar confectionery is usually composed of a mixture of *Antwerp blue* and some *vegetable pink*, as *rose-pink*, the *lakes*, or *cochineal*.

In addition to the various pigments above-mentioned, *bronze powders*, which consist of an alloy of copper and zinc, are sometimes employed in ornamenting sugar confectionery.

But like most other articles of consumption sugar confectionery is liable to further adulteration by admixture with a variety of substances cheaper than the sugar, of which they ought entirely to be formed. Although our attention has been directed principally to the detection of the colouring matters employed, we have yet not overlooked the general adulterations to which articles of sugar confectionery are subject.

The principal substances said to be used are various kinds of *starch*, *chalk*, *sulphate of lime* or *plaster of Paris*, *hydrated sulphate of lime* or *gypsum*, and *white potter's clay*, *pipe-clay*, or *Cornish clay*.

Ordinary plaster of Paris, although stated to be employed in the manufacture of confectionery intended to be eaten, can scarcely ever be so, since when this is moistened with water it quickly becomes solid, retaining its solid state after incineration; on the other hand, hydrated sulphate of lime does not remain solid, and when exposed to a red heat, it is still a powder.

Chalk is sufficiently identified by its appearance, by its effervescing on the addition of an acid, and by the lime being thrown down from its solution by oxalate of ammonia.

The *gypsum* must be tested both for sulphuric acid and for lime, and the *clay* for alumina.

The kind of *starch* employed is detected by means of the microscope, and the quantity may be estimated in either of the following ways: — When starch only is mixed with the sugar the latter may be dissolved out, and the precipitated starch dried and weighed; but when any other insoluble substance is present the precipitate left after the removal of sugar may be burned, and the loss of weight will give very nearly the quantity of starch present; or the precipitate may be boiled in water. The starch will be taken up, and the insoluble matter will subside, the supernatant liquid can then be decanted from the deposit, and the starch precipitated in the form of an iodide.

Results of the Chemical and Microscopical Examination of nearly One Hundred Samples of Different Kinds of

COLOURED SUGAR CONFECTIONERY.

Comfits of Various Kinds.

1*st Sample.* — Purchased of J. Lussenden, 64. Broad-street, Bloomsbury.

The comfits in this parcel are coloured *deep pink* and *yellow*, intermixed with *white* or uncoloured comfits. The colouring matters used are, for the pink, a *non-metallic* or *organic red pigment*, most probably a solution of *cochineal;* and for the yellow, CHROMATE OF LEAD or CHROME YELLOW. These comfits also furnished 43·66 per cent. of *ash.*

2*nd Sample.* — Purchased of A. W. Hearn, 56. Tottenham-court-road.

The comfits in this sample are all of a *pale pink* colour, the pigment used being a *non-metallic red colouring matter.* *Ash,* 1·72 per cent.

Coriander Comfits.

3*rd Sample.* — Purchased of R. Kilner, 4. Hanway-street, Oxford-street.

These comfits are all of a *deep pink.* The colour, which consists of a non-metallic red pigment, most probably *cochineal.*

White Caraway Comfits.

4*th Sample.* — Purchased of S. Clark, 117. Bishopsgate-street Without.

These comfits consisted externally of sugar, and internally of a large nucleus made up of *wheat-flour* enclosing the seed. The flour, when thoroughly dried, amounted to 8·90 per cent. Ash, 1·60 per cent.

Some ingenuity in deception was displayed in the manufacture of these comfits, for when placed in the mouth they were quite sweet to the taste at first, but after the external coating of sugar had been dissolved, there remained behind the hard and tasteless nucleus of considerable size.

Large Oval Comfits.

5*th Sample.* — Purchased of J. Lussenden, 64. Broad-street, Bloomsbury.

The comfits in this parcel were coloured *pink* and *yellow*, intermixed with a few *white* or uncoloured ones. The colouring ingredients used for the pink pigment are a *non*-metallic red, probably *cochineal*; and for the yellow, CHROMATE OF LEAD, the latter in rather large amount. *Ash* very inconsiderable.

Red Burnt Almonds.

6*th Sample.* — Purchased of J. Cooper, 209. Tottenham-court-road.

The almonds in this sample are coloured *deep pink.* The colour consists of the usual red pigment, probably *cochineal.* The *ash* furnished by the sugar portion amounted to 2·26 per cent.

7*th Sample.* — Purchased of R. Lumley, 427. Oxford-street.

Coloured with a non-metallic, red pigment, probably *cochineal.* *Ash,* 1·26 per cent.

8*th Sample.* — Purchased of W. C. Bowler, 13. Commercial-road.

Coloured with the usual *non-metallic, red pigment.* *Ash,* 1·72 per cent.

9*th Sample.* — Purchased of S. Martin, 118. Osborne-street, Whitechapel.

Coloured with a *non-metallic, red pigment.* *Ash,* 1·70 per cent.

10*th Sample.* — Purchased of W. Sessers, 4. Drury-lane.

These almonds are coloured apparently with the same non-metallic, red pigment. They also furnished 7·90 per cent. of *ash*.

Sugared Almonds.

11*th Sample.*—Purchased of J. Barrett, 24. New Church-street, Paddington.

The almonds in this parcel are coloured *deep pink* and *yellow*, mixed with *white* or uncoloured ones. The colouring matters used are, for the pink, an organic, red pigment, probably *cochineal;* and for the yellow, CHROMATE OF LEAD, in very considerable amount. *Ash*, 1·0 per cent.

12*th Sample.* — Purchased of W. Sessers, 4. Drury-lane.

The almonds in this sample are coloured *pink* and *yellow*, intermixed with a few *white* almonds. The colouring ingredients employed are, for the red pigment, a non-metallic pink, probably *cochineal;* and for the yellow, CHROMATE OF LEAD. *Ash*, 1·32 per cent.

13*th Sample.*—Purchased of M. Marchant, 303. Oxford-street.

The almonds in this parcel are coloured *pink*, *purple*, *blue*, and *yellow*, mixed with a few *uncoloured* ones. The colouring matters used are, for the pink, the usual non-metallic, red pigment; for the blue, *Prussian blue;* for the purple, *Prussian blue* mixed with red; and for the yellow, CHROMATE OF LEAD, the latter being present in immense quantity, so as to render the almonds quite poisonous. They were thickly and coarsely painted with the colouring matter, which, when touched with hydrosulphuret of ammonium, instantly turned quite black. *Ash*, very inconsiderable.

14*th Sample.*—Purchased of R. Kilner, 4. Hanway-street, Oxford-street.

The almonds in this sample are all of a *deep pink* colour, the colouring ingredient employed consisting of a non-metallic red pigment. *Ash*, very inconsiderable.

15*th Sample.* — Purchased of W. Offer, 3. Shepperds-market.

The almonds in this parcel are coloured *pink*, intermixed with a few *white* ones; the colouring matter employed consisting of the usual *non-metallic red pigment*. *Ash*, 1·76 per cent.

16*th Sample.*—Purchased of Mr. Blanchard, South-street, Manchester-square

The almonds in this parcel were *pink*, *yellow*, *salmon-colour*, and *pale purple*, mixed with a few *white* ones; the colouring matters employed being, for the pink, a non-metallic red pigment, probably *cochineal;* for the salmon-colour, a mixture of the usual red pigment, and some yellow colouring matter; for the purple, *Prussian blue*, combined with the non-metallic red, &c.; and for the yellow, CHROMATE OF LEAD, the latter in very large and poisonous amount. *Ash*, very inconsiderable.

Sugar Buttons.

17*th Sample.*—Purchased of Mr. Hampton, Grafton-street, Soho.

These buttons are about the size of half-a-crown; they are white, and coloured here and there with *bright red*, which, on analysis, was found to consist of VERMILION, or bisulphuret of mercury.

Scotch Mixture.

18*th Sample.* — Purchased of S. Martin, 118. Brick-lane, Spitalfields.

The confectionery in this parcel consists of a mixture of various sweets, as comfits of different kinds, almonds, &c., coloured *pink* and *yellow*, intermixed with some white ones. The colouring ingredients used are — for the pink, a non-metallic red pigment, probably *cochineal;* and for the yellow, CHROME YELLOW or CHROMATE OF LEAD, the latter in immense quantity. *Ash*, of a pale fawn colour, 2·20 per cent.

19*th Sample.*—Purchased of M. Marchant, 303. Oxford-street.

The sweets in this sample consist of a variety of comfits, almonds, &c. and coloured *pink*, *blue*, and *yellow*, intermixed with a few white ones. The colouring matters employed are — for the pink, *a non-metallic red pigment;* for the blue, *Prussian blue;* and for the yellow, CHROMATE OF LEAD, the latter being present in poisonous amount. *Ash*, brownish.

20*th Sample.*—Purchased of G. Bacon, 110. Houndsditch.

The confectionery in this parcel consists of comfits of different kinds, coarse lozenges made in various forms, rings, hearts, stars, &c., variously coloured, *pink*, *blue*, and *yellow*. The colouring matters employed being—for the pink *an organic red pigment;* for the blue, *artificial or German ultramarine;* and for the yellow, CHROME YELLOW, in rather large amount. *Ash*, slaty blue, 8·50 per cent.; residue deposited from watery solution, chiefly *wheat-flour*, 10·46 per cent.

When this sugar is dissolved in water, the hydrated sulphate of lime is not deposited, but is chemically held in solution by the sugar, the solution being scarcely rendered turbid by the presence of the lime. The same thing occurs in other similar cases, where the proportion of lime is not very great indeed. This is a very convenient property of sugar for the manufacturers of sugar confectionery, since they are not liable to detection in using the hydrated sulphate of lime, except the sugar be burnt and the ash tested. It is really surprising how much lime is thus held dissolved.

21*st Sample.*—Purchased of F. Allen, 119. High-street, Whitechapel.

The contents of this parcel are similar to the above sample, the prevailing colours being *pink*, *bright blue*, and *yellow*. The colouring ingredients used are—for the pink, *a non-metallic red pigment;* for the blue, *artificial ultramarine;* and for the yellow, CHROMATE OF LEAD in considerable amount. *Ash*, brown, consisting of *hydrated sulphate of lime*, 14·56 per cent.; residue deposited from watery solution, chiefly wheat-flour, 16·00 per cent.

22*nd Sample.*—Purchased of J. Edwards, 15. James-street, Covent-garden.

This sample consists of coarse lozenges, hearts, and rings, similar to the last; the colouring ingredients employed being—for the pink, the usual *red pigment;* and for the yellow, CHROMATE OF LEAD. *Ash*, brown, consisting of hydrated sulphate of lime, 15·00 per cent.; matter insoluble in water, principally *wheat-flour*, 14·80 per cent

Kiss-me-now.

23*rd Sample.*—Purchased of S. Lyons, 18. Brick-lane, Spitalfields.

The contents of this parcel are in the form of large flat lozenges or medals, of a very coarse description, vandyked round the edges, and having mottoes stamped upon the surface; they are coloured *pink* and *yellow*, and mixed with a few white ones. The colouring matters used are—for the pink, a non-metallic red pigment, probably *common cochineal;* and for the yellow, CHROMATE OF LEAD in considerable quantity. *Ash*, consisting of *hydrated sulphate of lime*, 7·70 per cent; residue thrown down from watery solution, mostly *wheat-flour*, 6·60 per cent.

24*th Sample.*—Purchased of G. Reading, 18. Church-lane, Whitechapel.

This sample is similar to the last, but the prevailing colour is *yellow;* this consists of CHROMATE OF LEAD in very considerable, indeed quite poisonous, amount. *Ash*, brownish-grey, composed of hydrated sulphate of lime, 7·80 per cent.; residue thrown down from watery solution, chiefly *potato-flour*, 14·50 per cent.

25*th Sample.*—Purchased of S. Martin, 118. Brick-lane, Spitalfields.

The sweets in this parcel are in the shape of stars, very large, larger than a crown-piece, and exceedingly thin; they are mostly coloured *yellow*, but a few are white; the yellow pigment employed is CHROMATE OF LEAD, which is present in very large amount. *Ash*, pale yellow, 1·96 per cent.; matter insoluble in water, consisting of *potato-flour*, 13·15 per cent.

26*th Sample.*—Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

The contents of this parcel consist of flat lozenges, cut into the form of a rude imitation of a bird, and are coloured *deep pink*, *blue*, and *yellow*, mixed with a few uncoloured ones. The colouring ingredients used are—for the deep pink, the *non-metallic red pigment;* for the blue, *German or artificial ultramarine;* and for the yellow, CHROMATE OF LEAD, the latter in very large quantity. *Ash*, dull, light blue, 2·26 per cent.; matter insoluble in water, chiefly *East India arrowroot*, 18·32 per cent.

27*th Sample.*—Purchased of A. C. Bowler, 13. Commercial-road.
These are large, flat, oval, white lozenges or tablets, having the figure of a jockey printed upon their surface in light blue ink, the colouring ingredient employed being *German ultramarine*. *Ash*, somewhat blue, 1·52 per cent.; residue thrown down from watery solution, consisting chiefly of *potato-flour*, 2·30 per cent.

28*th Sample.*—Purchased of W. Carr, 14. Pilgrim-street, Doctors'-commons.
This sample consists of flat lozenges or tablets moulded in the form of a heart, some being *reddish-orange*, and others *yellow*, having a motto, or the figure of a man, bird, or flower, impressed upon them in *pink*. The colouring matters used are—for the orange pigment, a mineral colour containing lead, and probably RED LEAD; and for the yellow, CHROMATE OF LEAD; the lead in both kinds being in immense, indeed quite poisonous amount. *Ash*, reddish-yellow, 18·26 per cent., consisting of *hydrated sulphate of lime*; residue thrown down from watery solution, chiefly *wheat-flour*, 15·25 per cent.

Coloured Shapes.

29*th Sample.*—Purchased of G. Osborne, 33. Bishopsgate-street Without.
The sweets in this parcel are made up into various fanciful shapes, such as dice, rings, caps, hats, coffee-berries, &c., also into lozenges variously flavoured, in the form of clubs, diamonds, hearts, spades, and stars; they are coloured *pink*, *blue*, and *dull green*, intermixed with white caraway and other comfits. The colouring matters employed are—for the pink, a *non-metallic red pigment*; for the blue, *artificial ultramarine*; and for the dull green, BRUNSWICK GREEN. *Ash*, light, slaty-blue, 5·14 per cent.; residue insoluble in water, chiefly *wheat-flour*, 10·75 per cent.

30*th Sample.*—Purchased of W. Lumley, 427. Oxford-street.
The contents of this parcel are similar to the above sample, and coloured deep *pink*, *blue*, and *yellow*, intermixed with a few uncoloured cinnamon comfits, &c. The colours employed are—for the deep pink, the *non-metallic red pigment*; for the blue, *artificial ultramarine*; and for the yellow, CHROMATE OF LEAD, the latter being present in very large and even poisonous quantity. *Ash*, 2·18 per cent.; matter insoluble in water, chiefly *wheat-flour*, 7·00 per cent.

31*st Sample.*—Purchased of R. Kilner, 4. Hanway-street, Oxford-street.
This sample is somewhat similar to the last two, the chief colours being *pink*, *blue*, and *yellow*. The colouring ingredients used are—for the pink, the usual *non-metallic red pigment*; for the blue, the colour known as *Antwerp blue*; and for the yellow, CHROMATE OF LEAD in rather large amount; it was found likewise that the blue shapes contained a considerable quantity of lead. *Ash*, bright orange yellow, 1·96 per cent.; residue insoluble in water, chiefly *wheat-flour*, 4·75 per cent.

32*nd Sample.*—Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.
The confectionery in this parcel is made up into the form of stars, rings, and diamonds, and also into rude imitations of shells, apples, pears, carrots, &c. The colouring of all these is most vivid, embracing *pink*, *blue*, *green*, *orange*, and *yellow*. The colours used are—for the pink, the usual *non-metallic red pigment*; for the blue, *Antwerp blue*; for the green on carrot-tops, *pale* BRUNSWICK GREEN, *containing lead*; for the orange-coloured part of carrots, RED OXIDE OF LEAD; and for the yellow, CHROMATE OF LEAD, in large and poisonous amount. *Ash*, buff-coloured, 1·86 per cent.; matter insoluble in water, chiefly *wheat-flour*, 2·65 per cent.

33*rd Sample.*—Purchased of Mr. Watkins, 26. Queen's Head Court, Princes-street.
The contents of this sample are similar to the last, but the colouring is much more bright and intense. The different shapes are variously coloured *pink*, *blue*, *orange*, *yellow*, and *green*. The colouring ingredients used are—for the pink, the usual *red*; for the blue, *Antwerp blue*; for the orange, RED LEAD; for the yellow, CHROMATE OF LEAD; and for the green, *pale* BRUNSWICK GREEN, in very large amount. *Ash*, orange-yellow, 1·66 per cent.; residue insoluble in water, mostly *wheat-flour*, 12·56 per cent.

It will be noticed that no less than three poisonous compounds of lead in large quantities enter into the colouring of these sweets.

Lozenges of different kinds.

Ginger Lozenges.

34*th Sample.*—Purchased of G. Osborne, 33. Bishopsgate-street Without.

These lozenges were found upon analysis to be coloured with chromate of lead in large quantity. *Ash*, yellowish-brown, 1·92 per cent.

35*th Sample.*—Purchased of J. Kilner, 4. Hanway-street, Oxford-street.

These lozenges contain a poisonous quantity of chromate of lead. *Ash*, 1·50 per cent.

36*th Sample.*—Purchased of C. W. Hearn, 56. Tottenham-court-road.

These lozenges are apparently genuine; at all events they certainly are not coloured with chromate of lead. *Ash*, white, 2·32 per cent.

37*th Sample.*—Purchased of J. Barrett, 84. Church-street, Paddington.

Like the last, these lozenges are not artificially coloured, and are therefore most probably genuine. *Ash*, white, 1·10 per cent.

38*th Sample.*—Purchased of J. Cooper, 209. Tottenham-court-road.

These lozenges were found to be coloured with chromate of lead, but not in large quantities; they also contained a little *wheat-flour*. *Ash*, brownish, 4·30 per cent.

Cayenne Lozenges.

39*th Sample.*—Purchased of J. Lussenden, 84. Broad-street, Bloomsbury.

These lozenges are coloured *rose-pink*, the colouring ingredient being a *non-metallic red pigment;* they contained 1·66 per cent. of *wheat-flour*. *Ash*, 1·26 per cent.

40*th Sample.*—Purchased of R. Lumley, 427. Oxford-street.

The lozenges in this parcel are of a deep rose-pink colour, being coloured with the usual *non-metallic pigment*. *Ash*, 1·12 per cent.

41*st Sample.*—Purchased of G. Osborne, 33. Bishopsgate-street Without.

The analysis of these lozenges, termed tonic lozenges, has been confined simply to the determination of the ingredient employed in colouring them; this consists of *carbonate of iron*. The *ash* furnished by incineration amounts to five per cent., and presents a characteristic ferruginous colour; cinnamon and apparently catechu are also present.

42*nd Sample.*—Purchased of G. Osborne, 33. Bishopsgate-street Without.

These lozenges, sold as fruit lozenges, were of a *pinkish-blue* colour, and on analysis were found to be coloured with a mixture of *Antwerp blue* and *rose-pink* or *cochineal*. *Ash*, bright yellowish-buff colour, 4·60 per cent.

Yellow Rock.

43*rd Sample.*—Purchased of Mr. Humphries, Dorville's-row, Hammersmith.

An opaque mass of boiled sugar, cast into large cakes three or four inches thick, known commonly as "rock," the surface being coated with transparent sugar, like barley-sugar, with veins of the same running in layers through the mass. The rock was a deep and bright yellow throughout, and *flavoured* with an essence which has somewhat the flavour of apples. The colouring matter consisted of chromate of lead in very large and poisonous amount.

Ginger Palates.

44*th Sample.*—Purchased of S. Berry, 21. Great Windmill-street, Haymarket.

These consist of large thick pieces of sugar confectionery, about two inches long and three quarters of an inch thick, weighing about half an ounce each. They are coloured throughout of an intense *yellow*, and flavoured with ginger; the pigment used was chromate of lead, in quantity absolutely poisonous.

45*th Sample.*—Purchased of A. C. Bowler, 13. Commercial-road.

These are large yellow balls, flavoured with ginger, and about a quarter of an ounce in weight; coloured *bright yellow*, the ingredient employed for the purpose of colouring consisting of CHROMATE OF LEAD in large amount. *Ash*, brownish-grey, 1·36 per cent.

46th Sample. — Purchased of W. T. Odell, 28. Brick-lane, Spitalfields.
The sweets in this parcel are large cushion-shaped balls, about a quarter of an ounce in weight each, and white, but on one side coloured *bright pink*, and on the other a brilliant *blue* colour. The ingredients employed for the colouring being—for the bright pink, a *non-metallic red pigment;* and for the blue, *artificial ultramarine.* *Ash*, greenish-blue, 1·28 per cent.

Clove Sticks.

47th Sample.—Purchased of S. Berry, 21. Great Windmill-street, Haymarket.
These sticks are round, about half an inch thick, flavoured with the essential oil of cloves, and having spiral stripes of transparent sugar running round them; these stripes are coloured with the usual *red pigment*, while the substance of the sticks is dyed throughout with yellow, the pigment used being CHROMATE OF LEAD, in poisonous quantity.

48th Sample.—Purchased of G. Reading, 18. Church-lane, Whitechapel.
This sweet, made of coarse brown sugar, and flavoured with oil of cloves, is in the form of long flat sticks, having bright red winding stripes around them. The colouring matter employed for the stripes consisted of RED OXIDE OF LEAD, or RED LEAD, and this in large and almost poisonous amount. *Ash*, 5·0 per cent.

Peppermint Pipe.

49th Sample.—Purchased of S. Martin, 118. Brick-lane, Spitalfields.
The sticks have stripes of *pink*, *blue*, and *yellow*, winding spirally round them. The colouring matters employed are—for the pink, a *non-metallic red pigment;* for the blue, *artificial ultramarine;* and for the yellow, LEMON CHROME or CHROMATE OF LEAD, in large quantity; LEAD was also detected in the red stripes. *Ash*, blue, 6·36 per cent., consisting chiefly of *hydrated sulphate of lime.*

50th Sample.—Purchased of S. Berry, 21. Great Windmill-street.
These sticks are white, and have *bright blue* spiral stripes running round them; the colouring matter of the stripes consisting of *artificial ultramarine.* *Ash*, bright blue.

Ginger Pearls.

51st Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.
Ginger pearls, or *ginger seeds* as they are more commonly called, consist of small hollow globules of sugar, flavoured with ginger, and coloured outside of an intense *yellow*, the colour being due to the yellow pigment so employed in confectionery—namely, CHROMATE OF LEAD, and this was in amount absolutely poisonous. Matter insoluble in water, consisting chiefly of *wheat-flour* and *ginger*, 11·60 per cent.

Sugar Dragees.

52nd Sample.—Purchased of R. Lumley, 427. Oxford-street.
These sweets are moulded in various forms, some being kidney-shaped, others crescentiform, or circular, or oval; they are hollow, crystallised in the centre, and filled with syrup flavoured with rose; one side of these ornaments is coloured *pink* or *purple*, and the other left *white.* The pink colouring matter is organic and most probably *rose-pink*, and the purple is composed of *Antwerp blue* and *rose pink.* *Ash* inconsiderable.

Coloured Sugar Seeds.

53rd Sample. — Purchased of G. Reading, 18. Church-lane, Whitechapel.
These sugar-seeds are small round globules, about the size of a large pin's head or mustard-seed, and commonly known as "hundreds and thousands;" they are variously coloured, the colours in the present sample being *crimson*, *pink*, *orange*, *dark blue*, and *yellow*, intermixed with white globules. The colouring matters used are, for the crimson and pink, the usual *non-metallic red;* for the blue, *Prussian blue;* for the orange, RED-LEAD; and

for the yellow, CHROMATE OF LEAD,—both these latter in poisonous quantity. The *ash* furnished by the *blue* seeds is brownish red; by the *yellow*, fawn; and by the *green*, brownish; residue thrown down from watery solution, chiefly *wheat-flour*, 5·72 per cent.

54*th Sample.* — Purchased of J. Bradley, 34. Leman-street, Whitechapel.

The seeds in this sample are of a coarser description than the last, and coloured *bright-blue*, *bright orange-red*, and *yellow*, mixed with white. The colours used are: for the blue, *Antwerp blue;* for the scarlet, RED LEAD; and for the yellow, CHROMATE OF LEAD, both these being in large and poisonous quantities. Ash, 20·72 per cent., consisting principally of *hydrated sulphate of lime;* the ash of the *blue* seeds was of a reddish colour, and of the *yellow*, yellowish-grey; matter insoluble in water, chiefly *wheat-flour*, 25·56 per cent.

55*th Sample.* — Purchased of S. Martin, 118. Brick-lane, Spitalfields.

These seeds are coloured crimson with the usual *red pigment*, bright blue with *Artificial ultramarine*, scarlet with RED LEAD, and yellow with CHROMATE OF LEAD, the two latter to a poisonous extent. *Ash*, 1·78 per cent.; that of the *blue*, deep blue; and of the *yellow* seeds, yellowish; residue deposited from watery solution, chiefly *wheat-flour*, 9·36 per cent.

56*th Sample.* — Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

The colours of these seeds are, *crimson*, *pale pink*, *light blue*, *dull greenish blue*, *light grass-green*, *orange-yellow*, and *lemon-yellow*, intermixed with white globules. The colouring ingredients employed are: for the crimson and pink, the usual *non-metallic red;* for the blue, *Antwerp blue;* for the dull greenish-blue, VERDITER, containing LEAD; for the grass-green, PALE BRUNSWICK GREEN; and for the orange and bright yellows, the orange and yellow CHROMATES OF LEAD, in large quantity. *Ash*, light reddish-brown, 1·06 per cent.; matter insoluble in water, chiefly *wheat-flour*, 9·60 per cent.

Thus no less than three active poisons containing LEAD and COPPER were present in this sample in considerable amount.

Cocoa-nut Candy.

57*th Sample.* — Purchased of J. Bradley, 34. Leman-street, Whitechapel.

Cocoa-nut candy was made of common brown sugar, moulded in square flat cakes, with thin slices of cocoa-nut introduced into it whilst still hot, and its surface was thickly covered with a layer of the same "hundreds and thousands," the analysis of which is given in Sample 54. This, therefore, is a highly deleterious article.

Transparent Sugar Confectionery.

58*th Sample.* — Purchased of G. Osborne, 33. Bishopsgate-street Without.

This sample consists of transparent crystallised drops, hollow in the centre, filled with some flavoured syrup, and coloured *blue;* the colouring matter being *Artificial or German ultramarine.* *Ash*, blue, 1·06 per cent.

59*th Sample.* — Purchased of R. Lumley, 427. Oxford-street.

The contents of this parcel are precisely similar to the above, and coloured blue with *German ultramarine.* *Ash*, dull blue, 1·12 per cent.

60th *Sample.* — Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

These sweets are somewhat like the last, but much smaller, and flavoured with peppermint. They are coloured *red* and *blue.* The colouring matters used are: a *non-metallic red pigment;* and for the blue, *artificial ultramarine.* *Ash*, dull blue, 2·12 per cent.

61*st Sample.* — Purchased of J. Lussenden, 64. Broad-street, Bloomsbury.

These drops are about the size of a raspberry, crystallised on the outside, and coloured of a *deep rich pink*, nearly *crimson*, and quite transparent, the colour used consisting of a non-metallic red pigment, most probably *cochineal.* *Ash* inconsiderable.

62*nd Sample* — Purchased of A. C. Bowler, 13. Commercial-road.

The confectionery in this parcel is made up into the form of large hearts and rings, transparent, crystallised upon the outside, and with a hollow in the centre filled with syrup. They are of a *deep blue* colour; the blue pigment employed being *German ultramarine.* *Ash*, slaty blue, 2·26 per cent.

63rd Sample.—Purchased of R. Lumley, 427. Oxford-street.
The contents of this parcel are similar to the last, and coloured *pale greenish-blue;* the colouring matter used being *Prussian blue. Ash*, orange colour.

64th Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.
This sample is precisely similar to the last, and coloured with *Prussian blue Ash*, fawn colour.

Rasher of Bacon.

65th Sample.—Purchased of J. A. Cooper, 209. Tottenham-court-road.
The rind of the bacon is indicated by a coating of a brown pigment, *Vandyke* brown, or some other ferruginous colouring matter; and the lean, by streaks of the red pigment commonly employed as the pink colouring ingredient for confectionery. *Ash* inconsiderable.

Mutton-chop on Plate.

66th Sample.—Purchased of R. Lumley, 427. Oxford-street.
The plate is a white one with a deep blue border, brilliantly coloured with *artificial ultramarine*, while that portion of the chop which represents the muscle or flesh, is deeply coloured with the usual *red organic pigment. Ash* of border of plate, intense blue, 1·96 per cent.

Oyster.

67th Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.
The colouring ingredient used in this instance, consists of *burnt umber*, *Vandyke brown*, or some analogous ferruginous earth. The *ash* was of a deep reddish-brown, and weighed 1·72 per cent.

Fish.

68th Sample.—Purchased of W. Offer, 3. Sheppard's-market.
The tip of the nose and gills of the fish are coloured with the usual *pink*, while the back and sides are highly painted with that virulent poison, ARSENITE OF COPPER, SCHEELE'S GREEN, or EMERALD GREEN.

Strawberry.

69th Sample.—Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.
The colours in this article are *red*, with a *little yellow* and *green*, to indicate the calyx of the strawberry. The red is the usual non-metallic pigment, and the green consisted of BRUNSWICK GREEN, and consequently contained CHROMATE OF LEAD.

Apples.

70th Sample.—Purchased of J. Edwards, 15. James-street, Covent-garden.
The apples in this sample are coloured *yellow*, and on one side *deep red;* the yellow colour extending to a considerable depth into the substance of the sugar; the red consists of the usual *non-metallic pigment;* and the yellow is due to the presence of CHROMATE OF LEAD in really poisonous amount. *Ash*, 1·44 per cent.

71st Sample.—Purchased of A. C. Bowler, 13. Commercial-road East.
These sugar-apples are coloured to the same deleterious extent as the former with CHROMATE OF LEAD.

Oranges.

72nd Sample.—Purchased of W. Carr, 14. Pilgrim-street, Doctors'-commons.
This is a very unnatural imitation of an orange; it being coloured with a coarse and very uneven coating of RED LEAD.

73rd Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.
This, on the contrary, is a very exact imitation of an orange; it is thickly coated, and, to a poisonous extent, with the variety of CHROMATE OF LEAD, known as *orange chrome. Ash*, dark rusty brown, 1·76 per cent.

Lemons.

74th Sample.—Purchased of T. Holloway, 102. Drury-lane.
The surface of this lemon was coloured with GAMBOGE.

75th Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.
The colouring matter used in this case was GAMBOGE. *Ash*, 1·26 per cent.

76th Sample.—Purchased of A. C. Bowler, 13. Commercial-road.

In this case the colour was of a much brighter yellow, very different to that of the two preceding samples; and it was found that the colouring matter consisted of that variety of CHROMATE OF LEAD termed LEMON CHROME, in very large quantity.

77th Sample.—Purchased of Mr. Humphries, Domville-row, Hammersmith.

The colour of this sample was of a *bright lemon yellow*, but exceedingly dense and opaque; so thick indeed was the coat of paint, that the surface had a coarse and rough appearance, and the coating could be separated with a knife, and if collected it would have weighed several grains. The pigment consisted of the light kind of CHROMATE OF LEAD, known as LEMON CHROME, of which there was sufficient to render it quite poisonous.

78th Sample.—Purchased of ——, Farringdon-street.

This imitation of a lemon is very highly coloured; the pigment employed consisting of GAMBOGE in very large quantity.

Plum.

79th Sample.—Purchased of A. W. Hearn, 56. Tottenham-court-road.

This sweet is moulded in the form of an egg-plum, and coloured purplish-red in imitation of the natural fruit, the colouring matters used consisting chiefly of a *vegetable red*, with, in parts, a small quantity of a yellow pigment, containing CHROMATE OF LEAD. *Ash*, pinkish-grey, 1·12 per cent.

Pears.

80th Sample.—Purchased of T. Holloway, 102. Drury-lane.

This sample consists of an imitation of a full-ripe pear, and is vividly coloured *yellow*, overlaid on one side with *bright orange red;* the colouring ingredients employed are: for the red, the usual *non-metallic red pigment*, which being laid on over the yellow, gives it the orange tint; and for the yellow, GAMBOGE.

81st Sample.—Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

This confection, like the last, is also an imitation of a pear, and similarly coloured. The colouring ingredients used, being the same *non-metallic red pigment*, and for the yellow, CHROMATE OF LEAD in rather large proportion.

Potato.

82nd Sample.—Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

This is also of a yellow colour, and is slightly tinted at one end with a little of the usual *non-metallic red pigment*, the yellow consists of CHROMATE OF LEAD.

83rd Sample.—Purchased of T. Holloway, 102. Drury-lane.

This potato resembled the previous sample in form and appearance, but was coloured with a thinnish coating of GAMBOGE.

Swan.

84th Sample.—Purchased of T. Holloway, 102. Drury-lane.

The colours in this are: *yellow*, for the beak; *brown*, for the top of the head; and a border of *dull green* round the base or stand. The yellow pigment consists of a thick coat of CHROMATE OF LEAD; the brown, of *umber*; and the green of MIDDLE BRUNSWICK GREEN, containing CHROMATE LEAD.

Pigeon.

85th Sample.—Purchased of T. Holloway, 102. Drury-lane.

The pigments employed for colouring the pigeon, are: *light yellow*, for the beak; *red* for the eyes; and *orange yellow*, for the base or stand. The yellow colour consists of the light kind of CHROMATE OF LEAD or PALE CHROME; for the eyes, BISULPHURET OF MERCURY or VERMILION; and for the stand, the deeper variety of CHROMATE OF LEAD or ORANGE CHROME.

Cock.

86th Sample.—Purchased of T. Holloway, 102. Drury-lane.

The beak of this bird is coloured *bright yellow;* the comb, *brilliant red;* the wings and tail are variegated with *black*, two different *reds*, and *yellow;* while the stand, as in most of these sugar ornaments, is painted *green*. The yellow of the beak consists of CHROMATE OF LEAD; the comb and part of the red colour on the wings, of VERMILION; while the second red colour on the wings and tail is the usual pink *non-metallic colouring matter*, and the stripes of yellow consist of GAMBOGE; lastly, the green of the stand is MIDDLE BRUNSWICK GREEN, and therefore contains CHROMATE OF LEAD. In the colouring of this article, then, no less than three active poisons are employed, as well as that drastic purgative, GAMBOGE.

PHEASANT.

87*th Sample.*—Purchased of S. Martin, 118. Brick-lane, Spitalfields.

This sugar figure of a pheasant is highly coloured on the back with *pink* and *bright yellow*, the base on which it stands having a deep margin of *bright green* running round it. The colouring ingredients used are: for the pink, the usual *non-metallic red pigment;* for the yellow, GAMBOGE; and for the green of the stand, that deadly poison ARSENITE OF COPPER, SCHEELE's or EMERALD GREEN. This sweet is, therefore, like very many of the others, highly poisonous.

DOG AND HARE.

88*th Sample.*—Purchased of A. C. Bowler, 13. Commercial road.'

The nose and ears of the dog, and the tongue of the hare, are coloured bright-red with VERMILION. The body is spotted with large patches of GAMBOGE and *burnt umber*, as also was the figure of the hare which lay at its feet; while the green pigment on the base, of which there was a very large quantity contained CHROMATE OF LEAD, and consisted of the pale variety of BRUNSWICK GREEN. *Ash*, dark reddish-brown, 2·0 per cent.

DOG.

89*th Sample.*—Purchased of W. Offer, 3. Sheppard's-market.

The colouring ingredients used for painting this sugar dog are: for the ears and nose, the usual *non-metallic pigment;* for the chief part of the back, a ferruginous brown earth, most likely *burnt-umber;* and for the stand on which the dog is represented as reclining, ARSENITE OF COPPER or EMERALD GREEN, in quantities so considerable as to be absolutely poisonous.

CROWN.

90*th Sample.*—Purchased of F. Allen, 119. High-street, Whitechapel.

This article is of a light but intense blue colour, the colouring ingredient employed being *German* or *Artificial ultramarine;* this pervades the whole substance of the sweet; the pearls are imitated by white sugar, and the other ornaments of the crown are stained deep pink, with the usual *non-metallic red pigment*. *Ash*, dark blue, 2·12 per cent.

FIGURE OF WOMAN.

91*st Sample.*—Purchased of A. W. Hearn, 56. Tottenham-court-road.

The head-dress of this figure is coloured bright yellow with CHROMATE OF LEAD; the eyes and shoes blue, with *German ultramarine;* the dress of a deep crimson, with the ordinary *red organic pigment;* and the ground with a few streaks of pale dull green. The only thing remarkable in the colouring of this sample is the large and poisonous quantity of CHROME YELLOW which enters into the painting of the head-dress.

FIGURES OF DANCERS.

92*nd Sample.*—Purchased of J. Clarke, 17. Bishopsgate-street Without.

The head-dresses of both these figures are of a bright yellow colour, which was found to be CHROMATE OF LEAD; the bodies bright and intense crimson, with the usual *non-metallic red pigment*, and the ground on which the figures stand, yellow, with spots of brown; the colouring ingredients of the ground are: for the yellow, CHROMATE OF LEAD in large and poisonous amount; and for the brown, *burnt umber*. *Ash*, dirty green, 1·66 per cent.

Mixed Sugar Ornaments.

93*rd Sample.* — Purchased of J. Finch, 65. Whitechapel-road.

The contents of this parcel consisted of sweets moulded into various forms, such as trumpets, flowers, and flower-pots, &c.; they are all hollow, filled with rose-flavoured syrup, and coloured deep blue, the surfaces being ornamented with the forms of the articles in white sugar, the prominent parts being painted *pink and yellow*. The colouring ingredients used are: for the blue, *Artificial ultramarine*; for the pink, the *ordinary pigment*; and for the yellow, CHROMATE OF LEAD in very large quantity. *Ash*, intense blue, 2·06 per cent.

94*th Sample.*—Purchased of Mr. Dunsmore, 17. Middle-row, Holborn.

The confectionery in this parcel is made up into a variety of forms and devices, as hats, jugs, baskets, and dishes of fruit and vegetables. One of the hats is coloured yellow with CHROMATE OF LEAD, and has a green hatband around it coloured with ARSENITE OF COPPER; a second hat is white, with a blue hatband, the pigment being *Prussian blue.* The baskets are coloured yellow with CHROMATE OF LEAD; into the colouring of the pears and peaches the usual *non-metallic red pigment*, CHROMATE OF LEAD, and MIDDLE BRUNSWICK GREEN, enter largely; while the carrots represented in a dish are coloured throughout with RED OXIDE OF LEAD, and the tops with the same green. This is one of the worst of all the samples of coloured sugar confectionery submitted to analysis, as it contains no less than four deadly poisons.

95*th Sample.*—Purchased of J. Robinson, 1. Maiden-lane, Covent-garden.

These mixed sweets are cast in different forms, representing birds, fish, rabbits, &c. The colours used consist of the usual *red organic pigment*, *Prussian blue* and GAMBOGE, while the bases or stands of all the ornaments are thickly painted with EMERALD GREEN or ARSENITE OF COPPER.

Almond Liqueurs.

96*th Sample.* — Purchased of A. W. Hearn, 56. Tottenham-court-road.

The confectionery in this parcel consists of oval comfits of the same size and appearance as "sugared almonds;" but instead of having an almond for a nucleus, they are hollow, and filled with a syrup, flavoured with vanilla, almond, rose, or shrub; they are coloured variously *pink*, *blue*, and *yellow;* the coloured ingredients used being—for the pink, an *organic pigment;* for the blue, *Prussian blue;* and for the yellow, a very thin coating of GAMBOGE. *Ash*, reddish, 1·80 per cent.

97*th Sample.* — Purchased of W. J. Odell, 28. Brick-lane, Spitalfields.

The contents of this parcel are similar in every respect to the preceding, the colours employed being the usual *non-metallic red pigment*, *Prussian blue*, and GAMBOGE. *Ash*, light brown, 1·36 per cent.

Twelfth Cake Ornaments.

98*th Sample.* — Purchased of F. Allen, 117. High-street, Whitechapel.

The ornaments in this parcel consist of a ship in full sail, a duck, a fox, and a bunch of flowers, the principal colours being green, yellow, red, and brown; the chief pigments employed are CHROMATE OF LEAD, RED OXIDE OF LEAD or RED LEAD, VERMILION, *sienna*, and ARSENITE OF COPPER; these being present in poisonous quantity.

99*th Sample.* — Purchased of J. Bradley, 34. Leman-street, Whitechapel.

The ornament in this case represents a lion. The mane is coloured brown with *burnt sienna;* the mouth red, with VERMILION; the ground and grass about him intensely coloured with ARSENITE OF COPPER and RED OXIDE OF LEAD.

100*th Sample.* — Purchased of J. Finch, 65. Whitechapel-road.

The articles in this parcel are an imitation of Prince of Wales's feathers, a melon on a yellow plate, and a bunch of radishes; the prevailing colours being pink, green, orange, lemon yellow, and deep red, the pigments are *lake*, a *red oxide of iron*, most probably *Indian red*, YELLOW AND ORANGE CHROMATES OF LEAD, and a very large quantity of ARSENITE OF COPPER.

101*st Sample.* — Purchased of J. Bates, 46. Whitechapel.

These twelfth-cake ornaments represent roses with stems and leaves, a fish on blue water, a steam-vessel on the sea, and a human face and figure. The colours and the pigments used were nearly all similar to the previous sample, with the exception of the blue imitation of the water, the colouring matter here used being *ferrocyanide of iron*, or *Prussian blue*.

In the case of all these cake ornaments, the colours are mixed up with WHITE LEAD or CARBONATE OF LEAD, which renders them still more poisonous.

From an examination of the preceding extensive series of analyses of coloured sugar confectionery, it appears —

That the principal colours employed are yellows, reds, including pink and scarlet, browns, purples, blue, and greens.

Of the yellows —

That *Seven* were coloured with LEMON CHROME, or the pale variety of CHROMATE OF LEAD.

That *Five* were coloured with ORANGE CHROME, or the deep variety of CHROMATE OF LEAD.

That *Forty-seven* were coloured with the bright or canary-coloured variety of CHROMATE OF LEAD.

That *Eleven* of the samples were coloured with GAMBOGE.

While the colour of the majority of the above samples was confined to the surface, in many cases it was diffused equally throughout the whole mass of the sugar used.

Of the reds —

That *Sixty-one* were coloured with *organic pink* colouring matters, consisting in most cases of *Coccus Cacti*, or *cochineal*.

That in *Twelve* of the samples the colouring matter was RED LEAD, RED OXIDE OF LEAD, or MINIUM.

That in *Six* cases the colouring ingredient consisted of VERMILION, CINNABAR or BISULPHURET OF MERCURY.

Of the browns —

That *Eight* were coloured with *brown ferruginous earths*, either *Vandyke brown*, *Umber*, or *Sienna*.

Of the purples —

That two samples were coloured with a mixture of *Antwerp blue*, which consists principally of Prussian blue, aud an organic red pigment, most probably *cochineal*.

Of the blues —

That one was coloured with *indigo*.

That *Eleven* were coloured with *Prussian blue*, or *ferrocyanide of iron*.

That *Eleven* were coloured with *Antwerp blue*, which is a modification of *Prussian blue*.

That in *Fifteen* samples the colouring matter consisted of GERMAN OR ARTIFICIAL ULTRAMARINE, which is a double silicate of alumina and soda with sulphuret of sodium.

Of the greens —

That *Five* samples were coloured with the *pale variety* of BRUNSWICK GREEN.

That *Four* were coloured with *middle* BRUNSWICK GREEN.

That *One* was coloured with the *deep variety* of BRUNSWICK GREEN.

These greens consist of a mixture, in different proportions, of the CHROMATES OF LEAD and *Prussian blue*.

That one sample was coloured with VERDITER or CARBONATE OF COPPER.

That *Nine* were coloured with SCHEELE'S GREEN, EMERALD GREEN, or ARSENITE OF COPPER.

The above colours were variously combined in different cases; as many as three, four, five, six, and even seven colours, occurring in the same parcel of confectionery, including three and even four poisons. (See samples 32, 33, 53, 56, 84 to 88, 94, 95, and 98 to 101.)

That in *Four* of the samples, the colours used were painted on with WHITE LEAD or CARBONATE OF LEAD. This was the case in all the cake ornaments.

It further appears from the above analyses —

That *Thirteen* of the samples were adulterated with *hydrated sulphate of lime*, the quantity varying from 4·3 to 43·66 per cent.

That *Twenty-one* of the samples were adulterated with different kinds of *Flour*, in quantities varying from 1·66 to 25·56 per cent. In *Seventeen* samples the farina consisted of *wheat-flour;* in *Three*, of *potato-flour*, and in *One*, *East India arrow-root.*

It will be observed that the list of colouring matters above enumerated includes some substances of an injurious character, and many which are amongst the most virulent and deadly of the mineral poisons. Of those which may be considered as more or less injurious, are *Ferrocyanide of iron* or *Prussian blue*, *Antwerp blue*, GAMBOGE, and *German* or *artificial ultramarine*. Amongst those which are deadly and poisonous, are—the three CHROME YELLOWS or CHROMATES OF LEAD; RED LEAD or RED OXIDE OF LEAD; WHITE LEAD or CARBONATE OF LEAD; VERMILION or BISULPHURET OF MERCURY; the three BRUNSWICK GREENS; VERDITER or CARBONATE OF COPPER; and EMERALD GREEN, SCHEELE'S GREEN, or ARSENITE OF COPPER.

It may be alleged by some that these substances are employed in quantities too inconsiderable to prove injurious; but this is certainly not so, for the quantity used, as is amply indicated in many cases by the eye alone, is often very large, and sufficient, as is proved by numberless recorded and continually occurring instances, to occasion disease, and even death; to some of these instances we shall hereafter refer. It should be remembered, too, that the preparations of lead, mercury, copper, and arsenic, are what are termed cumulative —that is, they are liable to accumulate in the system little by little, until at length the full effects of the poisons become manifested. Injurious consequences have been known to result from merely moistening wafers with the tongue; now the ingredients used for colouring these include many that are employed in sugar confectionery:—how much more injurious then must the consumption of sugar thus painted prove, when these pigments are actually received into the stomach.

That deadly poisons, like the above, should be daily used for the mere sake of imparting colour to articles of such general consumption as sugar confectionery—articles consumed chiefly by children, who from their delicate organisation are much more susceptible than adults—is both surprising and lamentable. It is surprising, on the one hand, that the manufacturers of these articles should be so reckless as to employ them; and, on the other, that the authorities should tolerate their use.

In other countries, some of which we are in the habit of looking down upon as being behind ourselves, manufacturers of sugar confectionery using injurious colouring ingredients are liable to penalties. In France the subject has been deemed of sufficient importance to occupy the attention of the Minister of Police and the Council of Health, and M. Andral, in 1830, at the instigation of the Council, drew up a report, addressed to the Prefect of Police, on the dangers which may result from the use of coloured sugar confectionery, and he suggested remedies. The result of this report was the issuing of an ordinance, in which the practice of colouring sugar confectionery was most emphatically denounced; the poisonous ingredients specified; the harmless enumerated; visits were made; penalties were inflicted; and it was further ordered that no confectionery should be sold, unless the papers in which it was enclosed were stamped with the name and address of the confectioner. Lastly by this edict the vendors were held responsible for all accidents occasioned by the confectionery or liqueurs sold in their establishments.

Regulations more or less resembling the above are in force in Belgium and Switzerland; in Zurich, indeed, the use of colouring matters of all kinds is interdicted.

Following the example of the Council of Health of Paris, we now furnish two lists, one of colours the use of which may be permitted, and the other, of those colours the employment of which should be strictly prohibited, on the ground that they are all more or less dangerous to the public health, and most of them absolutely poisonous.

List of Colours, the Use of which may be permitted.

YELLOWS.

Saffron.
Turmeric.
French berries.
Lake of ditto, or yellow lake.
Persian berries.
Lake of ditto.
Quercitron bark.
Lake of ditto.
Fustic wood.
Lake of ditto.

REDS.

Cochineal.
Lakes of ditto, including
Carmine and
Brazil wood.
Lake of ditto.
Pink madder lake.

PURPLES.

Madder purple.
Logwood and indigo.
Any of the lakes, with indigo or litmus.

BLUES.

Indigo.
Litmus.

GREENS.

Sap green (juice of Rhamnus catharticus).
Yellow lake, or French berries and indigo.
Any of the vegetable yellows, or lakes, with indigo, including Persian berries and indigo.

Obs.— Of the above colours one, viz., sap-green, is certainly liable to injurious adulteration, and it is stated that litmus is so likewise.

List of Colours, the Use of which should be prohibited.

YELLOWS.

Gamboge.
The three chrome yellows, or chromates of lead.
Yellow orpiment, or sulphuret of arsenicum.
King's yellow, or sulphuret of arscenicum, with lime and sulphur.
Iodide of lead.

REDS.

Red lead, minium, or red oxide of lead.
Vermilion, or bisulphuret of mercury.
Red orpiment, realgar, or bisulphuret of arsenic.
Iodide of mercury.

BROWNS.

Vandyke brown.
Umber.

PURPLES.

All purples resulting from the mixture of any of the prohibited reds or blues.

BLUES.

Prussian blue, or ferrocyanide of iron.
Antwerp blue, a preparation of Prussian blue.
Cobalt.
Smalt, a glass of cobalt.
Verditer, or carbonate of copper.
Ultramarine, a double silicate of alumina and soda, with sulphuret of sodium.
German or artificial ultramarine, which resembles in its composition natural ultramarine.

GREENS.

The three Brunswick greens.
Mineral green, or carbonate of copper.
Verdigris, or di-acetate of copper.
Emerald green, or arsenite of copper.
The true Brunswick greens, or Oxychlorides of copper.

THE VARIOUS BRONZE POWDERS.

Gold, silver, and copper bronzes; these consist of alloys, in different proportions, of copper and zinc.
White lead, or carbonate of lead.

By an examination of these lists, it will be perceived that nearly all the substances now employed by the manufacturers of coloured sugar confectionery belong to the second or prohibited list. Even the first list contains the names of two or three colours, the use of which is not wholly free from objection,—as indigo, litmus, and sap-green; the two latter in consequence of their liability to adulteration. Genuine litmus being a vegetable colour, is of course harmless; but its use is rendered objectionable from its being frequently adulterated, according to M. Andral, with common arsenic and peroxide of mercury. From ultramarine, in contact with an acid, sulphuretted hydrogen is freely liberated; and this liberation no doubt takes place readily in the stomach when any confectionery coloured by this pigment is partaken of.

For ourselves, we altogether object to the practice of colouring articles of consumption of all kinds and descriptions: while it merely gratifies the sense of sight, it serves to conceal other adulterations, and is attended in a variety of ways with the greatest danger to health. The danger arises, not merely from the wilful employment of substances of known hurtfulness, but also from their use through ignorance and accident. The excuse of ignorance may tell somewhat in favour of manufacturers, who in some cases may not be aware of the deadly nature of the articles which they daily use, knowing them only by their common or popular names.

Serious as the results recorded in these analyses really are, we have reason to believe that, some years since, things were even worse, and that nothing was more common than to meet with articles of sugar confectionery coloured with verdigris or acetate of copper, with the verditers or carbonates of copper, and with mineral green or arcenite of copper, all of which are virulent poisons.

We will now refer to a few of the cases recorded of poisoning resulting from the use of coloured sugar confectionery.

In September, 1847, Mr. Hetley, visiting surgeon to the Marylebone Infirmary, was requested to go as quickly as he could to Marylebone-lane, to see several persons who had been taken suddenly and dangerously ill.

He found three adults and eight children severely affected with vomiting and retching; the angles of their mouths and their linen were coloured green by the ejections. On inquiry into the case, one of the children stated that he had bought two-pennyworth of some coloured confectionery ornament, of which they had all partaken. The symptoms appeared within ten minutes of its being taken, and evidently corresponded to those produced by poisoning with verdigris or diacetate of copper. Some of the offending article (a thin cake of sugar and Paris plaster mixed, covered with a layer of bright green) was, however, found, which at once made the case clear.*

Dr. Guy, in commenting on the above case, states, that "an accident on a larger scale, but happily unattended by any fatal result, occurred in our own experience, one of the patients having been brought to the King's College Hospital on the day after the accident. An ornamental green basket, after having been used at an evening party, was given to one of the attendants, who distributed the fragments among the inmates of a large workshop. Severe vomiting and purging was the result."†

About the same time a terrible occurrence, arising out of a similar cause, took place at Nottingham. Mr. W. Cowfield, with twenty others, was poisoned at a public dinner given in that town, on the 7th of June, 1848. Mr. Cowfield lost his life. It appeared, on the investigation which followed, that he had partaken of a blancmange, the top of which was coloured with emerald green or arsenite of copper.

In February, 1849, Dr. W. Fergus published the cases of three children, who were poisoned by eating the green sugar ornaments from a twelfth-cake.‡

In the month of June following, Professor Christison exhibited to the Members of the Edinburgh Medico-Chirurgical Society a green powder, which he had purchased at a confectioner's in that city. It was a portion of the stock employed to colour jellies, &c.; and on examination he found that it consisted of sugar, mixed with verdigris and Scheele's green. His attention was drawn to it

* Pharmaceutical Journal, vol. vii. p. 199, 1847.
† Ranking's Abstract, vol. vii. p. 347.
‡ Medical Gazette, p. 304.

by the severe illness of two maid-servants who had partaken of some jelly coloured with it.*

Dr. Letheby, in May, 1850, made known the particulars of some cases which came under his observation in the London Hospital.†

"Hannah M——, aged four years and a half, Jane E——, aged ten years, and Amelia Levi, also aged ten years, were admitted into the London Hospital on Sunday, April 28th, suffering from violent sickness and great prostration of strength. It appeared that they had bought some sugar ornaments and coloured confectionery from a Jew in Petticoat-lane, and that, soon after they had partaken of these sweetmeats, they became very sick, complained of a burning sensation in the mouth, fauces, and œsophagus, of great pain in the stomach and abdomen, and were seized with violent retching, which was attended, after a few hours, with profuse purging. When they were admitted into the hospital they were seriously ill, for the features looked pale and shrunk, the extremities were deathly cold, the pulse was in each case small and feeble, and the surface of the body, especially of the last-named child, was covered with a clammy perspiration. Emetics of sulphate of zinc were instantly administered, and the vomited matters were saved for analysis. Antidotes of milk, white of eggs, and demulcents, were also given in great abundance, and, after the sickness had subsided, they were permitted to sleep, from which state they awoke considerably relieved. The vomited matters were evaporated to dryness, and the solid residue, not amounting to two drachms in weight, yielded abundant evidence of the presence of arsenic, copper, lead, iron, and zinc, all of which metals, excepting the last-named, had doubtless been derived from the confectionery of which the children had partaken. On making inquiry into the matter, we were informed that between thirty and forty children had been attacked in a similar way, and that they had all purchased sweetmeats from the Jew in question; but it does not appear that he was acquainted with the poisonous nature of his merchandise, for he had purchased it, so he stated, as the refuse stock of a large and very respectable firm in the City."

"I have been induced to record," states Dr. Letheby, "the preceding cases, not so much for the purpose of exhibiting the nature of the symptoms observed, as with the view of showing the necessity for some legislative interference in a matter of what may truly be termed wholesale public poisoning; for, without such evidence before the mind, it would not be credited by the great bulk of the community, that many of the prettiest and daintiest looking confections of the dessert-table are, like the choicest luxuries of the Queen-mother (Catherine de Medicis), but too often the source of danger to those who partake of them. Within the last three years no less than seventy cases of poisoning have been traced to this source; and how many, may we ask, have escaped discovery?"

PORTER, AND ITS ADULTERATIONS.

The London public are indebted for porter, their favourite beverage, to a brewer of the name of Harwood, who introduced it in the year 1730.

At this period it was probably not possessed of such distinct features as at present, as the drink in favour up to that time had been a mixture of ale and beer, sold at twopence per measure then in use. Porter being intended to supersede this mixture, no doubt at first resembled it in strength, flavour, and colour, and the present empyreumatic and strong bitter flavour, and the other characteristics which distinguish the porter of the present day, were the results of gradual experiment, and the growing favour with which the new compound was received. The popularity which porter has attained may be judged of when it is remembered, that until the last few years it had entirely excluded the manufacture of ales from the leading breweries in London; now, again, there is

* Lond. Journal of Medicine, vol. i. p. 792.

† Medical Times, vol. iv. p. 792.

an apparent slight reaction in favour of ale; but this is hardly real, as the returns show that very nearly, if not quite as much porter is consumed as ever, in proportion to the increased population, while there is a greatly increased consumption of ales in addition.

Porter and stout should be brewed of malt and hops only, and the colour, as well as flavour, should be due to these alone.

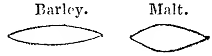
The colour of all malt liquors is dependent upon the degree of heat to which the malt has been subjected in the kiln, and upon the amount of ripeness the hops have attained before being stripped from the poles. Thus, for the pale bitter ales the greatest care is necessary to prevent the husk of the malt from charring in the least, and to maintain the original straw colour of the barley; and in the selection of the hops, that they should be picked as soon as sufficiently ripe to keep, and that no single brown or withered leaf should be suffered to remain The reverse of all this is the case with the malt and hops required for porter. The malt should be briskly dried, until the flower of the grain is of a light brown colour, and crushes with a crisp friability between the teeth; the hops, also, should have hung in the autumn sun till they have attained a rich golden hue, and the seeds are perfectly developed. With all attention to these requirements, however, the beer brewed would still be far from the necessary colour and flavour, and to attain these the malster is compelled to prepare malt in a peculiar manner. It must be remembered, nevertheless, that the strength of the porter is due almost entirely to the pale malt, as the other kinds have their saccharine properties so dried up and burnt as to render them nearly useless, except for colour and flavour, as before mentioned.

In addition to these distinctive properties of porter and stout, there is one other of still greater importance — the peculiarity of the fermentation. Up to the commencement of this last stage of the process of brewing, the manufacture of porter is conducted in exactly the same manner as that of ale, with the addition of the different flavouring malts before mentioned; but during the fermentation the great difference is effected, as all the sugar is converted into spirit, excepting only such portion as is required to preserve the beer from the acetous fermentation, which is less than in ale, by reason of the larger amount of hops used in proportion to the strength of the wort. The difference will be best appreciated by the figures on the next page. Good porter should weigh about twenty-two pounds specific gravity above water per barrel of thirty-six gallons before the fermentation, and single X ale about the same; but after fermentation, the porter will be found to retain only five pounds weight per barrel, while the ale has seven. Thus, ordinary ale is more liable to derange the stomach, by reason of its greater sweetness, while porter is more heady in proportion to its strength, and soporific in its tendency, from the strong infusion of hops in its composition.

It may be interesting to make a few remarks, succinct as possible, upon the preparation of malt and hops before they come into the brewers' hands; and upon isinglass, the only substance which should be used for fining beer. It may be well to observe, before doing this, that sugar is permitted by law to be used for brewing, and has been and will be consumed extensively whenever malt rises to a sufficiently high price to render it profitable: nevertheless, it is advisedly the dogma that "porter and stout (and indeed all malt liquors) should be brewed of malt and hops only," as was enunciated in the commencement of this paper; for beer brewed from sugar has greater tendency to the acetous fermentation than malt liquor, so that, setting aside the undoubted superiority of flavour in the latter, the risk, both pecuniary and otherwise, is too great to tempt the prudent man of business.

Malt is barley in which germination has been carried on to a certain extent, and then suddenly cut off by the application of heat: the process is conducted as follows:—After steeping the barley in a cistern of water till well swollen, it is thrown in layers on the slate floors of the long malt-house, buildings well known; it then heats and germinates very quickly; it is not, however, allowed to rest, but is turned over from time to time, until every grain has been alike exposed to the air, and to such light as is permitted to enter, which is not great, as the growth would otherwise be forced too speedily; and the object to be attained is the conversion of the starch into sugar, which is known to be complete when what is called the acrospire has reached three parts of the way up the grain, particularly observable by a thickening in the back of the grains of barley. When the grain has arrived at this condition, it is thrown into the

Barley. Malt.



kiln in a layer of about three inches in thickness, and while there constantly turned over. The kiln has a perforated bottom, through which the heated air from a small furnace of Welsh coal ascends. The briskness of the fire and the time of drying depend upon the colour required in the malt. The process is then complete, with the exception of screening away the "malt-dust,"—the dried roots of the embryo plant, technically so called, a very nutritious food for cattle, and which also does duty sometimes for ground coffee, Scotch snuff, and it is believed other things besides.

In the choice of malt, the brewer is guided by the growth of the acrospire, as, if it be not sufficiently developed, there is less saccharine matter in the grain than is requisite, and more gluten; and, if overgrown, the saccharine matter is absorbed by the progress of the germination.

Malt contains, besides saccharine matter, a substance called dyastase, which, in the mash tun, by the action of hot water, and agitation by machinery, converts a far greater portion of the already partially-converted starch into sugar than is present in the malt before immersion.

The pale malt thus manufactured is the base and strength of all malt liquors. It now remains to notice the other malts used for the purpose of flavouring and colouring stout and porter.

Amber malt, used in the proportion to pale malt of one-eighth part, differs merely in being dried rather faster than the ordinary kind, and by a hotter fire. The delicacy of the flavour of porter is much dependent upon this malt.

Brown or blown malt is of the usual colour externally, but internally it is charred a deep-brown colour. It is manufactured by being placed in the kiln in a layer of only one inch in thickness, and dried by a fierce fire of wood in a very short space of time. This malt, used in the proportion of one-half of the pale malt, is the source of the rich empyreumatic flavour of porter, and does much towards its colour; but this is finally effected by what is called patent malt, which is of a very dark brown colour. This malt is pale malt, perfected in the kiln in the ordinary way, and then roasted in a similar manner to coffee, only on an infinitely larger scale. The colour of porter, as before mentioned, is principally due to this malt; but it is so powerful an agent, that no more than one-fiftieth part of it is used in proportion to the other malts. Mr. Walmsley, of 24. New-road, Mile-end, is the principal maker of these malts for porter. His are the best in quality, and many improvements in the manufacture are due to him.

Hops will next demand our attention; but to consider the kinds and cultivation of these fully would occupy more space than can be afforded.

Hops are a very delicate and precarious crop, affected greatly by the weather, and they also fall a prey to various kinds of blight, of which the most devastating are the fly, technically so-called, and the mould or rust. The former is the well-known green insect and black fly, that attack the rose plants at the same time as, and accompanied with, honey dew; and its ravages are so great, that three-fourths of the year's crops are sometimes sacrificed. The latter is a fungus which attacks the hop itself, and not only prevents its proper development, and thus destroys its preservative properties, but also communicates an unpleasant flavour to the beer. Like the vine, the hop loves the sun, and can scarcely have too much of it; it also resembles that plant in the soils and situations it most prefers—the sunny sides of sloping hills, and the well-cultivated soil of Kent, resting on the Kentish rag or ironstone. The most choice hops are grown in East Kent, and the next in estimation, in mid-Kent. In ordinary seasons, the hops grown in Kent nearly suffice for all the malt liquors brewed in England; but in seasons like the last—a most disastrous one—foreign hops are much used. Hitherto, the hops grown in Belgium have been considered the best, and, in appearance, there is no doubt they are so, as the

Belgian growers have taken great pains to imitate our mode of preparation and packing; but the Bavarian hops are really much finer in quality and flavour, and the aroma is more perfectly preserved by their method of preparation, which differs from ours.

Some few hops are imported from America, but though very powerful, they are so rank and peculiar in flavour, that, without great improvement in cultivation, they are never likely to be extensively adopted.

The preparation of hops is a very simple process, and may be related in but few words. The poles, with the hop-plants still hanging on them, are pulled from the ground, when the hops are picked, by women and children principally, to a great number of whom it affords a temporary employment; they are then dried on a kiln, somewhat resembling the malt kiln, but the heat is much less, and the floor of the kiln is made of hair-cloth. A small portion of sulphur is burned on the kiln-fire, for the purpose, in the first place, of preserving the hops — at least this is the plea, and there may be some truth in it, as the sulphur may destroy any insect or fungus remaining in the hops, but the great reason for the use of sulphur is its bleaching property, which renders the hops more sightly to the eye. After they have been thus dried and bleached they are packed, by presses, tightly into the bags, or pockets as they are called, to exclude the air. They are packed so tightly by the hydraulic press that they become sufficiently solid to be cut in blocks with a knife.

All English hops are prepared in this manner, and the Belgians, finding that the bleaching and packing have a great effect upon the eye, have followed our example; but the Bavarian growers still adhere to the custom of their ancestors, and it is to be hoped they will continue to do so, with increased attention to cultivation and packing, which will render their hops equal to the best English produce.

The mode in use in Bavaria is as follows:— When the hops are ripe the plant is cut off close to the ground, and the hops are left on the poles to dry in the sun. This method preserves the aroma entirely, and all the essential oil; the consequence is, that although they are packed loosely in bales, and look like withered leaves, they have more strength and flavour in proportion to their quality than the English hops. It is somewhat premature to speak of this method as regards the preservation of the hops compared with that followed in England, as the Bavarian hops are a recent importation; in our variable climate the process by which they are dried would be unsuitable; but this at least may be deduced from the comparison, that great care should be taken in the use of the sulphur that the flavour is not affected; and also, that a very low degree of heat is advisable, as there is no doubt much of the essential oil flies off in the drying process.

Hops prepared in the foregoing manner will frequently become brown and musty by keeping: in such a condition they are wholly unsaleable; but we understand that so great is the demand for hops at the present time, in consequence of the great failure of the crop during the season which has just passed, that the most worthless description of foreign hops are purchased, and subjected to fumigation — by which means their colour is restored, and their property of checking fermentation revived. To effect this, as much as 10 lbs. of sulphur are employed in some cases for every hundredweight of hops. Dr. Letheby states that in one sample he analysed he found as large a proportion as 1·1 per cent. of free sulphuric acid, which had been formed by the subsequent oxidation of the sulphurous acid generated during the bleaching process.

Having touched, though imperfectly and cursorily, upon malt and hops, a few words upon isinglass will complete the account of the materials used in the brewing of porter.

The best isinglass comes from Russia, but a very large supply from the Brazils; that used by brewers is the cartilage of the sturgeon and other fish. The brewer buys it as imported, in rough pieces, as also the dressings and pickings rejected in the preparation of the finer sorts of isinglass for the confectioner, &c. The "finings" for porter are thus prepared: — The isinglass is put into some sour beer to dissolve, technically to cut, which takes place in different times, according to the kind of isinglass made use of.

A small portion of this solution is added to every cask of beer, and well mixed with it. It being lighter, it almost immediately ascends, and carries up with it much impurity, leaving the beer as clear as wine. It may, perhaps, be well to mention, that the brewer sends finings, prepared as above described, to each of the publicans he supplies, and they are, by them, added to the beer as may be found requisite.

For many of the preceding details respecting the different varieties of malt and hops, and their uses in the preparation of the several kinds of porter and ale, we are indebted to Mr. Thomas Druce, of the old and highly respectable firm of Druce and Sons, Hans-town Brewery, Chelsea.

Having given a very brief sketch of the manufacture of porter, we will next turn to the consideration of the subject of its adulteration.

Whatever may be the present practice with respect to the adulteration of beer, there is no question but that some years ago all kinds of malt liquor were extensively adulterated in a variety of ways, and this notwithstanding that Acts of Parliament had been passed for the special purpose of preventing such adulteration. Of this fact abundant evidence is to be obtained.

The author of a "Practical Treatise on Brewing," published some thirty-five years ago, and which passed through eleven editions, observes, after enumerating various ingredients employed for brewing porter, "That, however much they may surprise, however pernicious or disagreeable they may appear, he has always found them requisite in the brewing of porter, and he thinks they must invariably be used by those who wish to continue the taste, flavour, and appearance of the beer. And though several Acts of Parliament have been passed to prevent porter-brewers from using many of them, yet the author can affirm, from experience, he could never produce the present flavoured porter without them. The intoxicating qualities of porter are to be ascribed to the various drugs intermixed with it. It is evident some porter is more heady than others, and it arises from the greater or less quantity of stupifying ingredients. Malt, to produce intoxication, must be used in such large quantities as would very much diminish, if not totally exclude, the brewers' profit." *

Another writer, Mr. Morris †, describes and recommends a variety of articles to be employed in the brewing of beer and porter, as colouring, cocculus Indicus, sweet flag root, quassia, coriander seeds, capsicum, caraway seeds, grains of paradise, ginger, beans, oyster-shells, and alum. "The colouring," Mr. Morris remarks, "gives a good face to the beer, and enables you to gratify the sight of your different customers." And again — "Beans tend to mellow malt liquor, and from their properties add much to its inebriating qualities; but they must not be used in too large a quantity. Oyster-shells are very good to recover sour beer."

"Alum is generally put into the vat, as it gives the beer a smack of age."

"Cocculus Indicus is used as a substitute for malt and hops, and is a great preservative of malt liquor. It prevents second fermentation in bottled beer, and consequently the bursting of the bottles in warm climates. Its effects are of an inebriating nature."

The author first quoted, Mr. Child, gives the following receipt for porter: —

1 quarter of malt.
8 lbs. of hops.
9 lbs. of treacle.
8 lbs. of liquorice-root.
8 lbs. of essentia bina.
8 lbs. of colour.
Capsicum, half an ounce.
Spanish liquorice, two ounces.
Cocculus Indicus, a quarter of an ounce.
Salt of tartar, two drachms.
Heading.
Ginger, three ounces.
Lime, four ounces.

* Child on Brewing Porter. † Morris on Brewing Malt Liquors.

Linseed, one ounce.
Cinnamon, two drachms.

The essentia bina, he states, "is compounded of 8 lbs. of moist sugar, boiled in an iron vessel, for no copper one could withstand the heat sufficiently, till it comes to a thick, syrupy consistence, perfectly black and extremely bitter."

Colour "is composed of 8 lbs. of moist sugar, boiled until it obtains a middle state between bitter and sweet, and which gives to porter that mild, mellow colour usually so much admired."

The heading "is a mixture of half alum and half copperas, ground to a fine powder; and is so called from giving to porter the beautiful head of froth, which constitutes one of its peculiar properties, and which landlords are so anxious to raise to gratify their customers."

Mr. Morris gives the following receipts: —

Malt, 25 *quarters*.

	cwt.	qrs.	lbs.
Hops - - - -	1	2	0
Cocculus Indicus berry - -	0	0	6
Leghorn juice - - -	0	0	30
Porter extract			

Malt, 20 *quarters*.

	cwt.	qrs.	lbs.
Hops - - - -	2	0	0
Cocculus Indicus berry - -	0	0	4
Sugar - - - -	0	0	28
Fabia amara (nux vomica) - -	0	0	6

And also the following directions: —

To make up a Vat of 150 *Barrels*.

"Use half a barrel of colouring, a quarter of a hundredweight of cream of tartar, a quarter of a hundredweight of ground alum, one pound of salt of steel, and two barrels of strong finings. Mix these well together, and put them in a vat, rousing it thoroughly at the same time. Let the vat remain open three days, then close it and sand it over.

"In a fortnight it will be fit for use — your own good sense will inform you how to advantage."

The extensive employment of various drugs for porter-brewing led to the establishment, at about the period of the late French war, of a class of men termed "brewers' druggists." These persons issued regular price currents, and they made it their business to send travellers all over the country with lists and samples exhibiting the price and quality of the articles manufactured by them.

Mr. Accum* states that "their trade spread far and wide, but it was amongst the country brewers chiefly that they found the most customers, and it is amongst them, up to the present day, as I am assured by some of these operators, on whose veracity I can rely, that the greatest quantities of unlawful ingredients are sold."

"It was at the same time, also," writes Mr. Accum, "that a Mr. Jackson, of notorious memory, fell upon the idea of brewing beer from various drugs without any malt and hops. This chemist did not turn brewer himself, but he struck out the more profitable trade of teaching his mystery to the brewers for a handsome fee. From that time forwards, written directions and receipt-books for using the chemical preparations to be substituted for malt and hops were respectively sold; and many adepts soon afterwards appeared everywhere to instruct brewers in the nefarious practice first pointed out by Mr. Jackson."

The following remark, contained in Dr. Normandy's recent work, "Commercial Handbook of Chemical Analysis," would lead us to infer that the fraternity of brewers' druggists is not even yet extinct: —

"It is a publicly known fact, that carts may be seen bearing the inscription in staring paint, of 'C——, brewers' druggist.' Such a cart I have myself seen,

* Treatise on Adulterations of Food, &c., p. 154.

a few days ago, standing in the broad daylight of midday, before a publican's shop or gin palace."

The Act of Parliament, 56 Geo. III., c. 52., prohibited chemists, grocers, and druggists from selling ingredients for adulteration to brewers under a heavy penalty. Amongst the prohibited articles specified are "any liquor called by the name of, or sold as colouring, from whatever material the same may be made; or any material or preparation other than unground brown malt for darkening the colour of worts or beer, or any liquor or preparation made use of for darkening the colour of worts or beer, or any molasses, honey, vitriol, quassia, cocculus Indicus, grains of paradise, Guinea pepper or opium, any extract or preparation of molasses, or any article or preparation to be used in worts or beer, for or as a substitute for malt and hops; and if any druggist shall offend in any of these particulars, such liquor, preparation, molasses, &c., shall be forfeited, and may be seized by any officer of Excise, and the person so offending shall for each offence forfeit 500*l.*"

By the same Act it is stipulated, — "That no brewer, or dealer, or retailer of beer shall receive or have in his possession, or make, or use, or mix with, or put into worts or beer, any liquor, extract, calx, or other material or preparation for the purpose of darkening the colour of worts or beer, or any liquor, extract, calx, or other material or preparation other than brown malt, ground or unground, as commonly used in brewing; or shall receive or have in his possession, or use, or mix with, or put into any worts or beer, any molasses, honey, liquorice, vitriol, quassia, cocculus Indicus, grains of paradise, Guinea pepper or opium, or any article or preparation whatever, for or as a substitute for malt and hops, upon pain that all such articles and preparations as aforesaid, and also the said worts and beer shall be forfeited, together with the casks, vessels, and other packages, and may be seized by any officer of Excise; and such brewer of, dealer in, or retailer of beer so offending, shall for each offence forfeit 200*l.*"

In 1819, a committee of the House of Commons sat to examine into the price and quality of beer. In the evidence taken before this committee a variety of information is recorded respecting the adulteration of beer and porter as it prevailed at that time. A list is there given of twenty-nine *druggists* and *grocers* who were prosecuted and convicted, from the year 1812 to 1819, for supplying illegal ingredients to brewers for adulterating beer. Amongst the articles specified as thus supplied, are cocculus Indicus, molasses, and liquorice.

"At about the period of the late war, when the price of malt was very high, the London brewers," writes Accum, "discovered that a larger quantity of wort of a given strength could be obtained from pale than from brown malt. They therefore increased the quantity of the former, and diminished that of the latter. This produced beer of a paler colour, and of a less bitter flavour. To remedy these disadvantages they invented an artificial colouring substance, prepared by boiling brown sugar till it acquired a very dark-brown colour; a solution of this was employed to darken the colour of the beer. Some brewers made use of the infusion of malt instead of sugar colouring. To impart to the beer a bitter taste, the fraudulent brewer employed quassia-wood and wormwood as a substitute for hops.

"But as the colouring of beer by means of sugar became in many instances a pretext for using illegal ingredients, the legislature, apprehensive of the mischief that might, and actually did result from it, passed an Act, in July, 1817, prohibiting the use of burnt sugar.

"No sooner had the beer-colouring Act been repealed, than other persons obtained a patent for effecting the purpose of imparting an artificial colour to porter, by means of brown malt, specifically prepared for that purpose only. The beer coloured by the new method is more likely to become spoiled than when coloured by the process formerly practised. The colouring malt does not contain any saccharine matter. The grain is, by mere torrefaction, converted into a gum-like substance, wholly soluble in water, which renders the beer more liable to pass into the acetous fermentation, than the common brown malt is capable of doing; because the latter, if prepared from good barley, contains a portion of saccharine matter, of which the patent malt is destitute.

"But as brown malt is generally prepared from the worst kind of barley, and as the patent malt can only be made from good grain, it may become, on that account, an useful article to the brewer, (at least, it gives colour and body to the beer;) but it cannot materially economise the quantity of malt necessary to produce a good porter. Some brewers of eminence in this town have assured me, that the use of this mode of colouring beer is wholly unnecessary, and that porter of the requisite colour may be brewed better without it; hence this kind of malt is not used in their establishments."

The minutes of the Committee of the House of Commons already referred to, also contain a list of *publicans* prosecuted and convicted from 1815 to 1818, for adulterating beer with illegal ingredients, and for mixing table-beer with their strong beer. This list contains the names of nineteen publicans; the substances enumerated being, salt of steel, or sulphate of iron, common salt, molasses, and table-beer. The sulphate of iron is used to impart a fine frothy head to porter, considered to be one of the tests of good porter. To produce this property of frothing, the mixture called beer-heading was used, composed of green vitriol, alum, and salt. This addition, as we have seen by the previous list, was made by the publicans. How far this mixture really possesses the property of imparting this heading to beer, is open to some question. In reference to beer-heading, Morris, in his treatise on "Malt Liquors"* already referred to, makes the following observations: —

"On this part of our subject it may be necessary to observe that there are various modes of making it. Some make use of ground copperas and alum in about equal proportions; some resort to salt of steel, of which as much as will lie on a shilling is sufficient for a barrel of beer. But as the duties of a brew-house sufficiently employ every person engaged in it, I recommend it to be purchased of those who make it their business to have it ready prepared. Observe, that porter should not be sent out without it, as it causes the head so much admired in that liquor, and is agreeable to its flavour."

The committee of the House of Commons, more than once referred to, likewise published a list of *brewers* prosecuted and convicted from 1813 to 1819 for receiving and using illegal ingredients in their brewings. This list contains the names of thirty-four brewers. Amongst the ingredients enumerated are cocculus Indicus, hard multum, colouring, molasses, Spanish liquorice, honey, ginger, Guinea pepper, wormwood, coriander-seeds, hartshorn shavings, vitriol, and Guinea opium.

The following list contains the names of some of the illegal ingredients seized, from 1812 to 1818, at different breweries and brewers' druggists: —

July, 1812—*Mr. Nibbs.*

Multum - - -	84 lbs.
Cocculus Indicus - -	12 ,,
Colouring - - -	4 galls.
Honey - - -	180 lbs.
Hartshorn shavings -	14 ,,
Spanish juice - -	46 ,,
Orange powder - -	17 ,,
Ginger - - -	56 ,,
Caraway seeds - -	40 lbs.
Orange powder - -	14 ,,
Copperas - - -	4 ,,

Penalty, 300*l*.

June 13*th*, 1813—*Mrs. Willis.*

Cocculus Indicus - -	1 lb.
Spanish juice - -	12 ,,
Hartshorn shavings -	6 ,,
Orange powder - -	1 ,,

Penalty, 200*l*.

August 3*rd*—*Mr. Whiffing.*

Grains of paradise - -	44 lbs.
Quassia - - -	10 ,,
Liquorice - - -	64 ,,
Ginger - - -	80 ,,
Caraway seeds - -	40 lbs.
Orange powder - -	14 ,,
Copperas - - -	4 ,,

Penalty, 200*l*.

December 14*th*—*Mr. Abbott.*

Copperas, &c. - -	14 lbs.
Orange powder - -	2 ,,

Penalty, 500*l*., and Crown's costs. Proof of using drugs at various times.

February 15*th*, 1815.—*Messrs. Mantell and Cook.*

Proof of mixing strong beer with table beer, and using colouring with other things.

Compromised for 300*l*.

July 30*th*—*Mr. Lyons.*

Capsicum - - -	1 lb.
Liquorice root powder -	2 ,,
Coriander seed - -	2 ,,
Copperas - - -	1 ,,

* Page 108.

Orange powder	-	8 lbs.
Spanish liquorice	-	½ ,,
Beer colouring	-	24 galls.

November 25th—Mrs. Hasler.

Cocculus Indicus	-	12 lbs.
Multum	-	26 ,,
Grains of paradise	-	12 ,,
Spanish juice	-	30 ,,
Orange powder	-	3 ,,

Penalty, 200*l.*

1817—*From Mr. Stevenson, an old servant to Dunn and Waller, brewers' druggists.*

Cocculus Indicus extract	-	6 lbs.
Multum	-	560 ,,
Capsicum	-	88 ,,
Copperas	-	310 ,,
Quassia	-	150 ,,
Colouring and drugs	-	84 ,,

Mixed drugs	-	240 lbs.
Spanish liquorice	-	420 ,,
Hartshorn shavings	-	77 ,,
Liquorice powder	-	177 ,,
Orange powder	-	126 ,,
Caraway seeds	-	100 ,,
Ginger	-	110 ,,
Ginger root	-	176 ,,

Condemned, not being claimed.

August 6th—Mr. Gray.

Multum	-	4 lbs.
Spanish liquorice	-	21 ,,
Liquorice root powder	-	113 ,,
Ginger	-	116 ,,
Honey	-	11 ,,

Penalty, 300*l.* and costs, including mixing strong beer with table, and paying table-beer duty for strong beer, &c.

Other practices had recourse to were, mixing strong beer with table beer, converting mild beer into old by adding sulphuric acid or oil of vitriol; and on the other hand, of turning old beer into mild by the addition of carbonate of soda, potash, or oyster-shell powder. Mr. Child, in his treatise "On Brewing," directs, for the conversion of mild beer into old, the use of oil of vitriol.

Of the articles enumerated as being employed in the adulteration of beer and porter, many are nearly harmless; while others, as cocculus Indicus, copperas, opium, and strychnine, are highly deleterious.

It is interesting and important to notice, that no case of adulteration has ever been proved against any of our great London brewers.

We will next describe, very briefly, the method to be pursued in the analysis of porter.

One pint of the porter, either by measure or weight, as may be determined upon, should be first taken.

The specific gravity of this should be ascertained, and then its acidity, by means of a solution of dried carbonate of soda of known strength. The porter should next be submitted to distillation, using about 5000 grains. It is necessary that the acetic acid of the porter should be neutralised previous to distillation, otherwise it will pass over with the spirit, and so affect its quantity and specific gravity. It is also advisable that fully two-thirds of the liquid be distilled off, otherwise some of the spirit will remain behind. It is easy to convince oneself that this is really the case, either by distilling three separate pints of the same porter, taking off different quantities, or by removing the product of the distillation of the same sample at three different periods, when spirit will, in most cases, be found to be present in the last as well as in the first portion of liquid which comes over, although of course in greatly diminished amount.

Another portion of the porter, say 3500 grains, should next be taken, and the gum and sugar in this determined in the following manner: —

The gum, together with other matters, should be precipitated by subacetate of lead; the sugar remains in solution. The fluid part, after subsidence, is to be separated from the solid: this is best effected by decantation, and the addition to the precipitate of small quantities of distilled water. After separation, the lead in each is to be got rid of by means of sulphuretted hydrogen. We have now obtained two clear liquids, the one holding chiefly gum in solution, and the other sugar.

These are next carefully evaporated—the sugar over a water bath, until it ceases to lose weight—the gum until it becomes nearly solid, when it should be treated with a little alcohol, and dried and weighed. Finally, both the sugar and the gum should be incinerated, and the ash deducted.

Another portion of the porter, equal to the above, should be evaporated to dryness, and the weight of the extract determined; this should afterwards be burnt, the ash weighed, and, if necessary, tested for salt and iron.

The several results thus obtained are then all to be calculated to the imperial gallon of 70,000 grains.

It is scarcely necessary to observe that the detection of many organic infusions sometimes employed in the adulteration of porter and beer, is, in most cases, a matter of extreme difficulty, and in others it is altogether impossible in the present state of science.

One of the most injurious of the substances thus employed is the extract prepared from the seeds or berries of cocculus Indicus. Its detection in beer, and especially in porter, is attended with very great difficulty; and in many cases, when employed in small quantities, it cannot be discovered by any known means. Mr. Herapath has recently published the results of some experiments, instituted with the view of determining the presence in beer of picrotoxin, the active and poisonous principle of cocculus Indicus. He directs that the beer or porter should be first treated with an excess of acetate of lead, so as to throw down all gum and colouring matter. The clear liquor is then to be separated by filtration, and the excess of lead precipitated by sulphuretted hydrogen. After standing for some time, or boiling so as to get rid of uncombined sulphuretted hydrogen, it is to be filtered again. The liquor, thus obtained, is to be evaporated at a moderate temperature until it becomes rather thick, and then it is to be treated with a little pure animal charcoal. After standing for some time the charcoal is to be collected on a filter, washed with very little water, and dried at a steam heat. The charcoal contains the picrotoxin, which may be separated by boiling with a little pure alcohol, filtering, and evaporating to dryness on slips of glass. The picrotoxin is recognised by its forming plumose tufts of acicular crystals, or else by its producing oat-shaped forms.

M. Lassaigne has stated that picric acid is sometimes used to impart a bitter taste to beer and porter, and that it may be thus detected. He finds that this substance is not precipitated by subacetate of lead, which throws down most of the other colouring matters of beer, as well as the bitter principle of hops, and also that it is not absorbed by common bone charcoal thoroughly purified by acids. By means of one or other of these substances, he succeeds in obtaining a tolerably pure solution of picric acid. M. Lassaigne states that while pure beer is almost entirely decolorised by either subacetate of lead or purified bone charcoal, beer adulterated with even the one twelve-thousandth or the one eighteen-thousandth part of picric acid, remains of a yellow citron colour. Supposing the beer to contain a still more minute quantity of picric acid, it must, subsequent to the use of one or other of the above substances, be evaporated until the yellow citron colour is produced. It is possible that by the above method picric acid might be detected in poor and pale beers, but we very much doubt whether it would be successful in the case of London stout and porter, which are not entirely decolorised by either subacetate of lead or purified charcoal.

In order to save repetition, and to enable the reader more readily to comprehend and contrast the results of the different analyses, we have arranged them as displayed in the accompanying tables, pp. 632, 633.

From the examination of these Tables of Analyses it appears—

That the samples of STOUT either obtained from agents, or purchased at the taps of several of the principal London porter brewers, were considerably stronger than those procured from publicans; the alcohol, of specific gravity ·796, temperature 60° Fahr., contained in the former samples ranged from 7·15 per cent. the highest, to 4·53 the lowest; whereas that of the stouts procured from publicans varied, with one exception, from 4·87 per cent. to 3·25 per cent.

That the same difference of strength also characterised the various samples of PORTER procured from the two different sources; the amount of alcohol in the porters obtained from the taps varying from 4·51 per cent. to 2·42 per cent.; whereas those purchased of publicans ranged from 3·97 per cent. to 1·81 per cent.

That in nearly all the stouts and porters *salt* was present often in considerable amount.

That in some of the samples *cane sugar* and *treacle* was likewise present.

There is reason to believe that the variation of strength would have been still more considerable had the samples been procured direct from the several breweries, instead of, as in most cases, from the brewers' taps.

This diminution of strength in the beer purchased of publicans is only to be satisfactorily explained by the addition in many cases of water, this addition being no doubt sometimes practised by the publicans and other retailers of malt liquors.

The addition of water constitutes the principal, but not the only, adulteration to which these beverages are subjected.

Thus the addition of water reduces the strength, flavour, and colour, to such an extent as to necessitate in some cases the further adulteration of the beer, and this is usually effected by means of a very coarse description of brown sugar, containing much treacle, and known as *Foots*, and salt.

Since the use of cane sugar is permitted in the brewery, we did not attempt to ascertain which of the samples subjected to analysis contained that substance, because, had we found it in any of the samples, we should still have been unable to have declared whether the brewers or the publicans were the parties who made use of it. We believe, however, that the brewers do not often employ sugar, since it is alleged that beer made with any considerable proportion of cane sugar does not keep so well as that prepared from malt only. Moreover, the price of sugar forms an obstacle to its use in breweries.

It appears, from the analyses, that salt is almost constantly present in porter. This addition we know is made in the first instance by the brewers themselves; but there is also no doubt that a further quantity of it is frequently used by the publican to assist in bringing up the flavour of beer which has been reduced in strength by the addition of water. The quantity of salt contained in porter is often sufficiently large to communicate a perceptibly saline taste to the mouth. The salt is used by the brewers in the following manner:— It is first mixed up in a tub with some kind of flour—usually wheat-flour—and the mixture is cast by handfuls over the surface of the wort in the cooling vat. It is said to assist in the preservation and fining of the wort, and it is alleged that these are the only purposes for which it is employed by the brewer.

The three usual and principal adulterations of porter consist, then, of water, by which its strength is reduced and its bulk increased, and sugar and salt, whereby its colour and flavour are in a measure restored. But there is good reason for believing, from evidence given before the recent Committee of the House of Commons, of which Mr. Villiers was the chairman, that other adulterations are practised, and that sulphuric acid, or oil of vitriol, salt of steel, or sulphate of iron, and cocculus Indicus, are likewise not unfrequently used, and this both by the publican and brewer.

Not only is the fact of the addition of water proved by the present analyses, but evidence of another character has been supplied by different parties to the Committee above referred to, showing the same fact. In particular, it has been proved that a publican could not afford to sell porter at the price which he pays for it, in the state in which it is supplied to him by the brewers, and realise a profit upon it, unless he had recourse to adulteration.

The acidity of porter, as will be seen by referring to the analyses, is very considerable, and this is no doubt the reason why in some cases the beverage disagrees with the stomach, and occasions heartburn.

The acidity is very far from being due to acetic acid alone; for if this be distilled off, the remaining stout or porter, as the case may be, will still be found to be very acid; the acidity, where sulphuric acid has not been used, depending upon the presence of some fixed vegetable acid or acids, and most probably the malic and lactic acids, the presence of which would explain why malt liquors, including porter, are unsuited to all cases in which a tendency exists to rheumatism or gout. The large quantity of acid, and also sugar, contained in porter and other malt beverages, render them also unfit for nearly all cases in which any disposition to diabetes is manifested. The difference in the quantity of acetic and fixed acids in any sample of porter may be thus determined:—A weighed or measured quantity of the porter should be taken, and the amount of a solution of either caustic soda or dried carbonate of soda of

TABLE I.

RESULTS OF THE CHEMICAL ANALYSES OF SAMPLES OF STOUT AND PORTER, AS OBTAINED EITHER DIRECTLY FROM BREWERIES, OR AS PURCHASED AT THE TAPS OF DIFFERENT LONDON BREWERS.

Contents of Imperial Gallon, 70,000 *Grains,* BY WEIGHT.

Number.	Name.	Specific Gravity.	Alcohol, Specific Gravity 0·796.	Per-centage of Alcohol.	Acidity. Quantity of dried Carbonate of Soda.	Sugar.	Gum.	Ex-trac-tive.	Ash of Ex-trac-tive.	
			Grains.		*Grains.*	*Grains*	*Grains.*	*Grains.*	*Grains.*	
	STOUT.									
	FROM BREWERY.									
1	Messrs. Druce & Sons, George-street, Chelsea.	1·016	4097·4	5·85	504·0	2248·0	1047·2	3270·0	145·6	Contains a small quantity of salt.
	FROM TAPS.									
2	Meux & Co., G. Chantry, 267. Tottenham-court-road.	1·031	3661·1	5·23	358·4	3206·8	651·8	5724·4	95·2	
3	Reid & Co., J. Dye, 5. Liquorpond-street.	1·027	3517·1	5·02	504·0	3229·8	1298·0	6163·4	190·4	Contains salt.
4	Combe, Delafield, & Co., M. Davis, 11. Queen-street, Seven-dials.	1·017	3418·1	4·88	526·4		357·4	4189·8	193·4	Contains salt.
5	Truman & Hanbury, A. Johnston, 63. Brick-lane, Spitalfields.	1·022	3342·7	4·77	470·4	3139·0	490·0	5588·1	123·2	Contains salt.
6	Barclay & Perkins, C. Sutton, Park-street, Southwark.	1·026	3616·0	5·16	504·0	2047·4	929·6	5784·8	128·8	Contains salt.
7	Whitbread & Co., H. Wilson, 49. Chiswell-street.	1·024	3172·9	4·53	464·8	2285·0	1271·2	5712·0	140·0	Contains rather much salt.
	FROM BOTTLER.									
8	Guinness & Sons.	1·018	3247·2	4·64	537·6	2965·3	603·3	3892·7	100·8	
9	Ditto.	1·018	5009·5	7·15	554·4	2466·0	536·3	4603·0	140·0	
10	Ditto.	1·015	3535·4	5·05	604·8	3206·7	265·1		128·8	
	PORTER.									
	FROM BREWERY.									
11	Reid & Co., Liquorpond-street, No. 1.	1·014	2763·3	3·94	358·0	2132·3	432·2	3701·6	179·2	Contains a small quantity of salt.
12	Reid & Co., Liquorpond-street, No. 2.	1·013	3161·4	4·51	392·0	2580·5	446·3	3701·6	190·4	Contains rather much salt.
13	Truman & Hanbury, Brick-lane, Spitalfields, No. 1.	1·015	2752·8	3·93	415·0	2584·7	443·6	3998·4	184·8	Contains rather much salt.
14	Ditto. Ditto, No. 2.	1·014	2926·1	4·18	347·2	2358·5	530·2	3936·8	184·8	Contains rather much salt.
	FROM TAPS.									
15	Messrs. Druce & Sons, George-street, Chelsea.	1·009	2506·6	3·58	280·0	1644·8	317·0	2735·5	140·0	Contains a small quantity of salt.
16	Meux & Co., G. Chantry, 267. Tottenham-court-road.	1·017	3068·7	4·38	459·2	2293·0	248·0	3551·2	100·8	Contains a very small quantity of salt.
17	Reid & Co., J. Dye, 5. Liquorpond-street.	1·014	2620·9	3·74	408·8	2028·6	692·1	2959·3	100·8	Contains salt.
18	Combe, Delafield, & Co., M. Davis, 11. Queen-street, Seven-dials.	1·011	2293·8	3·27	532·0	1626·3	368·9	3040·7	152·7	Contains a small quantity of salt.
19	Truman & Hanbury, A. Johnston, 63. Brick-lane, Spitalfields.	1·018	2735·9	3·95	539·0	2613·0	368·9	3817·0	89·6	Contains a small quantity of salt.
20	Barclay & Perkins, C. Sutton, Park-street, Southwark.	1·013			324·8	1962·6	161·3	3139·0	56·0	Contains a little salt.
21	Whitbread & Co., H. Wilson, 49. Chiswell-street.	1·012	1699·2	2·42	392·0	2041·8	363·3	3240·8	145·6	Contains salt.

*** The differences indicated in the Table would have been much more considerable and obvious, had equal quantities by MEASURE of the Stouts and Porters been taken, in place of by Weight.

TABLE II.

RESULTS OF THE CHEMICAL ANALYSES OF SAMPLES OF STOUT AND PORTER, AS PURCHASED OF PUBLICANS RESIDENT IN LONDON.

Contents of Imperial Gallon, 70,000 Grains, by WEIGHT.

Number.	Name.	Specific Gravity.	Alcohol, Specific Gravity. 0·796.	Per-centage of Alcohol.	Acidity. Quantity of dried Carbonate of Soda.	Sugar.	Gum.	Ex-tractive.	Ash of Ex-tractive.	
			Grains.		*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	
	STOUT. From Publicans.									
22	R. Roberts, 1. Glasshouse-street, Regent-street	1·022	3409·7	4·87	274·4		461·5	4801·4	186·0	Contains salt.
23	W. Smith, 227. Piccadilly	1·014	3208·2	4·58	285·6	3089·1	90·0	4160·1	196·0	Contains salt.
24	Messrs. Blockey, 80. Jermyn-street	1·019	3137·6	4·48	209·0	3628·5	468·2	4181·4	128·8	Contains rather much salt.
25	S. Cook, 56. Oxford-street	1·017	4369·8	6·24	268·8	2656·4	1084·3	4833·3	168·0	Contains a little salt.
26	J. Mercer, 12. Marylebone street, Regent-street	1·030	2947·4	4·21	352·8	4313·3	702·0	6294·3	168·0	Contains much salt.
27	A. Campbell, 7. Beak-street, Golden-square	1·017	3185·3	4·55	376·3		914·1	4746·3	34·8	Contains salt.
28	W. Blackman, 287. Oxford-street	1·025	3326·7	4·75	278·3	3780·2		6290·0	163·4	Contains salt.
29	L. Hammond, 248. Oxford-street	1·019	2344·6	3·35	205·3	3396·7	481·2	5065·2	212·8	Contains salt.
30	Hospital stout	1·012	2664·5	3·80	285·6	1609·1	438·6	2674·9	67·2	
31	R. Eykyn, (in bottle) 7. Silver-street, Bloomsbury	1·015	2232·2	3·19	716·8	1695·6	588·2	3397·5	134·4	Contains salt.
32	Emery & Muffitt, (in bottle, labelled "Findlater, Mackie, & Co.,") Catherine-street, Strand	1·010	2276·7	3·25				3687·7		
	PORTER. From Publicans.									
33	H. Ridler, 9. Brewer-street, Golden-square	1·010	1878·8	2·68	296·8	1224·1	449·9	2331·3	145·6	Contains much salt.
34	J. H. Hutchinson, 19. Little Pulteney-street, Golden-square	1·017	2033·6	2·90	358·4	2115·1	587·9	2879·6	84·0	Contains salt.
35	Mr. Scarfe, 100. Berwick-street, Soho	1·016	2190·0	3·[illegible]2	408·8	2019·0	102·6	4150·4	95·2	Contains salt.
36	H. Rennell, 16. High-road, Knightsbridge	1·014	2075·7	2·96	476·0	1556·9	836·1	3903·2	235·2	Contains much salt.
37	H. Hubbard, Holborn-hill	1·009	2211·6	3·15	347·2	2002·2	211·7	2834·1	128·8	Contains much salt.
38	H. Lloyd, 28. High-row, Knightsbridge	1·012	1650·8	2·35	476·0	1736·7	591·0	3141·4	218·4	Contains much salt.
39	G. Goddard, 22. Berwick-street, Soho	1·015	2369·0	3·38	375·2	1691·4	576·5	3084·9	145·6	Contains salt.
40	Messrs. Young & Co., 13. Hemming's-row	1·010	1869·6	2·67	352·8	2259·2	614·0	3593·4	218·4	Contains salt.
41	J. Medworth, 167. Oxford-street	1·017	1323·9	1·89	369·6	1756·8	551·8	371·[illegible]	151·2	Contains salt.
42	T. Sulway, 7. Little New-port street, Soho	1·014	2059·6	2·94	504·0	2070·5	559·8	3231·0	184·8	Contains much salt.
43	Messrs. Coates & Co., 25. Whitechapel High-street	1·018	2089·3	2·98	436·8	2635·4	993·3	4428·0	123·2	Contains rather much salt.
44	J. Bishop, 48. Gerrard-st., Soho	1·016	1716·8	2·45	420·0	1560·0	445·8	2828·[illegible]	173·6	Contains rather much salt.
45	H. Weston, 242. High Holborn	1·014	2685·9	3·83	358·4	1745·7	691·2	3808·0	140·0	Contains a little salt.
46	W. Hancock, 1. White-chapel High-street	1·013	1993·7	2·84	364·0	1186·0	867·0	2373·2	295·0	Contains salt.
47	R. Skipper, 3. Cable-street, Wellclose-square	1·009	2201·9	3·14	459·2	1241·2	551·8	2055·0	134·4	Contains salt.
48	J. Brown, Whitechapel High-street	1·015	1902·4	2·71	425·6	2571·1	359·3		151·2	
49	J. Cotton, 5. Edgware-road	1·012	2033·6	2·90	347·2	1690·1	620·0	3164·0	162·4	Contains a little salt.
50	H. Brand, 77. Leman-street, Whitechapel	1·014	2098·6	2·99	408·8	1718·3	1178·5	4317·4	263·2	Contains salt.
51	T. Bell, 25, Cable-street, Wellclose-square	1·014	1267·5	1·81	403·2	1942·4	991·[illegible]	3460·1	190·4	Contains much salt.
52	Hospital porter	1·012	2780·1	3·97	369·6	2154·9	542·4	3712·8	72·8	

known strength required to neutralise it ascertained; a similar quantity of the same porter should then be submitted to distillation, and the acidity of the residue determined; the difference in the amount of soda required in each case shows the quantity of fixed and volatile acids present.

In one respect the analyses above given may be considered to be satisfactory, inasmuch as they show that sulphate of iron is not usually contained in London draught stouts or porters, nor in most bottled porters; if used at all, as it no doubt sometimes is, it is in the inferior bottled porters that it will be found. From experiments which we have made, we have ascertained that when sulphate of iron is present in porter, in so small a proportion as two grains to a nine-gallon cask, the well burned ash of the extract of the porter will be found to be more or less coloured with the red oxide of iron. This is a very delicate means of determining the presence of iron in porter extract; and if iron in the above small quantity be found in it, there will be every reason for suspecting that sulphate of iron has been added to the beer; for the ash of genuine porter extract is never in the slightest degree coloured, but is always, when well freed from carbonaceous matter, either white or greyish-white.

We should also state that we made full analyses of two samples of finings obtained from different brewers, and found that they consisted entirely of weak and very sour beer, holding, dissolved, a considerable quantity of a description of isinglass, which was readily precipitated by a decoction of oak bark.

The remedy by which the adulteration of malt liquors may be met appears to us to be clear and simple, and it is one to which we recently had the opportunity of directing the attention of the Committee of the House of Commons on Public-houses; it is, *that no malt liquors should be permitted to be sold by any publican under certain fixed or standard strengths*, the tests of strength being not the specific gravity of the beers, but principally the amount or per-centage of alcohol contained in them.

Such a regulation, properly enforced, would effectually put a stop to the adulteration of malt liquors, by the addition of water, sugar, salt, and the other substances mentioned in the present report; and it need not in any way interfere with the different recognised strengths and qualities of malt liquors now in use, as single and double stouts, ales, and porters.

GIN, AND ITS ADULTERATIONS.

Gin was made originally in Holland, in the distilleries of Schiedam, and hence that which is brought to this country is termed Hollands Gin. At one time, when the duty was low, it used to be largely imported, but owing to the high rate of duty levied upon it for some years past, which was, until 1846, £1 2*s*. 10*d*. per imperial gallon, and since that period has remained at 15*s*., — but little now reaches this country.

In Holland it is made solely from unmalted rye and barley-malt, rectified with juniper berries. In Britain, gin is for the most part obtained from a mixture of malt and barley, molasses and corn being sometimes employed, particularly when there is a scarcity of grain, and it is usually flavoured not only with juniper berries, but with certain other substances, most of which are aromatics, and amongst which are the following: coriander, cardamom, and caraway seeds, grains of paradise, angelica root, calamus root, crushed almond-cake, liquorice powder, and orange-peel. These ingredients, variously combined, form what are known in the trade as "gin-flavouring."

In Dr. Muspratt's "Chemistry, Theoretical, Practical, and Analytical," the following receipts from the note-book of an extensive distilling rectifier are given.

"For a *Fine Gin*, take

960 gallons of spirit, hydrometer proof.
96 lbs. German juniper berries
6 lbs. coriander seeds.
4 lbs. grains of paradise.
4 lbs. angelica root.
2 lbs. orris root.
2 lbs. calamus root.
2 lbs. orange peel.

Eighty or ninety pounds of liquorice powder are occasionally added to impart colour and sweetness.

Plain or *London Gin* is made as follows: —

700 gallons of the second rectification.
70 lbs. German juniper berries.
70 lbs. coriander seeds.
3½ lbs. almond cake.
1½ lbs. angelica root.
6 lbs. liquorice powder.

For the manufacture of *West Country Gin*, the annexed is the process given in Dr. Muspratt's work: — Introduce into the still 700 gallons of the second rectification, and flavour with —

14 lbs. German juniper berries,
1½ lb. calamus root, cut, and
8 lbs. sulphuric acid.

This gin is much used in Cornwall, and particularly in the western counties of England; it is also used in making British Hollands, and in that case is mixed with about five per cent. of fine gin, reduced to twenty-two under-proof with liquor. Our own examination of this variety of gin, usually called Plymouth Gin, tends to show that it is little else than a moderately pure rectified spirit, unsweetened, containing fusel oil, and flavoured with a little juniper and acetic ether.

For *Geneva*, charge of still being 950 gallons of second rectification, the proportions are —

84 lbs. juniper berries.
112 lbs. coriander seeds.
6 lbs. cassia buds.
4 lbs. angelica root.
6 lbs. calamus root.
6 lbs. almond cake.
½ lb. cardamoms.

Plain *Geneva*. — For 950 gallons of spirit of second rectification, take —

84 lbs. juniper berries.
84 lbs. coriander seeds.
2 lbs. almond cake.
2 lbs. orris root.
2 lbs. calamus.

Another prescription for making Geneva, and one which is much esteemed, is the following: — Add to 950 gallons —

14 lbs. grey salts, and
4 lbs. white salts.

The rectification to be conducted with the usual care.

At the second operation, add —

168 lbs. juniper berries.
74 lbs. coriander seeds.
12 lbs. almond cake.
8 lbs. grains of paradise.
8 lbs. angelica root.
1 lb. cardamoms.
2 lbs. calamus."

On the Adulteration of Gin.

Turning to our earliest great authority, Accum, on the adulteration of spirituous liquors, including gin, we, as usual, meet with much valuable and important information. "If we examine gin as retailed," states Accum,* "we shall soon be convinced that it is a custom, pretty prevalent amongst dealers, to weaken this liquor considerably with water, and to sweeten it with sugar. This fraud may be readily detected by evaporating a quantity of the liquor in a table-spoon over a candle to dryness; the sugar will thus be rendered obvious, in the form of a gum-like substance, when the spirit is volatilised.

"One hundred and twenty gallons of genuine gin, as obtained from the wholesale manufactories, are usually *made up* by fraudulent retailers into a saleable commodity, with fourteen gallons of water, and twenty-six pounds of sugar. Now this dilution of the liquor produces a turbidness, because the oil of juniper and other flavouring substances which the spirit holds in solution become precipitated by virtue of the water, and thus cause the liquor to assume an opaline colour; and the spirit thus weakened cannot readily be rendered clear again by subsidence. Several expedients are had recourse to to clarify the liquor in an expeditious manner; some of which are harmless, others criminal, because they render the liquor poisonous.

"One of the methods, which is innocent, consists in adding to the weakened liquor first, a portion of alum dissolved in water, and then a solution of sub-carbonate of potash. The whole is stirred together, and left undisturbed for twenty-four hours. The precipitated alumina thus produced from the alum by virtue of the sub-carbonate of potash, acts as a strainer upon the milky liquor, and carries down with it the finely divided oily matter which produces the blue colour of the diluted liquor. Roche or Roman alum is also employed, without any other addition, for clarifying spirituous liquors."

Further on Accum writes — "Another method of fining spirituous liquors consists in adding to it first a solution of sub-acetate of lead, and then a solution of alum. This practice is highly dangerous, because part of the sulphate of lead produced remains dissolved in the liquor, which it thus renders poisonous. Unfortunately this method of clarifying spirituous liquors, I have good reason to believe, is more frequently practised than the preceding method, because its action is more rapid, and it imparts to the liquor a fine *complexion*, or great refractive power; hence some vestiges of lead may often be detected in malt spirit.

"The weakened spirit is then sweetened with sugar, and, to cover the raw taste of the malt spirit, a *false strength* is given to it with grains of paradise, Guinea pepper, capsicum, and other acrid and aromatic substances." — pp. 271, 272.

Under the head, "Spirituous Liquors and their Adulterations," Mitchell writes — "Spirituous liquids, as brandy, rum, gin, &c., being unfortunately in such common use, and bearing so high a price, are peculiarly adapted for the purposes of adulteration, which may be of various kinds; the most general, however, is the addition of water. Were this the only adulteration practised, it would be rather productive of good than harm, for obvious reasons; yet, in reality, it has the very opposite effect; for in order to disguise the dilution, it is necessary to add some substance, capable, by its pungency or other similar property, of completely counteracting the addition of water; such substances are capsicum, Guinea pepper, oil of turpentine, &c., all of which, when taken in combination with spirit, affect the stomach very injuriously." †

Again, at page 144, Mr. Mitchell remarks — "Gin is usually adulterated with water in considerable quantity; sugar is also added, and a mixture, composed of alum, carbonate of potash, almond oil, sulphuric acid, and spirits of wine; this compound not only fines the gin, but communicates to it the property of 'beading,' or hanging in pearly drops or beads on the sides of the glass containing it. When gin does this, it is generally supposed to be strong in proportion as it beads, and the above mixture communicates to weak gin that

* Treatise, page 265.

† On the Falsification of Food, p. 140.

property, so that it will be evident gin can be considerably diluted with water, and yet, by the addition of the above, appear of its proper strength."

On the detection of the adulterations of gin with capsicum, cherry-laurel water, &c., Mr. Mitchell makes the following observations: —

"*Detection of Capsicum, &c.* — If the spirit suspected to contain capsicum, guinea-pepper, or grains of paradise be evaporated to dryness in a water-bath, the residual matter will, if the sample had been adulterated, taste of the above-mentioned substances, and in proportion to the quantity present.

"*Detection of Cherry-laurel Water*, or *Spirit of Almond-cake.* — Take a portion of the suspected spirit, and distil it nearly to dryness; add to the distilled liquid a slight excess of caustic potash, and evaporate until the bulk of the liquid is considerably diminished. Divide the evaporated liquid into two equal portions; to the one add a few drops of a solution, obtained by dissolving proto-sulphate of iron (green vitriol) in water, and exposing the so-made solution to the action of the air for a short time, (ten or twelve hours,) and a few drops of a solution of potash. If, now, a little hydrochloric acid be added, and the liquid acquires a blue tinge, the spirit under examination has been falsified with cherry-laurel water, or spirit of almond-cake.

"The *rationale* of the above process is as follows: — Both cherry-laurel water and spirit of bitter almond-cake contain hydrocyanic (prussic) acid. When spirit thus adulterated is distilled, hydrocyanic acid passes over with the spirit, and on the addition of caustic potash is converted into cyanide of potassium. It is then concentrated by evaporation, and the addition of the salt of iron and hydrochloric acid causes the formation of prussian blue, which is a certain indication of the presence of hydrocyanic acid, and consequently of cherry-laurel water, or spirit of almond-cakes.

"The following process can be performed on the other half of the liquid. This method has been lately described by Liebig, and is far more sensitive than the above, so that smaller quantities of the substances in question can be detected.

"Hydrochloric acid in slight excess must be added to the reserved portion of the liquid, and then a drop of sulphide of ammonium added, and the whole heated until colourless. If, now, a little perchloride of iron be added, a blood-red coloration will immediately ensue. This depends on sulpho-cyanide of ammonium being formed by the reaction of sulphide of ammonium on hydrocyanic acid, which strikes a blood-red colour with a persalt of iron, in common with all the soluble sulpho-cyanides."

In Shannon's work, "On Brewing and Distilling," we meet with the following instructions for reducing unsweetened gin, and for preparing and sweetening British gin: —

"*To Reduce Unsweetened Gin.*

"A tun of fine gin - - - - - -	252 gallons.
Water - - - - - -	36 ,,
Which, added together, make - - -	288 ,,
The *Doctor is now put on,* and it is further reduced with water - - - -	19 ,,
Which gives - - - -	307 gallons of gin."

"This done, let one pound of alum be just covered with water, and dissolved by boiling; rummage the whole well together, and pour in the alum, and the whole will be fine in a few hours.

"*To Prepare and Sweeten British Gin.* — Get from your distiller an empty puncheon or cask, which will contain about 133 gallons. Then take a cask of clear rectified spirits — 120 gallons — of the usual strength as rectifiers sell their goods at; put the 120 gallons of spirits into your empty cask.

"Then take a quarter of an ounce of oil of vitriol, half an ounce of oil of almonds, a quarter of an ounce of oil of turpentine, one ounce of oil of juniper berries, half a pint of spirit of wine, and half a pound of lump sugar. Beat or rub the above in a mortar. When well rubbed together, have ready prepared half a gallon of lime-water, one gallon of rose water: mix the whole in either a pail or cask, with a stick, till every particle shall be dissolved; then add to the foregoing twenty-five pounds of sugar dissolved in about nine gallons of rain or Thames water, or water that has been boiled: mix the whole well together, and stir them carefully with a stick in the 133 gallon cask.

"To *force down* the same, take and boil eight ounces of alum in three quarts of water for three quarters of an hour; take it from the fire, and dissolve by degrees six or seven ounces of salt of tartar. When the same is milk-warm, pour it into your gin, and stir it well together as before, for five minutes, the same as you would a butt of beer newly fined. Let your cask stand as you mean to draw it. At every time you propose to sweeten again, that cask must be well washed out, and take great care never to shake your cask while it is drawing."

But it appears there are other little practices, beside those connected with adulteration, which are sometimes had recourse to by retailers of spirits. Mr. Shannon, from whose work "On Brewing and Distilling" we have just quoted, gives the following advice and recommendations as to certain manipulations and particulars which should be observed in retailing spirits over the counter.

"When you are to draw a sample of goods to show a person that has judgment in the proof, do not draw your goods into a phial to be tasted, or make experiment of the strength thereof that way, because the proof will not hold except the goods be exceedingly strong; but draw the pattern of goods either into the glass from the cock, to run very small, or rather draw off a small quantity into a little pewter pot, and pour it into your glass, extending your pot as high above the glass as you can without wasting it, which makes the goods carry a better head abundantly, than if the same goods were to be put and tried in a phial.

"You must be so prudent as to make a distinction of the persons you have to deal with; what goods you sell to gentlemen for their own use who require a great deal of attendance, and as much for time of payment, you must take a considerably greater price than of others; what goods you sell to persons where you believe there is a manifest, or at least some hazard of your money, you may safely sell for more than common profit; what goods you sell to the poor, especially medicinally, (as many of your goods are sanative,) be as compassionate as the cases require."

Method of Estimating the Quantity of Alcohol present in any Spirituous Liquid.

There are several methods by which the amount of alcohol contained in any spirituous liquid may be determined with greater or less accuracy. One of the readiest of these means is to ascertain the specific gravity of the spirit by a specific-gravity instrument for liquids. Of these instruments, many different kinds have been invented, with scales adapted to the range of the liquids for the determination of the density of which they have been constructed: thus we have urinometers, saccharometers, hydrometers, alcoholometers, &c.; but the principle on which these instruments are constructed is alike in all cases.

The instrument in general use for determining the specific gravity of spirituous liquids in this country is what is known as Sykes' hydrometer. It differs, however, from the ordinary hydrometer in the division of its scale, and also in the use of weights. The hydrometer is calculated to show the strength in spirit either above or below a certain fixed standard, denominated "proof." The stem of the instrument is graduated and subdivided, so as to meet the extremes of variation in the strength of the liquors examined by it.

Sykes' hydrometer is the instrument mostly used by the Excise, by brewers, distillers, and publicans.

Since the specific gravity of a spirituous liquid is subject to great variations at different temperatures, it is necessary that the temperature of the spirit at the time of taking its weight should be noted, and corrections made for this by means of certain tables which have been constructed for the purpose. The temperature at which the specific gravity of the spirit is referred as the standard is usually 60° Fahrenheit.

The specific gravity test for determining the amount of alcohol present in liquids is applicable only when they are free from any solid substance, as extractive, sugar, &c., the presence of which, by affecting their weight, of course influences their specific gravity. When, therefore, any liquid contains saccharine or any other solid matter, it is requisite that the spirit should be separated by distillation, and that the specific gravity of the alcohol thus obtained should be taken. Where strict accuracy is required, it will be necessary to have recourse to distillation in almost all cases, since there are but few spirits which do not contain more or less solid matter.

A considerable improvement on Sykes' hydrometer is the instrument invented by M. Gay Lussac many years since, called the centesimal alcoholometer. This instrument, when immersed in any spirituous liquid at the temperature of 15° centigrade, equal to 59° Fahr., at once indicates the quantity of alcohol by measure present. As its name implies, the stem is divided into a hundred parts or degrees, and is so contrived that each degree represents one hundredth part of anhydrous or pure alcohol; thus the point at which it floats, when immersed in any spirit at a certain temperature, indicates exactly the per-centage of absolute alcohol contained in that spirit. The great value of this instrument is, that it shows at once the per-centage of alcohol, all subsequent calculations, with the loss of time involved, and the possibility of inaccuracies, being thereby avoided.

Another instrument, constructed on a totally different principle to the ordinary densimeters, is the ebullioscope or ebullition alcoholometer. This instrument is based upon the fact that the boiling point of spirituous liquids varies according to the amount of alcohol contained in them, (a discovery made by the Abbé Brossard-Vidal, of Toulon,) without its being essentially modified, like the other instruments, by the presence and nature of any solid ingredients which may be contained in them.

There are several forms of this instrument; there is the original one of M. Brossard-Vidal, and the modifications by M. Conaty, by MM. Lerebours and Secretan, and by Dr. Ure.

The mercurial thermometer used in the modification of the instrument by MM. Lerebours and Secretan is graduated centesimally in degrees, which correspond to those of the centesimal alcoholometer of M. Gay Lussac, and its bulb is plunged in the liquid to be proved. The liquid is carefully heated by means of a spirit lamp, the flame of which should not be strong, lest it occasion the too rapid ebullition of the spirit. Before using the instrument, it is necessary to determine the boiling point of pure water, and the barometrical pressure of the atmosphere on the day on which the experiments are made.

In Dr. Ure's modification of the instrument, the scale is adapted to that of Sykes' hydrometer.

It would be of the greatest possible advantage — would save immense time and trouble — if densimeters of all kinds were revised, and were reduced to one uniform centesimal scale, as is done, in fact, in many of the instruments in use on the Continent.

The ebullioscope is probably sufficiently accurate in the results which it furnishes as to be of considerable service to the distiller, the rectifier, the winemaker, and the brewer; but is certainly not so where strict accuracy is required.

Dr. Ure's modification of the ebullioscope, together with a full description of its principles and application, may be obtained of Mr. Joseph Young, Little Tower-street.

Another instrument which has been invented for the determination of the proportion of alcohol in spirituous liquids is the alcoholometric dilatometer of M. Silbermann. By this instrument, the amount of spirit is determined by the dilation of the spirituous liquid at various temperatures.

A still more accurate method of determining the quantity of alcohol contained in spirituous liquids from their specific gravity, is by means of the specific-gravity bottle. In using this, the same precaution with regard to temperature and the presence of any solid substance in the spirit must be observed.

For ordinary purposes, in the hands of manufacturers and dealers, of all the instruments for determining the strength of spirituous liquors, the centesimal alcoholometer of M. Gay Lussac is the safest and best, and, next to that, Sykes' hydrometer. But the chemist, when any solid matter is contained in the liquid to be examined, should, in all cases, separate the alcohol by distillation, and determine its amount from the distilled liquid, and this is the method by which we have proceeded in the determination of the alcohol contained in the samples of gin the results of the analyses of which we are about to make known. The exact steps adopted were as follows: —

The temperature of the several spirits was reduced in all cases, by means of a solution of ice and salt, to one uniform degree — viz., 60° Fahr., and its specific gravity at that temperature determined by means of the specific gravity bottle; 1500 grains by measure were next distilled, and the distillation carried nearly to dryness; the distilled liquor was brought to 60° Fahr., weighed, and its specific gravity again taken. These particulars being determined, the per-centage of alcohol was ascertained by the following alcoholmetrical table of Tralles: —

ALCOHOLMETRICAL TABLE OF TRALLES.

Alcohol* in 100 Measures of Spirit.	Specific Gravity at 60° Fahr.	Difference of the Specific Gravity.	Alcohol in 100 Measures of Spirit.	Specific Gravity at 60° Fahr.	Difference of the Specific Gravity.
0	9·991	—	51	9·315	20
1	9·976	15	52	9·295	20
2	9·961	15	53	9·275	20
3	9·947	14	54	9·254	21
4	9·933	14	55	9·234	20
5	9·919	14	56	9·213	21
6	9·906	13	57	9·192	21
7	9·893	13	58	9·170	22
8	9·881	12	59	9·148	22
9	9·869	12	60	9·126	22
10	9·857	12	61	9·104	22
11	9·845	12	62	9·082	22
12	9·834	11	63	9·059	23
13	9·823	11	64	9·036	23
14	9·812	11	65	9·013	23
15	9·802	10	66	8·989	24
16	9·791	11	67	8·965	24
17	9·781	10	68	8·941	24
18	9·771	10	69	8·917	24
19	9·761	10	70	8·892	25
20	9·751	10	71	8·867	25
21	9·741	10	72	8·842	25
22	9·731	10	73	8·817	25
23	9·720	11	74	8·791	26
24	9·710	10	75	8·765	26
25	9·700	10	76	8·739	26
26	9·689	11	77	8·712	27
27	9·679	10	78	8·685	27
28	9·668	11	79	8·658	27
29	9·657	11	80	8·631	27
30	9·646	11	81	8·603	28
31	9·634	12	82	8·575	28
32	9·622	12	83	8·547	28
33	9·609	13	84	8·518	29
34	9·596	13	85	8·488	30
35	9·583	13	86	8·458	30
36	9·570	13	87	8·428	30
37	9·556	14	88	8·397	31
38	9·541	15	89	8·365	32
39	9·526	15	90	8·332	33
40	9·510	16	91	8·299	33
41	9·494	16	92	8·265	34
42	9·478	16	93	8·230	35
43	9·461	17	94	8·194	36
44	9·444	17	95	8·157	37
45	9·427	17	96	8·118	39
46	9·409	18	97	8·077	41
47	9·391	18	98	8·034	43
48	9·373	18	99	7·988	46
49	9·354	19	100	7·939	49
50	9·335	19			

* Anhydrous Alcohol of specific gravity 7·939.

The third column of this table exhibits the differences of the specific gravities which give the denominator of the fraction for such densities as are not found sufficiently near in the table, and the difference of their numerators is the next greatest to the density found in the table; for example, if the specific gravity of the liquor found for 60° Fahr. = 9·605, (the per-centage will be between 33 and 34,) the difference from 9·609 (which is the next greatest number in the table) = 4, and the fraction is $\frac{4}{13}$, therefore the true per-centage is $33\frac{4}{13}$, or, decimally, thus, 33·31. In order to ascertain the amount, by volume, of alcohol in the gin or other spirit under examination, it is necessary to proceed as follows:—In order to find the per-centage of absolute alcohol of 7·939 specific gravity in a sample of spirit, divide the number of grains distilled over by the specific gravity of the distilled spirit. Multiply this quotient by the per-centage according to Tralles, and divide this sum by the bulk of the original sample taken; the quotient is the per-centage. This per-centage multiplied by 700 gives the number of grains of absolute alcohol by volume in the gallon. The above comprise all the calculations necessary for arriving at this result. The following is a statement of the several sums:—

1500 gr. by volume yield 1334·6 gr. by weight; sp. gr. ·9484; per-centage, 41·62

The bulk of the distilled spirit is obtained by

As ·9484 : 1· :: 1334·6 : A

The volume of absolute alcohol obtained by

As 100· : A :: 41·67 : B

The per-centage by volumes in the sample by

As 1500 : B :: 100· : C = 39·09

To find the quantity of absolute alcohol in a gallon,

As 100· C : 700· D

the quantity required.

From the construction of Tralles' table, the per-centage of alcohol by weight may also be found—for instance, multiply the number representing the volumes of alcohol given in the table for any determinate specific gravity of the mixture by the specific gravity of the pure alcohol—that is, by 7·939, and the product is the number of pounds of alcohol in so many pounds, as the specific gravity multiplied by 100 gives. Thus, in the mixture, 9·510 specific gravity, there are 40 measures of alcohol; hence there are also in 95·100 lbs. of this spirit 7·939+ 40 = 31·756 lbs. of alcohol; and in 100 lbs. of the spirit of 0·9510 specific gravity 33·39 lbs. of alcohol are contained.

Method of Determining the Amount of Sugar in Gin.

This is readily determined in either of the two following ways:—The syrupy liquid contained in the retort after distillation should be removed and evaporated with a gentle heat, until the water has been driven off, and the sugar crystallised. Or a fresh weighed portion of the gin may be evaporated in the same manner, and the weight of the sugar furnished by it ascertained. The latter is the more accurate method, because the heat employed in distilling off the spirit not unfrequently modifies the sugar considerably, so that in all cases it will not crystallise properly.

Method of Detecting the Presence of Capsicum, Grains of Paradise, and other fixed Acrid Substances in Gin.

The presence of these may usually be ascertained by simply tasting a portion of the syrupy extract left after distillation. The acrid principle of capsicum is a fixed one, and no part of it passes over during distillation. Of the two acrid principles contained in grains of paradise, one is volatile, and the other fixed. The taste of the fixed principle very closely resembles that of Cayenne pepper, but may be usually distinguished with a little care. The plant which furnishes Malaguetta pepper, or grains of paradise, is the *Amomum Grana Paradisi.*

On the Detection of Cinnamon or Cassia in Gin.

As the flavour of these depends upon the presence of essential oils, they of course readily pass off during distillation, and the extract, therefore, does not usually furnish any evidence characteristic of their presence. For the purpose of detecting these oils, the spirit should be gently evaporated, and at such a temperature as does not occasion the volatilisation of the oils.

On the Detection of Sulphate of Zinc in Gin.

The sugar, having been dried, and its weight determined, is to be re-dissolved in distilled water. Half of the solution is to be tested with acid nitrate of baryta for sulphuric acid, and the other half treated with sulphuretted hydrogen, by which means the zinc will be thrown down as a white hydrated sulphuret, from which, if sufficient of the spirit be used, the metal itself may be separated. We give these directions for the detection of this salt, because it is very probable that it is sometimes used to clarify adulterated gin.

On the Presence of Sulphates in Gin.

The addition of acid nitrate of baryta to gin, which has not been adulterated with water, should not occasion any precipitation of sulphates, because the water contained in the spirit is all distilled. When, therefore, on the addition of the above reagent, a precipitate is thrown down, this is due either to the presence of free or combined sulphuric acid; if the latter, and there be no sulphate of zinc or iron present, the sulphates are derived either from the water used for the dilution of the spirit, or from the alum employed for clarifying and beading it, so that, alumina being absent, the presence of sulphates affords in all cases a certain indication of the adulteration of gin with water.

Out of ten samples of gin to which the baryta test was added, four turned slightly opalescent, but scarcely any deposition of sulphate occurred; while in six of the samples there was a decided, and in three a considerable precipitation. These gins were likewise evaporated, the residues dissolved in a little distilled water, and the solution divided into two parts; to one the acid nitrate of baryta was added as before, when sulphate of baryta was thrown down in every case, and in most in great abundance. Through the other half of the solution sulphuretted hydrogen was passed; in not one instance was any white precipitate observed, from which the absence of zinc is to be inferred. These observations are important, because they afford us the means of judging of the adulteration of gin by the addition of water. Heretofore the presence of water has been inferred rather than proved, from the deficiency of alcohol in the spirit supposed to contain the water.

On the Presence of Lead in Gin.

As we have seen, it is commonly stated that acetate of lead is employed in the clarification of adulterated gin; in order, therefore, to ascertain whether the metallic base of this salt is to be found in gin, eight ounces of ten different samples were evaporated, the residues dissolved in a little distilled water, and sulphuretted hydrogen passed through them: in one case a decided brownish discoloration ensued; in some of the others slighter discolorations were observed; but in none of the gins was lead discovered in the ashes treated with nitric acid and water, and tested with iodide of potassium. If lead was, therefore, present in any of the samples, it was so only in traces.

The absence of lead may be explained in some cases even where it has really been used. The lead of the acetate would combine with the sulphates of the water, and the insoluble sulphate of lead would be precipitated; it is, therefore, only when the quantity of lead added is in excess of the sulphates that it would be found in gin; and when sulphates are present in gin, we may safely conclude that it does not contain lead.

From the following Table of Analysis it appears,—

1st. That the *strength* of the various samples ranged from 15,645 grs. to 34,160 grs. per imperial gallon; the per-centages ranging from 22·35 to 48·80 per cent.

It thus appears, that some of the spirits contained only half as much alcohol as was present in some of the other samples, and therefore that their commercial value was reduced to the enormous extent of more than one half; thus, supposing sample 2. to be worth 12*s*. per gallon, sample 35. would be worth less than 6*s*. per gallon. This variation in the strength of the spirits is doubtless principally attributable to dilution with water.

2nd. That the quantity of *sugar* ranged from 3 oz. 4 dr. 23 gr. to 13 oz. 4 dr. 13 gr. per gallon.

3rd. That *two* of the samples contained *oil of cinnamon*, or more probably of *cassia*.

4th. That *seven* of the samples contained CAYENNE PEPPER, some of them in very large quantity, so that the syrupy extract left on evaporation possessed a burning and fiery taste.

5th. That in no case was *free sulphuric acid* detected; its absence being sufficiently shown, by all the samples being neutral to test paper.

6th. That *most* of the samples contained combined sulphates, mostly derived from the water and alum used in the adulteration and clarification of the gins.

In addition to the above adulterations, we have the authority of a gin distiller for stating that the practice of adding sulphate of zinc, or as it is commonly called, white vitriol or white copperas, to gin is very common. Here again, then, we have obtained evidence of the adulteration of gin in a manner calculated to prove injurious to health.

It is impossible to conceive of more scandalous adulterations of gin or other spirits than those by cayenne pepper or grains of paradise, for they are almost equally hot and pungent. The introduction into the stomach of raw spirits is sufficiently destructive to health of itself, but the addition of such powerful and acrid substances as cayenne and grains of paradise to spirit, forms a compound which no human stomach or system, however strong, can long withstand.

Although sulphuric acid was not present in any of the samples of London gin which we examined, it is yet, no doubt, sometimes employed, and this in large quantity, Dr. Muspratt states that it is so in West Country gin. If any sample of gin exhibit an acid reaction, the presence of sulphuric acid may be suspected, and it may be discovered simply by the evaporation at a gentle heat of a little of the gin, placed on the hob of a fire-place. As soon as all the spirit and water have been driven off, the sulphuric acid will act on the sugar, and quickly reduce it to a black carbonaceous mass.

It would appear that all West Country gin does not contain free sulphuric acid. The following are the results of the analysis of a sample of Plymouth gin, by Dr. Letheby. It contained 29·2 per cent. of alcohol, had only a mere flavour of juniper or any other flavouring agent, did not contain sugar, and there was present in it sulphuric acid in combination. It consisted, in fact, of little more than raw and unsweetened corn spirit, brought down to gin strength.

The adulteration of gin with cayenne pepper is mostly effected by means of tincture of capsicum, and it is practised in the majority of cases by the publicans themselves. We are acquainted at the present time with the name of a publican whom we have ascertained to make periodical purchases of tincture of capsicum. We know the chemist of whom he purchases it, and we have detected it in more than one sample of the gin sold by him to his customers at the bar.

We have often in the course of these Reports commented upon what we conceived to be the remissness of the Excise authorities. Here is a gross adulteration of gin, commonly practised, and detectable in a ready and simple manner, by which the revenue is defrauded, and which is seriously detrimental to health; and yet we do not remember to have ever heard that the Excise had noticed it in any way, or taken any steps to put a stop to so iniquitous an adulteration.

The different kinds of spirits are obtained in a comparatively crude state from the grain by the distiller. They are afterwards submitted to purification by the rectifier, as well as procured of a higher strength. The impurity of raw spirits arises principally from the presence of a peculiar volatile oil, termed fusel oil, and possessing very deleterious properties. Of this oil, and of the method of freeing spirits from it, we meet with the following account in Ure's Dictionary*:—" Sometimes, after moist autumns, when damaged grain abounds, the alcohol distilled from its fermented wash contains a peculiar volatile body. When we apply our nose to this species of spirits in its hot state, the volatile substance dissolved in it irritates the eyes and nostrils; it has very

* 4th Edition, vol. i. p. 30.

TABLE SHOWING THE RESULTS OF THE CHEMICAL ANALYSIS OF DISTILLERS AND

Number.	Name.	Address.	Specific Gravity before Distillation.
1	Messrs. Bowerbank & Sons	77½ Sun-street, Bishopsgate-street	
2	Messrs. J. & J. Vickers & Co.	Stoney-street, Borough	
3	Messrs. Hodges & Co.	Church-street, Lambeth	954·2
4	J. Bell	25. Cable-street, Whitechapel	977·2
5	Rose & Mathews	4. Wells-street, Whitechapel	960·9
6	R. Skipper	Cable-street	968·7
7	W. Coates & Co.	25. High-street, Whitechapel	963·6
8	D. Morton	2. Whitechapel-road	970·3
9	F. Junge	66. Cable-street	974·0
10	J. Hancock	11. Somerset-place, Aldgate	965·9
11	J. Brown	30. High-street, Whitechapel	965·0
12	W. Freshwater	Back-church-lane, Whitechapel	971·0
13	J. Williams	45. High-street, Whitechapel	970·4
14	J. Brand	77. Leman-street, Whitechapel	973·0
15	J. Colliss	King-street, Smithfield	973·2
16	M. Chance	69. Long-lane, Smithfield	964·0
17	J. Champion	33½. Grays Inn-lane	973·4
18	G. Stockdell	78. Gray's Inn-road	966·3
19	J. Young	72. High Holborn	972·0
20	J. Denyer	15. High-street, St. Giles'	966·3
21	W. Latimer	47. Broad-street, St. Giles'	968·5
22	R. Sinclair	36. High-street, St. Giles'	975·9
23	H. Cusack	6. Tottenham-court-road	964·1
24	W. Cripps	1. Newport-market	968·5
25	W. Tillyard	19. Moor-street, Soho	972·1
26	W. Moss	Seven-dials	967·3
27	G. A. Compton	84. Edgware-road	964·5
28	Walker & Co.	63. Westminster-bridge-road	970·1
29	C. Watchorn	1. Marsh-gate, Lambeth	964·6
30	J. Empson	107. Lambeth-marsh	968·5
31	T. Grammar	Waterloo-road	964·6
32	W. Jorden	52. Tothill-street, Westminster	968·1
33	W. Carpenter	11. King-street, Westminster	970·5
34	W. Vickress	11. Bridge-street, Westminster	966·3
35	H. Rennell	High-road, Knightsbridge	988·8
36	W. Weatherley	Knightsbridge	970·4
37	J. Upton	Hemming's-row, Charing-cross	969·6
38	T. West	9. Bear-street, Leicester-square	966·8

THIRTY-EIGHT SAMPLES OF LONDON GIN AS OBTAINED FROM PUBLICANS.

Number.	Amount of Anhydrous Alcohol, Sp. Gr. 793·9, Temp. 60 Fahr. per Gallon by Volume.	Per-centage of Alcohol, Sp. Gr. 793·9 by Volume.	Sugar per Gallon. oz.	dr.	gr.	Remarks.
1	28336	40·48	None.			
2	34160	48·80	None.			
3	33740	48·20	5	7	35	
4	17969	25·67	4	5	31	Contains the Oil either of Cinnamon or Cassia.
5	28448	40·64	5	3	12	
6	25452	36·36	5	0	52	
7	28497	40·71	7	6	48	
8	27349	39·07	6	4	5	Contains tincture of Capsicum or Cayenne; residue after distillation pungent to the taste.
9	23758	33·94	5	5	15	Contains a considerable quantity of Cayenne.
10	27160	38·8	4	3	30	
11	27377	39·11	5	6	0	Extract bitter; contains much combined Sulphate, most probably derived from the water used.
12	24143	34·49	4	7	14	Contains a large quantity of Cayenne; residue hot and fiery.
13	25354	36·22	5	3	35	Contains a considerable quantity of the Oil of either Cinnamon or Cassia; extract bitter, contains combined Sulphate.
14	24374	34·82	6	2	5	
15	23730	33·90	6	5	43	Contains a large quantity of Cayenne; residue very fiery.
16	25571	36·53	8	2	48	
71	22806	32·58	5	2	16	
18	17850	25·5	5	3	32	
19	23163	33·09	6	1	59	
20	25004	35·72	4	1	56	
21	24395	34·85	4	6	36	
22	28868	41·24	13	4	13	
23	27321	39·03	5	6	51	
24	24339	34·77	5	2	25	
25	22715	32·45	4	5	3	
26	28987	41·41	5	3	33	
27	27405	39·15	6	6	25	
28	28000	40·00	9	3	42	
29	29197	41·71	6	6	22	
30	24724	35·32	5	0	10	
31	28959	41·37	7	9	8	
32	16828	24·04	3	4	23	Contains Cayenne in rather large amount.
33	27033	37·19	7	2	0	
34	29071	41·53	8	0	23	
35	15645	22·35	6	0	35	Contains a large quantity of Cayenne; residue intensely fiery.
36	22414	32·02	4	1	52	Contains a large quantity of Cayenne; residue very hot.
37	22106	31·58	5	2	16	
38	25102	35·86	5	4	36	

nearly the same smell as an alcoholic solution of cyanogen, as any chemist may discover by standing near the discharge-pipe of the refrigeratory worm of a raw-grain whisky still. Such spirits intoxicate more strongly than pure spirits of the same strength, and excite, in many persons, even temporary frenzy. It is a volatile fatty matter, of a very fetid odour, when obtained by itself, as I have procured it in cold weather at some of the great distillers in Scotland. It does not combine with bases. At the end of a few months, it spontaneously decomposes in the spirits, and leaves them in a less nauseous and noxious state. By largely diluting the spirits with water, and distilling at a moderate temperature, the greater part of this oil may be separated. Part of it comes over with the strongest alcohol, and part with the latter runnings, which are called by the distillers strong and weak feints. The intermediate portion is purer spirit. The feints are always more or less opalescent; or become so on dilution with water, and then throw up an oily pellicle upon their surface. The charcoals of light wood, such as pine or willow, well calcined, and infused in sufficient quantity with the spirits prior to rectification, will deprive them of the greater part of that oily contamination. Animal charcoal, well calcined, has also been found useful; but it must be macerated for some time with the empyreumatic spirits before distillation. Another method of separating that offensive oil is to agitate the impure spirits with a quantity of fat oil, such as olive oil, or oil of almonds, to decant off the oil, and re-distil the spirits with a little water.

"Digestion and agitation with calcined magnesia for some time, followed by filtration and distillation, are also good means for improving the flavour of alcohol. The taste of the oil of grains is best recognized by agitation with water, whereby, on standing, the diluted spirit throws up a film of oil visible by reflected light. If the spirit be mixed with a few drops of nitrate of silver, and exposed for some time to sunshine, the oil will react upon the oxide of silver, and cause a brown tinge; but if there be no oil present, the spirits will remain limpid. If one part of hydrate of potash, dissolved in a little water, be mixed with 150 parts of spirits, and if the mixture be well shaken, then slowly evaporated down to 15 parts, and mixed with 15 parts of dilute sulphuric acid in a phial, to be then corked, there will soon exhale from the mixture a peculiar offensive odour characteristic of the quality and origin of the impure spirit, whether obtained from raw grain, from malt, from potatoes, rye, arrack, rum, brandy, &c. This excellent process may be used also for testing wines. Lime and alkalis always injure the flavour of ardent spirits of all kinds."

Heavy duties are levied upon all descriptions of spirits according to their strength. The specific gravity or strength of spirits of the legal standard of the Excise is technically called *Proof*, or *Proof Spirit*. "This liquor not being spirit sweetened, or having any ingredient dissolved in it to defeat the strength thereof, at the temperature of 51° Fahr. weighs exactly $\frac{12}{13}$th parts of an equal measure of distilled water;" and with this standard the strength of all other spirits are compared according to law. The duty on British spirits is 7*s.* 10*d.*, Scottish, 5*s.* 8*d.*, and Irish, 3*s.* 4*d.* per proof gallon.

The following are some of the enactments relating to the trade in spirits:—

"No spirits made in England, Scotland, or Ireland, shall be conveyed from England to Scotland or Ireland, or from Scotland or Ireland to England, otherwise than in casks containing *twenty* gallons at the least, and in vessels of not less than *fifty* tons burden.

"All persons whatsoever, not being licensed distillers, rectifiers, or compounders, having more than *twenty* gallons of spirits in their possession, shall be deemed dealers in spirits, and subject to the survey of the officers of Excise, and to all the regulations, penalties, &c., to which such persons are liable." (16 Geo. 4. c. 80. § 122.)

"Dealers in British spirits are prohibited selling or having in their possession any plain British spirits, except spirits of wine, of any strength exceeding the strength of 25 per cent. above hydrometer, or of any strength below 17 per cent. under hydrometer proof, or any compounded spirits, except shrub, of any greater strength than 17 per cent. under hydrometer, under pain of forfeiting all such spirits with the casks," &c.—§ 124.

"Dealers in foreign and British spirits are to keep them separate in cellars, vaults, or other places specially entered for that purpose, under a heavy penalty; and any person mixing, selling, or sending out any British spirits mixed with foreign or colonial spirits, shall forfeit 100*l.* for every such offence." — § 126.

"No retailer of spirits, or any other person, licensed or unlicensed, shall sell or send out from his stock or custody any quantity of spirits exceeding one gallon, unless the same be accompanied with a true and lawful permit, under pain of forfeiting 200*l.*; and any rectifier, compounder, or dealer in spirits receiving the same into their stock, or allowing any one else to receive it, and any carrier, boatman, or other person knowingly carrying the same, shall forfeit the sum of 200*l.* with the boat, horse, cart, &c., used in the carriage,"— § 116.

"No licence to be granted for retailing spirits within gaols, houses of correction, or workhouses for parish poor; nor are spirits to be used there, except medicinally prescribed by a regular physician, surgeon, or apothecary. Penalty for a first offence of this sort committed by gaolers, &c., 100*l.*; a second offence to be deemed a forfeiture of their office,"—§ 134.

"Persons *hawking spirits* to forfeit them and 100*l.*; and if the penalty be not immediately paid, they are to be committed to the House of Correction for three months, or until paid,"— § 138. "Any person is authorised to detain a hawker of spirits, and give notice to a peace-officer, who is to carry the offender before a Justice."— § 140.

"Any officer of Excise, or other person employed in the Excise, taking any sum of money or reward from, or entering into any collusive agreement with, any person, to act contrary to his duty, to forfeit 500*l.* and be incapacitated; and any person offering such reward, or proposing such agreement, to forfeit 500*l.*" — § 145.

The high price of alcohol in this country, in consequence of the heavy duties to which it is subject, and the low price in other countries, where it is nearly duty free, has led to its contraband importation under various disguises. Sometimes it is mixed with oil of turpentine, from which it can be sufficiently freed by rectification for the purpose of the gin manufacturer. Sometimes it is disguised by wood naphtha and wood vinegar — from the latter of which it may be separated by distillation in a water bath — but from the former the separation is more difficult, as alcohol and wood spirit are nearly equally volatile. It has also been disguised with coal naphtha, but from this it may be easily separated by distillation, on account of the great difference of the boiling point of the liquids; besides, coal naphtha will not combine with water as alcohol does.

The following directions are given by Ure for discovering whether wood spirit contains alcohol: — "Add to the suspected liquid a little nitric acid of sp. g. 1·45. If alcohol be present, in even small proportion, an effervescence will ensue, from the evolution of etherised nitrous gas, with its characteristic etherous smell. On treating the mixture with a nitrous solution of mercury, as in the process for fulminate of mercury, an effervescence will take place, the dense vapour of etherised mercurial gas will appear, and a certain proportion of fulminate will be formed, corresponding pretty closely to the proportion of alcohol in the wood naphtha mixture." *

* Ure's Dictionary, 4th Edition, vol. i. p. 31.

FLOUR, AND ITS ADULTERATIONS.

"This Wilson carries on an extensive business at the Old Mill, Lancashire-hill, Heaton Norris; and he has been summoned before the Stockport borough magistrates. The superintendent of the borough police deposed that he searched the premises of the defendant, and found a sack of mineral white, or hydrated sulphate of lime; and the defendant's son told him that all the flour that contained the mineral was sent away that morning: he found other sacks full of China clay, which the defendants said had been bought to mix with flour, but was found to be of too soft and oily a nature. John Eaton, a man who had been in the defendant's employment, swore that he had been employed to mix the mineral white with flour in the proportion of one sack of mineral to nine of flour. About the end of September, some wheat belonging to Mr. Henry Marsland, which had been sent to this mill to be ground, was treated in this way, and a portion of the genuine flour kept back. Witness had also taken two sacks of flour to Mr. Hayes, a provision dealer, and with this he had mixed mineral white by defendant's orders. A great portion of it was afterwards returned, having been found so bad that it could not be used. Mr. Wheeler, for the defence, admitted the nature of the ingredients found on the defendant's premises; and called Mr. W. O. Wilson, defendant's son and manager, to show that the wheat ground was of an inferior description; and that the flour was manufactured for sizing and oiling purposes only. The mineral white was used to improve the colour; but the only flour defendant ever sold for human consumption, was the two sacks to Hayes, and neither these nor those belonging to Mr. Marsland contained a particle of mineral. Mrs. Hayes had requested them as a favour to send her the flour, which she thought would do for brown bread; but as it was found not to answer the purpose required, a portion was sent back. The witness Eaton had threatened to make them repent it when he was discharged. Witness was not aware that the mineral white would injure machinery. This remarkably lame defence, it would seem, was attentively listened to by the bench of magistrates, who, after consulting for some time, decided that the defendant had no right to have such ingredients on his premises; but as they believed that Wilson was not aware that he was acting contrary to law, they would inflict the mitigated penalty of 5*l.* and costs. The counsel for the defendant gave notice of appeal at the next Quarter Sessions, but of course there will be no appeal. This "ignorant" man, with so slight a knowledge of the law, as not to know that he was infringing it, we suspect has wit enough to let the matter drop, and put up with the loss of his 5*l.* and costs. If he had his deserts, he ought now to be the inmate of a jail."—*Dispatch*, 3rd Dec. 1854.

ADULTERATION OF TOBACCO.

Bow-street.—"Edward Arthur Welch, tobacco manufacturer of John-street, Clerkenwell, was summoned at the instance of the Excise, on a charge of adulterating tobacco, and having a quantity of treacle in his possession. Mr. Dwelly, solicitor to the Board, produced witnesses, and he showed samples of the tobacco, stating that the mixture of treacle was in the proportion of about 5 per cent.; the object of which was to increase the weight of the article. The defendant pleaded guilty to the articles being found in his possession, but said the tobacco was adulterated as found before it came to his house. Mr. Dwelly urged strongly the infliction of the full penalties, as it had been ascertained that, within a short period, the defendant had purchased two tons of treacle from the sugar-refiners of London; and supposing this quantity to be used with tobacco for adulteration, it would entail a loss upon the revenue of 1,200*l.*, to say nothing of the extent to which the public would be defrauded by the same process. Mr. Henry inflicted the full penalty of 300*l.* for the first offence, and 200*l.* for the second; a distress warrant to issue in the event of non-payment. The defendant said he should petition the Board for a reduction of penalties."—*Observer*, Dec. 10. 1854.

DATES OF PUBLICATION OF REPORTS.

	1851.
Coffee	January and April.
Canister Coffee	May.
Sugar	January.
Arrow-root	February and October.
Pepper	February.
Water	February and March.
Chicory	March and May.
Mustard	March.
Bread and Flour	March, April, October and November.
Cocoa	May, June and July.
Ervalenta Revalenta	June.
Farinaceous Foods	June.
Oatmeal	July.
Tea	July and August.
Milk	September and October.
Chicory and Coffee	November.
Isinglass	November.
	1852.
Vinegar	January, August and September.
Pickles	January.
Ginger	February.
Turmeric	February.
Cinnamon	February.
Cassia	February.
Nutmegs	May.
Mace	May.
Cloves	June.
Pimento	June.
Mixed Spice	June.
Preserved Provisions	March and April.
Bitter Beer and Ale	May.
Poisonous Cayenne Pepper	July.
Curry Powder	July.
Poisonous Bottle Fruits and Vegetables	August.
Anchovies	October.
Potted Meats and Fish	November.
Sauces	December.
	1853.
Preserves and Jams	January.
Lard	February.
Coffee	April and May.
Butter	June.
Tobacco	July, August and September.
Cigars and Cheroots	November and December.
Snuff	November and December.
	1854.
Coloured Sugar Confectionery	April and May.
Porter and Stout	September.
Gin	December.

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THE END.

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