A GUIDE

TO THE

FOOD COLLECTION

IN THE

SOUTH KENSINGTON MUSEUM.

BY EDWIN LANKESTER, M.D., F.R.S.,

SUPERINTENDENT OF THE ANIMAL PRODUCT
AND FOOD COLLECTIONS.

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Regulations for the Guidance of Contributors to the Animal Products and Food Collections of the South Kensington Museum.

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1. The Museum will be open, FREE, on Mondays, Tuesdays, and Saturdays, in the daytime, and in the evenings of Mondays and Tuesdays. The Students' days are Wednesdays, Thursdays, and Fridays, and the evening of Wednesdays. The hours are from 10 till 4, 5, and 6, according to the season, in the daytime, and from 7 till 10 in the evening.

2. Contributions accepted for exhibition must be forwarded at the risk of the Contributors. The specimens will be classified and arranged by the officers of the Museum.

3. Descriptive labels will be attached to the various contributions, giving their names, uses, prices, &c.

4. It is desirable that the usual retail price should be distinctly marked on all articles sent for exhibition.

5. Objects admitted to the Museum cannot be removed (except under special circumstances, by written agreement) until they have been exhibited for a period of at least twelve months.

6. The exceptions to the foregoing regulation would be for articles of a perishable nature, and for such as may have become damaged by exposure or from other causes.

7. In order to protect the property of Exhibitors, no article will be allowed to be removed from the Museum without a written authority from the Keeper.

8. A Catalogue will, from time to time, be published, so as to keep pace as much as possible with the additions to, and the withdrawals from, the Museum.

9. Exhibitors desirous of advertising in the Catalogue may send their prospectuses, illustrations, price-lists, &c., 1,000 copies at a time, and printed in demy 8vo., so that they may be bound up in the Catalogue. The binding will be free of cost to Exhibitors.

10. All contributions forwarded to the Museum must be addressed to the Secretary of the Science and Art Department, South Kensington, care of Richard A. Thompson, Keeper of the Museum.

HENRY COLE, *Secretary*.

By order of the
Committee of Council on Education.

SOUTH KENSINGTON MUSEUM.

A GUIDE TO THE FOOD MUSEUM.

THE original idea of the Food Museum, which is placed in the South Gallery, was suggested by Mr. Twining, as part of a plan for the establishment of an Economic Museum that should comprise illustrations of every-day life for the working classes. The Food Museum was for some time carried on under the direction of Dr. Lyon Playfair, and as now constituted, has been arranged with the express object of teaching the nature and sources of the food which rich and poor alike need for the maintenance of their daily life. Although great progress has been made in carrying out this design, the collection is not yet in a condition to justify the publication of a catalogue, and this Guide is intended as an introduction to the general principles and plan upon which the Museum has been arranged. Two great objects have been kept in view in the collection:—First, to represent the chemical compositions of the various substances used as food; and, secondly, to illustrate the natural sources from which the various kinds of food have been obtained. Where the processes of the preparation of food admit of illustration, these are also exhibited.

There are many methods by which such a collection might be arranged, but the chemical composition of food has recently been discovered to have so close a connexion with its action on the system that it has been deemed advisable to follow a chemical arrangement. All food is found to be composed of the same materials or elements as the human body. The necessity of the supply of food from day to day depends on the fact, that the elements of the human body are daily wasted by the processes of

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COMPOSITION OF THE HUMAN BODY.

Not only does food supply the daily waste of the human body, but, as the body increases in size from birth to adult age, it is supplied with materials for this increase by the aid of food. In order, therefore, to understand the value of food from its composition, it is necessary to know the composition of the human body. Just as any other compound substance can be submitted to chemical analysis and the elements of which it consists ascertained, so can the composition of the human body be discovered. Such analyses of course become difficult in proportion to the complication of the body analysed, and only an approach to the true quantities in which the elements exist can be expected. In case No. 1, Division A, the results of such an analysis has been attempted, and the quantities of each element entering into the composition of a human body weighing 11 stones or 154 pounds is (as far as possible) presented to the eye.

The following are the elements and their quantities :—

Ultimate Elements of the Human Body.

	lbs.	oz.	grs.
1. *Oxygen*, a gas. The quantity contained in the body would occupy a space equal to 750 cubic feet - - -	111	0	0
2. *Hydrogen*, a gas. The lightest body in nature. The quantity present would occupy about 3,000 cubic feet - -	14	0	0
3. *Carbon*, a solid. When obtained from animals it is called animal charcoal	21	0	0
4. *Nitrogen*, a gas. It would occupy, when free, about 20 cubic feet - -	3	8	0
5. *Phosphorus*, a solid. This substance is so inflammable that it can only be kept in water - - - -	1	12	190

	lbs.	oz.	grs.
6. *Calcium*, a solid. The metallic base of lime which has not yet been obtained in sufficient quantity to be employed in the arts. It is about the density of aluminium - - - - - -	2	0	0
7. *Sulphur*, a solid. A well-known substance. It unites with hydrogen, forming sulphuretted hydrogen, which gives the unpleasant smell to decomposing animal and vegetable matter - -	0	2	219
8. *Fluorine*, a gas. This substance has not been separated in such a manner as to permit of an examination of its properties, and cannot be exhibited. It is found united with calcium in the bones -	0	2	0
9. *Chlorine*, a gas. When combined with sodium it forms common salt -	0	2	47
10. *Sodium*, a metal. It is so light that it floats on water, and is kept in naphtha to prevent its oxidation -	0	2	116
11. *Iron*, a metal. In small quantities it is necessary to the health of the body	0	0	100
12. *Potassium*, a metal. Like sodium it floats on water, and burns with a flame when placed on it - - -	0	0	290
13. *Magnesium*, a metal. Combined with oxygen it forms magnesia - -	0	0	12
14. *Silicon*, a metallic substance. With oxygen it forms silex or silica. It enters into the composition of the teeth and hair - - - - - -	0	0	2
	154	0	0

Other elements have been found in the body, as copper and manganese, but these are probably accidental.

These elements, when combined together, form a set of compound bodies called "proximate principles," out of which the tissues and fluids of the body are formed.

Proximate Principles of the Human Body.

	lbs.	ozs.	grs.
1. *Water*, composed of oxygen and hydrogen gases - -	111	0	0
2. *Gelatin*, of which the walls of the cells and many tissues of the body, as the skin and bones, are principally composed -	15	6	0
3. *Fat*, which constitutes the adipose tissue - - - - -	12	0	0
4. *Phosphate of Lime*, forming the principal part of the earthy matter of the bones - - - - -	5	13	0
5. *Carbonate of Lime*, also entering into the composition of bone - -	1	0	0
6. *Albumen*, found in the blood and nerves - - - - - -	4	3	0
7. *Fibrine*, forming the muscles and the clot and globules of the blood - -	4	4	0
8. *Fluoride of Calcium*, found in the bones - - - - - -	0	3	0
9. *Chloride of Sodium*, common salt -	0	3	376
10. *Sulphate of Soda* - -	0	1	170
11. *Carbonate of Soda* - - -	0	1	72
12. *Phosphate of Soda* - -	0	0	400
13. *Sulphate of Potash* - - -	0	0	400
14. *Peroxide of Iron* - - -	0	0	150
15. *Phosphate of Potash* - -	0	0	100
16. *Phosphate of Magnesia* - -	0	0	75
17. *Silica* - - - -	0	0	3
	154	0	0

These compounds, in passing away from the body, form many others, which may be here left out of consideration as not forming a necessary part of the fabric of the human body.

None of these constituents of the body remain permanently in the system, and whilst the old particles are being removed new ones are supplied by the food. It is calculated that in this way a quantity of material, equal to the weight of the whole body, is carried away every forty days. So that we may be said to moult or cast away our old body and get a new one every forty days.

The materials for the food of man, and containing the above elements, are derived from the mineral, vegetable, and animal kingdoms. The vegetable kingdom, however, is the great source of food to man and animals, as it is in the cells of the plant that the elements undergo those chemical changes which fit them for food. The animal can only supply what it obtains from them, and the substances supplied by the animal kingdom as food are identical with those obtained from plants. To a certain extent the physiological action of food depends upon its chemical composition, and in the following Classification of Food, according to which the museum is arranged, this fact is recognized.

CLASSIFICATION OF FOOD.

Class I. Alimentary or Necessary.

Group 1. *Mineral:*

- *a*, Water;
- *b*, Salt;
- *c*, Ashes of Plants and Animals.

Group 2. *Carbonaceous or Respiratory=Heat-giving:*

- *a*, Starch;
- *b*, Sugar;
- *c*, Fat.

Group 3. *Nitrogenous or Nutritious=Flesh-forming:*

- *a*, Albumen;
- *b*, Fibrine;
- *c*, Caseine.

Class II. Medicinal or Auxiliary.

Group 1. *Stimulants:*

- *a*, Alcohol;
- *b*, Volatile Oils.

Group 2. *Alteratives:*

- *a*, Acids;
- *b*, Alkaloids.

Group 3. *Narcotics :*

a, Tobacco ;
b, Hemp ;
c, Opium.

Group 4. *Accessories :*

a, Cellulose ;
b, Gum ;
c, Gelatine.

CLASS I. ALIMENTARY OR NECESSARY FOOD.

GROUP I. MINERAL FOOD.

WATER.

The first and most essential constituent of food is Water. Three fourths of the body is composed of water, and it is by the agency of water that all kinds of food are taken up into the system. Solid food contains large proportions of water, but, in proportion to the dryness of food, water should be added to it, in the form of some kind of beverage.

QUANTITIES OF WATER IN 100 POUNDS OF DIFFERENT KINDS OF SOLID FOOD.

Vegetable Food.

Potatoes	lbs. 75	Indian Meal	lbs. 14
Carrots	86	Rye	13
Turnips	87	Peas	14
Parsnips	79	Rice	13
Mangel Wurzel	85	Beans	14
Cabbage	92	Bread	44
Flour	14	Cocoa	5
Barley Meal	14	Lentils	14
Oatmeal	13	Buckwheat	14

Animal Food.

Milk	lbs. 86	Mutton	lbs 44
Bacon	30	Pork	38
Veal	62	Fish	78
Beef	50	Eggs	80
Lamb	50	Cheese	40

Water for dietetical purposes is obtained principally from three sources:—1. Rivers; 2. Surface wells; 3. Deep or Artesian wells. Water from all three sources contains saline or mineral matters in solution, and, provided they are not in quantities so large as to act injuriously on the system, water may become a source of supply of these constituents to the body. The following Table gives the quantities of saline matters found in waters supplied to the metropolis.

Analysis of the Quantities of Saline Substances found in London Water.

—	River Thames at Twickenham.	Surface Well at Clapham.	Artesian Well, Trafalgar Square.
Silica	0·27	0·24	0·97
Sulphate of Potash	0·66	6·74	13·67
Sulphate of Soda	2·00	10·77	8·74
Chloride of Sodium	—	11·46	20·05
Chloride of Calcium	1·75	—	—
Carbonate of Lime	12·75	15·09	3·25
Carbonate of Magnesia	1·02	13·97	2·25
Sulphate of Lime	0·45	15·32	—
Carbonate of Soda	—	—	18·04
Phosphate of Lime	—	—	0·03
Phosphate of Soda	—	—	0·29
Total	18·90	73·59	67·29

Besides these *inorganic* substances, water contains *organic* matters arising from the decomposition of animal and vegetable substances, either growing in the water or cast into it. This organic matter, when it putrifies, may render the water in which it is present very injurious, and even fatal, in its effects. The following analyses give the quantities of organic matter, in grains, in a gallon of surface well, river, and Artesian well waters:—

SURFACE WELLS.

	Organic Matter.	Inorganic Matter.	Total.	Analyst.
Belgrave Mews -	15	110	125	Aldis.
Grafton Street -	26	115	141	Hillie r.
Wandsworth Road -	19	72	91	Odling.
Spencer's Court -	14	172	186	R.D.Thomson.
Broad Street (Golden Square) - -	5	102	107	Powell.
RIVER WATER.				
Grand Junction Water Company -	1½	21½	23	Hoffman.
New River -	1	21	22	,,
Thames at Twickenham - -	2	20	22	Clark.
DEEP WELLS IN CHALK.				
Trafalgar Square -	—	68·	68	Abel.
Richmond - -	·80	27·20	28	Henry.
Long Acre - -	—	57·	57	Graham.

From these analyses it will be seen that the organic matter is most abundant in surface well waters, which derive this matter from soaking through the soil which is permeated with house drainage, &c. The best remedy for impure water is filtering, which may be done by passing the water through charcoal and sand. "A Poor Man's Filter" is exhibited in the Museum, which can be constructed by using a common flower-pot, with a layer of charcoal and sand. Filters from the establishments of the Messrs. Lipscombe, the Messrs. Ransome, and the Carbon Filter Company are also exhibited. The passing water over iron has been found to have a remarkably purifying effect, and this been patented by Dr. Medlock. Specimens of water thus purified are exhibited.

Specimens of Thames water, taken at various points from Southend to Thames Ditton, are exhibited, to show the influence of the sewage of London in rendering the water unfit for drinking purposes.

A series of specimens of waters from the surface wells of the parish of St. James, Westminster, are also exhibited, which show the large quantities of organic matter contained in these comparatively pure surface wells. The erection of drinking fountains supplied with filtered river water will be a great improvement on this kind of water.

Water from the chalk is generally hard, arising from its holding in solution carbonate of lime, which, although insoluble in water, is dissolved by the agency of carbonic acid. By Clark's softening process the carbonic acid is neutralized by lime, and the carbonate of lime is thus thrown down.

Illustrations of this process, presented by Mr. Homersham, are exhibited in the Museum.

The *organic* impurities of water are best tested by the aid of the microscope, but, as an examination by this instrument requires much time, a ready method of obtaining a knowledge of the comparative organic impurity of waters is the addition of the permanganate of soda or potash. This salt, which gives to water a beautiful red colour, is easily decomposed by organic matters. When the same quantity of the permanganate is added to a series of waters containing organic matters, those which contain the least retain the most colour and *vice versâ*. Waters thus coloured are exhibited in the Museum.

SALT.

Common Salt is a chloride of sodium, and exerts an extraordinary influence on animal as well as vegetable life. All marine animals and plants seem to have their existence determined by this substance. It enters into the composition of the human body, and all over the world man uses it, when he can obtain it, in its mineral form, as an addition to his food.

Salt occurs in large quantities in the bowels of the earth, and in many parts of Great Britain and the continent of Europe it is worked for the purpose of supplying the market. It is obtained in the form of Rock Salt, and in Brine Springs, both of which contain many impurities; but, when prepared, it is sold under the names of "bay salt" and "fine salt."

Specimens of this substance from various parts of the world will be found in the Museum.

Salt has the power of preventing the decomposition of animal and vegetable substances. It is extensively employed in this country, sometimes in conjunction with saltpetre (nitrate of potash) for the preservation of pork and beef. In other countries it is employed for the preservation of fruits and vegetables, and might certainly be made more extensive use of in this country than it is for the preservation of the latter for winter use.

MINERAL MATTERS IN FOOD.

Case 2 contains examples of some of the mineral substances known to exist in vegetable and animal food.

This Case is accompanied with the following Labels:—

Mineral Matter in Food.

The body of a man weighing 154 lbs. contains about 8 lbs. of mineral matter, consisting of Phosphoric Acid, Silica (or Flint), Chlorine combined with Sodium (common Salt), Fluorine combined with Calcium (Fluor Spar), Sulphur, Soda, Potash, Lime, Magnesia, and Oxide of Iron. These substances are extracted from food, and distributed by means of the blood to the various parts of the body, where they are taken up, or absorbed, into the system; different portions of the body showing a strong affinity for different mineral substances: thus, Phosphorus is found in the brain, and also in the form of Phosphoric acid in combination with Lime, in the bones; Fluorine in the bones and teeth; Silica or Flint in the teeth, hair, and nails; Sulphur in the hair; Phosphate of Magnesia and Phosphate of Potash in the flesh; and Phosphate of Soda in the blood and the cartilages. In some cases, as in Phosphate of Lime, which forms the ground-work of bones, the use of Mineral matter in the body is sufficiently obvious; but, in other cases, its use is less understood, though it is supposed to exert important action on the transformation of tissues, and the support of respiration. Mineral matter is quite indispensable to health, and disease results from a deficient supply of it. All animals, man included, require salt for the digestive processes and for the proper secretion of bile; in fact, each substance has its peculiar uses, of many of which we are yet to a great extent ignorant.

Minerals in Food.

This Case shows the principal Mineral Substances, excepting water, in food. They are generally essential to proper nutrition. In the body of a man, weighing 154 lbs., there are about 8 lbs. of mineral matter. Different parts of the body show peculiar affection for particular ingredients to the exclusion of others.

1. *Phosphate of Lime,* or Bone Earth, consists of 3 proportions of Lime and 1 of Phosphoric Acid. There is no animal tissue in the body in which it is not present. In bone it forms from 48 to 59 parts in 100; the bones most exposed to mechanical influences containing the largest quantity. It is always found with flesh-forming substances, whether derived from the Vegetable or Animal Kingdoms; generally in the proportion of 0.5 to 2 per cent. Casein contains 6 per cent.

2. *Carbonate of Lime,* or Chalk, always occurs in the bones, though in much less quantity than Bone Earth, the proportions being 1 to 4 parts in a newly-born child, 1 to 6 parts in an adult, and 1 to 8 parts in the old. It is also found in animal concretions.

3. *Phosphate of Magnesia.* This substance is present, in only small quantities, in the bones and in animal fluids.

4. *Fluoride of Calcium,* or Fluor Spar, exists in small quantities in animal tissues, but more abundantly in the bones and teeth.

5. *Silica,* or Flint, exists in small quantities in the enamel of the teeth and hair.

6. *Chloride of Sodium,* or Common Salt, forms the greatest part of the soluble mineral ingredients in all animal tissues. In blood, 6 parts in 1,000 consist of Salt. It no doubt exerts an influence on the change of tissues, on the action of the gastric juice, and on other functions.

7. *Carbonate of Soda* is found in small quantities in blood, and is useful in dissolving Fibrin, Casein, and other flesh formers; it may also aid in respiration.

8. *Phosphates of Soda and Potash.* Salts of Soda and Potash certainly exist both in blood and the tissues, and they may be present as phosphates, but our knowledge on this subject is deficient.

9. *Iron* is found in blood, gastric juice, hair, black colouring matter of the eye, etc.

10. *Sulphates of Soda and Potash* exist occasionally in animal fluids, but do not appear to be essential.

11. *Carbonate of Magnesia* occurs very sparingly in the body, and is not deemed essential.

12. *Oxide of Manganese* is found in bile, gall-stones, etc., but would appear to be only accidentally present.

13. *Copper and Lead* are rarely found in the blood, but generally in the bile, of man. They are no doubt deleterious, and introduced accidentally.

14. *Sulphocyanide of Sodium,* though not existing in food, is found generally in the saliva of man.

It should be recollected, that in the boiling of food many of the mineral substances are dissolved out of it, and where the liquid that they are boiled in is not consumed such mineral matters are thrown away. This is the case with boiled meat and vegetables, and a constant use of such food may lead to injurious effects. The best corrective to such a diet is the use of uncooked fruit and vegetables. In this way the eating of ripe fruits, as apples, pears, gooseberries, &c., and salads, has a beneficial effect on the system.

GROUP II. CARBONACEOUS, RESPIRATORY, OR HEAT-GIVING FOOD.

The substances belonging to this group of food contain three elements, carbon, hydrogen, and oxygen. Carbon is the preponderating ingredient, hence they are called carbonaceous. When taken into the system they do not, with the exception of fat, remain there, but are employed in the production of animal heat, hence they are called *heat-givers.*

The production of heat is effected by the union of the carbon of the food with the oxygen of the air; and the result is the formation of carbonic acid gas. This gas is formed in the same way by the combustion of carbon in the burning of coal, gas, and other substances. The oxygen is introduced into the blood, and the carbonic acid is expelled from it by the agency of the function of respiration; hence these substances are called *respiratory.*

The accompanying Label is intended as an introduction to this class of foods :

Heat-givers in Food.

A class of ingredients in food, such as Starch, Gum, Sugar, and Fat, containing three elements—*Carbon, Oxygen,* and *Hydrogen,* the fourth element, *Nitrogen,* being absent. They are of no use in building up the structure of the body, or in repairing its waste; they are in fact the Fuel which keeps up animal heat. The body of a man has a temperature of 98° Fahrenheit. This warmth results from the burning of these substances, which produce as much heat in the body as they would if burned in an open fire out of the body. A man inhales about 3,000 gallons of air in 24 hours, in order to burn the daily amount of food-fuel, containing about 10 oz. of Carbon or Charcoal. The products of combustion pass out by the mouth, just as they would fly up the chimney of an open fire, were the charcoal burned in it. Less food-fuel is required in hot weather than in cold; and less in hot climates than in cold ones. Tropical foods contain about 20 to 30 parts in the 100 of charcoal; Arctic blubber and fats from 80 to 90. The intense cold of the polar regions compels the inhabitants to devour large quantities of food-fuel to keep up the heat of the body to 98°. Arctic travellers state that 20 lbs. of blubber is not an uncommon meal for one person.

Case No. 3 contains specimens of various kinds of Heat-givers, of which a summary is given in the following Label:

Heat-givers.

The heat of Animals is chiefly supported by the burning, within the body, of substances free from Nitrogen, such as Starch, Sugar, Gum, and Fat; although occasionally Flesh-formers, as in the case of Carnivora, also produce heat. The value of Heat-givers depends upon their relative richness in Carbon and free Hydrogen. To keep the body at the same heat, there must be burned in it the quantities given of either of the following substances:—

Fat - -	40 parts.
Alcohol - -	54 „
Starch - -	97 „
Cane Sugar -	100 „
Grape Sugar -	106 „
Flesh - -	310 „

These numbers show the relative value of the Heat-givers; Fat being the most, and Flesh the least, valuable.

The Case shows the varieties of Heat-givers found in food.

1. *Cane Sugar* found largely in the Cane, but also in Beet-root, Carrots, Turnips, Potatoes, &c.

2. *Fruit Sugar* is an uncrystallizable sugar found in fruits, and abundantly in Molasses; it is less sweet than Cane Sugar.

3. *Grape Sugar* is the Sugar found in dried Figs, Raisins, &c. It crystallizes; but is much less sweet than Cane Sugar, of which 1 lb. equals 2½ lbs. of Grape Sugar.

4. *Milk Sugar* is a crystallizable sugar found chiefly in the milk of Vegetable feeders, but also in the milk of Carnivora. It is even less sweet than Grape Sugar.

5. *Starch*, as obtained from the Potato and other vegetables. The granules differ in size in various kinds of food, but the chemical composition is not different except in the case of the Dahlia, Chicory, &c., which contain *Inulin*, a peculiar variety of Starch.

6. *Gum* is found in the juices of almost all plants. In Gum Arabic it is nearly pure. Linseed, Quince-seed, &c., contain a modification of gum called Mucilage, or *Bassorin*, which softens but does not dissolve in water.

7. *Pectin*, found in Turnips, Carrots, Parsnips, Pears, Apples, &c., is a kind of gummy or gelatinous substance, and is similar to other substances known as vegetable jelly, pectic acid, &c.

8. *Cellulose, or Woody Fibre*, forms the ground-work of all plants, and is the same in composition though variable in texture. Cotton and Linen are nearly pure Cellulose.

9. *Fat*, being rich in Carbon, is a powerful heat-giver, though it is doubtful whether it is so easily combustible in the body as Starch or Sugar. It plays an important part in the animal economy, and is found in all food. Fats of a like kind exist both in Animals and Vegetables.

Alcohol was formerly regarded as a Heat-giver, but recent experiments lead to the conclusion that it contributes to this process only by exciting the circulation. Its properties will be mentioned under Auxiliary Foods. Of the series in the Case, Gum, Pectin, and Cellulose do not appear to aid much, if any, in the function of producing animal heat.

STARCH.

Various preparations of Starch are exhibited in the Cases 4, 5, and 6. They are generally described in the accompanying Label.

STARCH.
(*Amylum.*)

The substance called Starch is found very abundantly in the vegetable kingdom. Its presence was at one time regarded as characteristic of plants, but it has recently been found in the animals. It occurs in the form of irregularly-shaped granules, which vary in size from the $\frac{1}{400}$ to the $\frac{1}{2,000}$th of an inch in diameter. These granules are simple or compound. They vary in shape and size in every species of plant, and are insoluble in water, but are easily diffused through it. They are thus separated from the insoluble Cellulose, amongst which they are deposited in plants. In order to separate the Starch, the plant is bruised or crushed, and put into a vessel of water, when the Cellulose sinks, and the Starch is diffused through the water, which is decanted and set aside till the Starch is deposited. On being mixed with water, and exposed to a temperature of 180°, the Starch gelatinises, and, mixing with the water, thickens it. This occurs in the cooking of Starch, and this property lies at the foundation of pudding making.

Starch is turned blue by Iodine, which is the best test of its presence. It is composed of Carbon, Hydrogen, and Oxygen, of which Carbon constitutes one half by weight, and the Hydrogen and Oxygen are in the proportions to form water. When Starch is taken as an article of diet, the Carbon is burned in the system in contact with the Oxygen of the air, and carbonic acid gas is formed and heat is given out. Starch is readily converted into Glucose or Grape Sugar by the action of nitrogenous substances, especially the salivine of the saliva, and it is in the form of Glucose that it enters the blood of animals. All Starch in diet, not converted into Glucose, is waste. Starch is, therefore, less readily convertible into aliment than Sugar.

Starch is abundantly present in all the more common forms of vegetable diet. It exists in a state of almost absolute purity in the substances known as Arrowroot, Tapioca, and Sago. These substances, from whatever source obtained, contain little or no nutritious or flesh-forming food, and, consequently, ought never to become the substantive diet of human beings. Many plants contain so large quantities of Starch, and so small quantities of flesh-forming matter, that they ought only to be taken on account of their Starch. Such are the Potato and Rice, in which the quantity of Starch to flesh-forming matter is as 14 to 1, whilst in wheat it is only as 5 to 1. Potatoes and Rice, therefore, can never form the staple article of the diet of the people of this country, who need a large quantity of flesh-forming matter in order to enable them to perform their work.

During the growth of plants, Starch is converted into Dextrine, Gum, and Sugar; it also assumes different properties in certain groups of plants. Thus it exists in an amorphous form in Sea Weeds and Lichens, and is then called Lichenine; and there are other varieties, as Friuline found in the Elecampane.

Starch is extensively used in the arts. It is prepared for this purpose from the potato, wheat, rice flour, and the coarser kinds of Sago.

Common Starch, which is used for domestic and manufacturing purposes, is obtained from Wheat, Rice, Potatoes, and other sources. Sago is a form of Starch obtained from several kinds of plants. That which is most commonly used in Europe is the produce of the Sago Palm (*Sagus lævis*), which grows in the islands of the Indian Archipelago. The Sago is obtained from the cellular tissue in the interior of the trunk of the tree. Other palms, as the *Sagus Rumphii* and the *Saguerus saccharifera,* also yield Sago. A coarse kind of Sago is also obtained in the East Indies from various species of plants belonging to the order *Cycadaceæ*. Such are *Cycas circinalis, Dion edule,* and *Encephalartos horrida*.

Arrowroot is also a name given to various forms of Starch, obtained more especially from the root-stocks of plants. The most common source of Arrowroot is the *Maranta arundinacea,* which is a native of tropical America and the West Indian islands. This plant yields the best West Indian and Bermuda Arrowroots. Another species, the *Maranta Indica,* is said to yield the East Indian Arrowroot. The *Tous les Mois* is produced by a plant belonging to the same order, the *Canna edulis,* which is a native of Peru. Arrowroot is prepared from the root of the water-lily in China.

Tapioca is Starch from the Mandioc Plant, *Janipha Manihot* (*Jatropha Manihot*). This plant is a native of South America, and belongs to the order *Euphorbiaceæ*. It contains hydrocyanic acid, and is very poisonous. The poison is, however, separated from the root, and, after preparation, it yields Cassava and Tapioca. Cassava is formed into cakes and eaten by the natives. Tapioca is extensively consumed in Europe for the same purposes as Sago and Arrowroot.

Cakes and various other preparations are made from Arrowroot, Sago, and Tapioca.

Salep or *Saloop* (Case No. 14A) consists principally of Starch, and is prepared from the roots of the common male Orchis (*Orchis mascula*). When it is boiled it forms an agreeable article of diet, and was commonly used in this country before the introduction of tea and coffee. Sassafras chips were frequently introduced into the decoction for the purpose of giving it a flavour. The roots of the *Orchis maculata* also yield an inferior kind of Salep. Although now almost entirely disused in this country, it is still used in Turkey and the East.

Starch differs in its physical and chemical properties according to the plants from which it is obtained. Thus *Inuline* is a form of Starch obtained from the Elecampane (*Inula Helenium*), a plant not uncommon in this country.

Lichen Starch or (*Lichenine*) is found in Lichens and in Algæ. This Starch has the same power of thickening water at a high temperature as Arrowroot, Sago, and Tapioca. The gelatinous character of the liquid thus obtained has led to the erroneous supposition that it is nutritious, and to the use of Lichens and Sea-weeds as articles of diet.

One of the plants of this kind, which has been used most extensively, and is still largely employed, is the Iceland Moss (*Cetraria Islandica*). It belongs to the family of Lichens, and is a native of the northern parts of the world. This and other Lichens probably contain other dietetical secretions besides Starch, as we find they are capable of supporting animal life. The Rein-Deer Moss (*Cenomyce rangiferina*) is an instance of this. In the northern parts of the world, as well as in mountainous districts, this Lichen grows in great abundance, and during the winter season is the principal support of the rein-deer. In spite of the extreme cold to which it is subjected, this plant grows with vigour, and the rein-deer, in order to obtain it as food, is obliged to remove with its nose the snow with which it is sometimes covered for many feet. The Cup Moss (*Cenomyce pyxidata*) of our own moors belongs to the same genus as the Rein-Deer Moss, and is also used as an article of diet in the same way as the Iceland Moss. The *Tripe de Roche* is another of these Lichens which has been used as an article of diet. It has a melancholy interest attached to it, as it has so often formed the chief article of diet of our arctic navigators. Two species of Lichens, the *Gyrophora proboscidea* and *G. erosa* afford the *Tripe de Roche.* Although they are said to be nutritious, they are described as having bitter, nauseous, and purgative properties.

Amongst the sea-weeds (*Algæ*) (Case 7) which have been used as articles of diet, none is better known than the *Chondrus crispus*, which, under the name of Carrageen Moss, Irish Moss, and Pearl Moss, has been for a long time used in Europe. It grows on the rocky sea-shores of Europe; and when washed and dried, and then boiled with water, makes a mucilaginous decoction, which, like the same preparation of the Iceland Moss, has been recommended in consumption, coughs, diarrhœa, and other diseases. It has, however, no bitter principle, and is probably less tonic than the Lichen. This and other sea-weeds have been occasionally had recourse to by the poor inhabitants of the sea-shores of Europe, more especially Ireland, when the ordinary corn or potato crop has failed. They contain, however, but little nutritious matter, and persons soon famish who live upon nothing else. There are certain forms of sea-weed which are often eaten as an addition to other kinds of food. There is in all of them a certain flavour of the sea, arising, probably, from the saline matter they contain, which renders them very objectionable to some persons as articles of food, and which will, probably, always form an objection to their general use. Of those which are eaten in England, we may mention—

1. Laver, Sloke, Slokam (*Porphyra laciniata*). It is found on all our sea-shores, and when employed as food is salted and eaten with pepper, vinegar, and oil.

2. Green Laver, Green Sloke, Oyster Green (*Ulva latissima*). The Ulva is not so good to eat as the Porphyra, and is only had recourse to when the latter is not abundant.

3. Tangle, Sea Ware, Sea Girdles, Sea Wand, Red Ware (*Laminaria digitata*). It is cooked by boiling for a long time, and adding pepper, butter, and lemon juice. Cattle are fed on it in some parts of the British islands.

4. Badderlochs, Hew Ware, Honey Ware, Murlins (*Alaria esculenta*). The part of the plant which is eaten is the thick middle rib which runs through the frond. It is sometimes called the Eatable Fucus.

5. The Dulse of the south-west of England is the *Iridea edulis* of botanists. It is eaten by the fishermen of the south-west coasts of England, who before eating it pinch it between red-hot irons. In Scotland it is cooked in the frying-pan. It is said to resemble in its flavour roasted oysters.

6. Dulse of the Scotch, Dellisk, Dellish, Duileisg, Water-Leaf (*Rhodomenia palmata*). The Islanders and Irish, before the introduction of tobacco, were in the habit of drying this weed and using it as a masticatory. The Icelanders use it as an article of diet, under the name of the Sugar Fucus. In the islands of the Mediterranean Archipelago it is employed as an ingredient to flavour soups, ragouts, and other dishes.

Several other sea-weeds have been employed as food, but these are the principal that are at present used in this country. In China the people are very fond of sea-weeds, and many kinds are collected and added to soups, or are eaten alone with sauce. One of these, the *Plocaria tenax*, is sometimes brought to this country under the name of Chinese Moss. The decoction it makes is so thick that it is used as glue. The Corsican Moss, which has a reputation in medicine as well as a diet, is the *Plocaria Helminthocorton*, and is found on the coasts of the Mediterranean. Another sea-weed was recently imported into London under the name of Australian Moss (*Eucheuma speciosum*); but, although affording a very thick jelly, it tastes too strongly of the sea to be rendered pleasant by any kind of cooking. Another sea-weed used at Valparaiso is the *Durvillea utilis.* Specimens of the two latter have been presented to the Museum by Dr. Harvey, of Dublin.

Many kinds of food contain so much Starch, in proportion to the flesh-forming or nutritive matters, that they ought more properly to be classed with carbonaceous than with nitrogenous foods. On this account the Potato and Rice have been placed with the starch-yielding foods (Cases 8, 9, 10, 11, 12).

THE POTATO.

Although this plant contains but a small quantity of flesh-forming matter, it yields an abundance of Starch and mineral matters in a condition which acts very beneficially on the human system, and its introduction into Europe has been of the greatest benefit to its teeming populations.

The following Labels are descriptive of its history and composition :—

Potato.

(*Solanum tuberosum.*) Nat. Ord. Solanaceæ.

The Potato is an herbaceous plant producing annual stems from an underground tuber or root-stock which is the part that is used as an article of food. It has white flowers and a green fruit, which, like all the plants of the order to which it belongs, contain a poisonous principle. The native country of the plant is South America. It has been found wild in various parts of Chili, and also near Monte Video, Lima, Quito, Santa Fe de Bogota, and in Mexico. This plant was first cultivated in Spain in Europe, from thence it extended into Italy. It was first grown in the British Islands by Sir Walter Raleigh in his garden at Youghal in Ireland, but it was not generally cultivated in Great Britain till the middle of the last century. The only part of the plant employed as food is the tuber which is a kind of underground stem. Upon this stem buds are formed which are called "eyes," and from these, by cutting up the potato, the plant is propagated. The tubers of the wild potato are small in size, but by culture they may be very much enlarged. In this country many varieties of the potato are known under the name of "kidneys," "rounds," "reds," "blues," "whites," &c. Many of these varieties are now disappearing, the "white," "kidney," and "round" potatoes being preferred to all others. The potato contains large quantities of water (75 per cent.), and less flesh-forming to the heat-giving matters than any other plant cultivated for human food. It is therefore not adapted for consumption as a principal article of diet, and should only be employed as an addition to more nutritious kinds of food. It contains a variety of mineral matters which also render it valuable as an article of diet. It has for many years been liable, in Europe, to a diseased condition in which the water seems to be increased, and decomposition consequently readily sets in. The decayed parts are attended with a Fungus, but this has really nothing to do with the production of the disease. Potatoes are largely employed in this country for the production of starch, which is used for a variety of purposes in the Arts. Potatoes are cooked in many ways, and all the varieties of food which can be obtained from the flour of the Cerealia may be procured from the potato, as starch, maccaroni, vermicelli, &c. The quantities of potatoes consumed in the United Kingdom is about ten millions of tons annually.

Potato.

(Solanum tuberosum.)

The Potato, from its poverty in flesh-formers, is little nutritive: 100 lbs. of fresh potatoes contain only 1½ lb. of flesh-forming matter. In 100 parts there are:—

Water	75·2.	or,	Water	75·2.
Flesh-formers	1·4.		Flesh-formers	1·4.
Starch	15·5.		Heat-givers	22·5.*
Dextrin	0·4.		Mineral matter	0·9.
Sugar	3·2.			
Fat	0·2.			
Fibre	3·2.			
Ashes	0·9.			

The Case shows the actual quantities of these ingredients in 1 lb. of fresh potatoes:—

1. 1 lb. of fresh potatoes containing 75 per cent. of Water.

2. 1 lb. of potatoes after the Water has been evaporated —4 oz.

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* In this and the following Tables the Heat-givers include Gum, Pectin, and Cellulose or woody fibre, which, as they are generally indigestible, probably do not act upon the system. They are generally, however, in small quantities.

3. The quantity of Water got from 1 lb. of potatoes—12 oz.

4. The quantity of flesh-formers found in 1 lb. of potatoes—$\frac{1}{3}$ oz.

5. The quantity of Starch in 1 lb. of potatoes—$2\frac{1}{2}$ oz.

6. The quantity of Sugar found in 1 lb. of potatoes—$\frac{1}{2}$ oz.

7. The quantity of Dextrin, or Gum, found in 1lb. of potatoes—$\frac{1}{10}$ oz.

8. The quantity of Fat found in 1 lb. of potatoes—$\frac{7}{100}$ oz.

9. The quantity of Woody fibre found in 1 lb. of potatoes—$\frac{3}{4}$ oz.

10. The quantity of Mineral matter, or Ashes, in 1 l. ofb potatoes—$\frac{7}{8}$ oz.

11. *The quantity of Carbon found in* 1 *lb. of the foregoing substances—*2 *oz.*

RICE.

(*Oryza sativa.*)

This plant belongs to the natural order of Grasses (*Graminaceæ*). It is a native of the East Indies, and, unlike many of the cultivated cereals, is found wild about the borders of lakes in the Rajahmendy Circars. The wild plant does not yield so much as the cultivated varieties. Rice is now cultivated extensively in Asia, from whence it has extended to the southern parts of Europe, and been introduced into America. It is extensively cultivated in the marshy grounds of North and South Carolina. It is brought into this country from various parts of the world, and, in 1852, 35,000 quarters were imported. A large number of varieties are known in the countries where it is cultivated, and specimens are exhibited in Cases 12 and 13. The most abundant varieties are known under the names of "common rice," "early rice," "mountain rice," and "clammy rice." Rice in the husk is known by the name of "Paddy." Although Rice is more largely consumed by the inhabitants of the world than any other grain, it contains less flesh-forming matter. This will be seen by the following analysis:—

(*Oryza sativa.*)

Rice, though used largely as an article of food, is poor in flesh-formers, which scarcely amount to 7 parts in 100; and from its small quantity of fat it is not a laxative food. In heat-givers it is rich. One hundred parts of Rice contain the following ingredients:—

Water	13·5.
Gluten	6·5.
Starch	74·1.
Sugar	0·4.
Gum	1·0.
Fat	0·7.
Fibre	3·3.
Mineral matter	0·5.

or,

WATER	13·5.	
FLESH-FORMERS	6·5.	
HEAT-GIVERS	79·5.	CARBON 38·0.
MINERAL MATTER	0·5.	

The Case shows the ingredients in 1 lb. of Rice.

1. Shows 1 lb. of Rice with its husk.
2. 1 lb. of Rice deprived of its husk.
3. Water from 1 lb. of rice— 2$\frac{1}{8}$ oz.
4. Gluten in 1 lb. of rice—1 oz.
5. Starch in 1 lb. of rice—11$\frac{8}{10}$ oz.
6. Sugar in 1 lb of rice—$\frac{1}{16}$ oz.
7. Gum in 1 lb. of rice—$\frac{1}{5}$ oz.
8. Fat or Oil in 1 lb. of rice—$\frac{1}{8}$ oz.
9. Woody fibre in 1 lb. of rice—$\frac{1}{2}$ oz.
10. Ashes in 1 lb. of rice—$\frac{1}{16}$ oz.
11. *Carbon in 1 lb. of the above substances*—**6 oz.**

Rice can only be the substantive article of diet of an indolent and feeble people. When employed in this country it should only be used as an adjunct to other kinds of food more rich in flesh-givers. Boiled, as an addition to meat, or in the form of pudding or curry, it may be judiciously employed, as a variety, especially in the food of the young.

The following Table gives the quantities of Starch in 100 parts of various kinds of food:—

Rice	74	Rye	51
Potatoes	15	Lentils	35
Oats	39	Carrots	11
Wheat	59	Turnips	10
Beans	36	Parsnips	17
Barley	48	Mangel Wurzel	12
Peas	37	Cabbage	4
Buckwheat	50	Bread	48
Maize	60		

SUGAR.

Sugar has a chemical composition very nearly resembling starch, but it differs in both chemical and physical properties. Sugar is soluble in water, whilst starch is only diffusible through it. Sugar undergoes the process of fermentation, which starch does not. Sugar has a sweet taste, whilst starch is almost tasteless. Starch is, however, convertible into sugar by the agency of nitrogenous substances. If starch is placed in contact with saliva a little time, it becomes soluble, and gives the reactions of sugar; and it is probable that in this way starch itself becomes absorbed into the blood. Sugar, like starch, assumes various forms, and three of these are found in common articles of diet. These are—

Cane sugar (*Sucrose*),
Grape sugar (*Glucose*), and
Milk sugar (*Lactose*).

They vary in composition as follows:—

	Carbon.	Hydrogen.	Oxygen.
Cane sugar - - -	12	10	10
Grape sugar - -	12	12	12
Milk sugar - -	11	12	12

They are all sweet and soluble, but the two latter differ from the first in the readiness with which they enter into a state of fermentation and become decomposed. Although cane sugar ferments, it must be first converted into grape sugar.

The action of sugar on the system is identical with starch. As it is more readily absorbed into the blood than starch, it is better adapted as a heat-giver for the young. Hence it is found supplied to the young in all the mammalia, in the milk secreted by their mothers. That it is adapted for the young is shown by the instinctive propensity children display to partake of this form of diet. Although adapted for children, the facility with which it decomposes renders it frequently injurious to adults.

Cane sugar is found very generally in plants at certain periods of their growth. Thus it is found during germination in the seeds. This is well illustrated in the process of malting, which consists in allowing the seed of the barley to germinate; and when the starch has been converted into sugar, the process of growth is arrested, and sugar secured for the purposes of fermentation. All kinds of grain may be thus converted into malt, and used for the purposes of making wine, beer, and distilled spirits.

Another period at which plants contain sugar is previous to the unfolding of their buds. Thus in the spring of the year the sap of the birch (*Betula alba*) contains sugar, and in Scotland it is collected and fermented, and birch wine is manufactured. Large quantities of sugar are annually obtained in America from the sap of the sugar maple (*Acer saccharinum*). Many other trees yield sugar in their sap.

The grasses and the palms contain the largest quantity of sugar in their sap when their leaves are perfected, and they are about to blossom. This is the case with the sugar-cane (*Saccharum officinarum*), the plant from which the chief supplies of sugar are obtained which are consumed in this country. The jaggary palm (*Caryota urens*), the cocoa-nut palm (*Cocos nucifera*), the wine palm (*Saguerus saccharina*), and many others, yield sugar in their sap, which is extensively employed by the natives of tropical climates as an article of diet, and for the production of wine. Sugar is obtained in the United States of America from the stalks of the maize, by cutting the plant down previous to its period of flowering.

All the ordinary grasses contain sugar, and those which are found best for feeding cattle contain the largest quantities. A grass has lately been introduced into this country from the north of China, of which the following is a brief account:—

The Chinese Sugar Millet, or Sugar Sorgho.

(*Sorghum saccharatum. Holcus saccharatus.*)

This plant, like the sugar-cane, belongs to the family of grasses, and is cultivated in the north of China for the sugar it contains. It has been grown successfully in France, Lombardy, Tuscany, Russia, Algeria, the United States, and Australia. The specimens exhibited were grown in the neighbourhood of London, and other parts of this country, and contain a considerable quantity of sugar. Sugar has been obtained from the plant in France; and syrup, rum, wine, cider, and vinegar have been made from it. It is highly recommended as a fodder for cattle, the produce being variously estimated at from 20 to 50 tons per acre. A variety of this millet, or an allied species, is cultivated by the Zulu Kafirs under the name of *Imphee,* which likewise yields sugar, and the seeds of which are eaten by the Kafirs. Poultry and other animals may be fed on the seed of the sugar millet. The sugar is said to be most abundant after the seed is ripened, and it remains in the plant long after it is gathered, and may be extracted from the cane when it is quite dry. In France, starch and semola have been prepared from the seeds.

Most plants contain sugar in their roots. But in some, large quantities are deposited, as in the Beet, or Mangel Wurzel (*Beta vulgaris*), which is employed most extensively in France and on the continent of Europe for the supply of sugar for dietetical purposes. A series of specimens illustrating the manufacture of Beet-root Sugar, from Messieurs Serret, Hamoir, and Co., of Valenciennes, are exhibited in the Museum.

In all cases the preparation of the sugar depends on the same principles. The juice of the plant containing the sugar in solution is submitted to a process of purifying and evaporation, and the sugar is allowed to crystallize. This sugar, as it is obtained from the sugar-cane in the West Indies, is called "Brown Sugar" (Case 15). Sugars brought in this state from our own colonies are called "Muscovado Sugars," whilst those brought from foreign colonies are called "Clayed Sugars." The difference consists mainly in the fact that the latter are drained by applying damp clay at the top of the hogshead.

The brown sugar is refined in this country. Formerly, this process was effected by boiling the sugar with bullocks' blood and other albuminous substances. Now, lime is more frequently used, and a process has been recently patented in which burnt alumina is employed. Specimens of this process are exhibited by Messrs. Oxland, of Plymouth, in Case 16.

Sugar is the basis of all kinds of confectionery, of which a variety of specimens are exhibited by Messrs. Fortnum and Mason, Piccadilly, in Case 18.

When refined sugar is melted and pulled out whilst cooling, it constitutes "Barley Sugar." When brown sugar is melted and butter added, "Toffy" is formed. When the sugar is melted, and it is allowed to cool and crystallize gradually, "Sugar Candy" is formed. This is brown or clear according to the sugar employed, and is coloured with various colouring matters. When the sugar is melted and various seeds, flavours, and colours introduced, it is called by various names, as "Comfits," "Bon-bons," &c. Care should be taken that mineral matters are not introduced to colour these articles of taste, as fatal consequences have frequently resulted from eating confectionery coloured with poisonous substances.

In Case 17 a variety of sugars are exhibited, obtained from different kinds of plants. They are as follow:—Bengal Date Sugar; Cocoa-nut Sugar; Sugar from Egypt, the Sandwich Islands, and Natal; Beet-root Sugar; Maple Sugar; and Sugar of Milk.

When organic substances are mixed with sugar they can be kept for a great length of time without decomposition. From a knowledge of this fact has arisen the practice of making "jellies," "jams," and "preserves" of fruits in sugar. Apples, pears, apricots, cherries, damsons, plums, gooseberries, currants, and other fruits are thus preserved. A collection of these are exhibited by Messrs. Batty and Son, of London.

Fruits after being saturated with sugar are also preserved and kept dry. A Case of preserved fruits of various kinds are exhibited by Messrs. Fortnum and Mason. It is in this way that fruits are brought to this country which otherwise would not be seen on account of their perishing nature.

In the collection of Chinese foods there will be found a number of curious fruits and substances which could only be preserved by the aid of sugar.

Cane Sugar, when exposed to a high temperature, is charred, and becomes of a black colour. Under the name of "Burnt Sugar," it is used for colouring sherry, brandy, vinegar, and other liquids to which it is thought desirable to communicate a dark colour. When it has undergone the same process, and is solid, it is called "Caramel," and is used for the same purposes.

Treacle or *Molasses* is the uncrystalized portion of sugar which is separated by draining from the brown sugar. It is brought into this country in large quantities, and consumed both in the arts and as an article of diet. Treacle is dark or clear according to the impurities it contains. When clarified it resembles syrup, and as a saccharine food is quite unobjectionable. Lollypops are made from treacle. It is also used in the preparation of the coarser kinds of gingerbread.

Grape Sugar or *Glucose* is found in the fruits of plants, and is especially abundant in the grape. Cane sugar, woody fibre, starch, sugar of milk, are all converted into grape sugar by the action of dilute acids. It may also be obtained from starch by the action of infusion of malt or of diastase. A sugar is also formed in the human system either identical or closely analogous to glucose. This sugar is formed in the liver, and apparently formed from the various materials of the food. It is probably by the agency of this liver sugar that the heat-giving substances are used in the system for the purpose of producing animal heat.

Of the various forms of sugar, glucose appears to be the only fermentable form, and when cane or milk-sugar are fermented they first assume the form of glucose. This form of sugar is most commonly found in fruits, and it is especially abundant in the fruit of the grape; hence it is called grape sugar. Grapes, when dried, are eaten on account of the glucose they contain. They are known in the shops under the name of "plums," "raisins," and "currants." The latter word is a corruption of Corinth, the small grape yielding this, being cultivated in the vicinity of Corinth, on the classic soil of Greece.

Dried fruits of the grape-vine, presented by Messrs. Fortnum and Mason, Piccadilly, are exhibited in Case 21.

Grape sugar or glucose occurs in fruit both in a crystallized and uncrystallized state. The latter can be formed from starch by boiling it with dilute sulphuric acid. It is then called *starch-sugar*. Sometimes the term "glucose" is applied alone to this form of sugar.

Honey, which is the stored food of the bee, contains both crystallizable and uncrystallizable grape sugar. The crystals of the former may be easily detected by the aid of a low power of the microscope.

Standing between starch and sugar are many vegetable substances having a chemical composition closely allied to them, but differing in physical properties. Some of these enter into the composition of food, although it is very doubtful if they act on the system in the same way as starch and sugar.

Dextrine (Case 10) is formed in plants whilst starch is passing into the composition of sugar. Like sugar it is soluble in water, but not sweet.

Gum may be regarded as fixed dextrine; it is soluble in water, but incapable of being converted into sugar. Although gum enters largely into some kinds of food, it does not enter the blood or act as an aliment. It may be therefore properly regarded as an accessory food. Sugar is added to it, and it is used in the manufacture of lozenges. These are flavoured with various substances, as in the case of the *Pâté de Jujubes.* (Case 20.)

Liquorice is found in many plants, but it is separated from the juice of the Liquorice Plant (*Glycyrrhiga glabra*). Like gum it is soluble in water, and has the sweet taste of sugar. It differs from sugar in not being fermentable. It is obtained from the root of the Liquorice Plant in the form of an extract, and comes to this country in solid sticks, which are sold under the name of "Spanish Juice." This is boiled down and refined, and sold under the name of "refined or pipe liquorice." The liquorice plant is cultivated extensively at Pontefract or Pomfret in Yorkshire, and a manufacture of the liquorice is carried on in that town. The liquorice is made into cakes, which are called "Pomfret cakes." Liquorice, like gum, does not act as an aliment in the system. (Case 16A.)

Manna is another sweet substance, soluble in hot water, but not capable of fermentation. It is obtained for medicinal purposes from a species of ash, the *Fraxinus ornus*. Several other plants yield manna, and it is used in some countries as an article of diet. Its value is, however, doubtful. This substance has sometimes been supposed to be the "manna" of Scripture, but the putrescent nature of that substance, and the absence of dietetical properties in the substance in question, renders this supposition exceedingly doubtful.

There are other kinds of so-called sugar, as Mushroom Sugar and Eucalyptus Sugar, but these are not used as articles of diet.

Amongst plants yielding sugar may be enumerated the Sweet Potato, of which the following is an analysis:—

Sweet Potato.

(*Convolvulus Batatas.*)

The Sweet Potato is eaten largely in Tropical America. It may be used as food as a substitute for the Potato. In 100 parts it contains :—

Water	67·50.
Starch	16·05.
Sugar	10·20.
Albumen	1·50.
Fat	0·30.
Woody Fibre	0·45.
Gum, &c.	1·10.
Ashes	2·90.

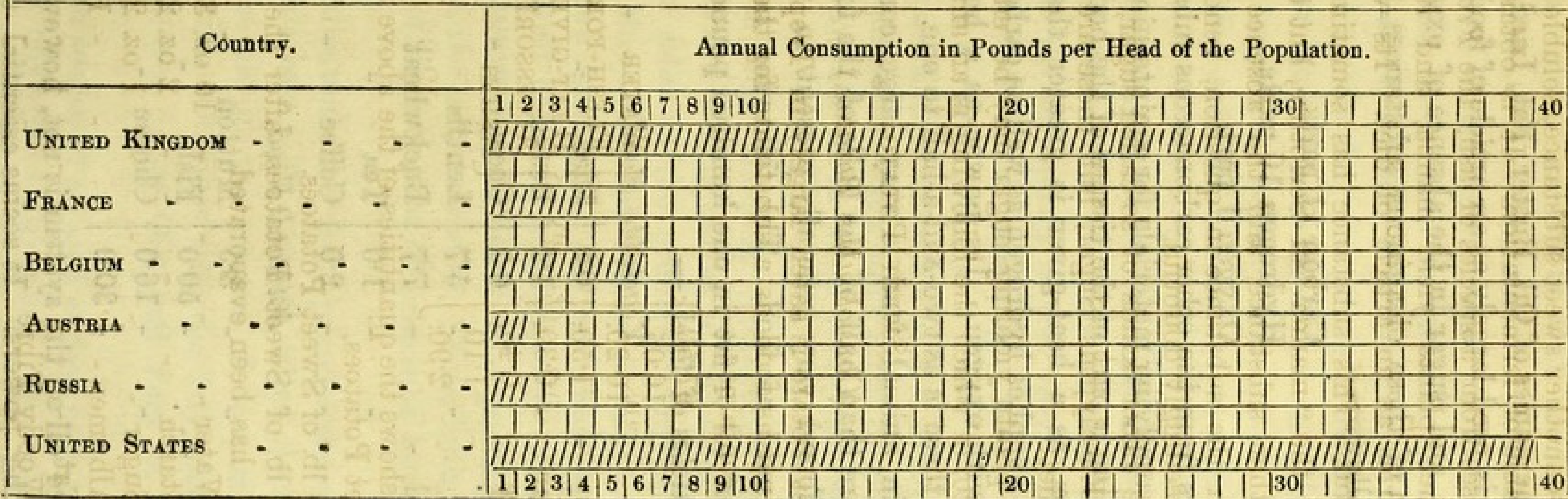
or,

Water	67·50.
Flesh-formers	1·50.
Heat-givers	26·55.
Accessories	1·55.
Ashes	2·90.

The Case shows the quantities of the above ingredients in 1 lb. of Sweet Potatoes.

1. 1 lb. of Sweet Potatoes.
2. 1 lb. of Sweet Potatoes, after the water has been evaporated.
3. Water - - - - 10 oz. 340 gr.
4. Starch - - - - 2 oz. 249 gr.
5. Sugar - - - - 1 oz. 277 gr.
6. Albumen - - - - - 105 gr.
7. Fat - - - - - - - 18 gr.
8. Woody Fibre - - - - 35 gr.
9. Gum, &c. - - - - - - 77 gr.
10. Ashes - - - - - 210 gr.

TABLE, showing the RELATIVE CONSUMPTION of SUGAR in different COUNTRIES.



Oil.

Under the names of Oil, Butter, Fat, Lard, Suet, Tallow, a substance is used largely as an article of food, which differs from starch and sugar in the absence of oxygen gas. The composition of these oleaginous substances may be represented as follows :—

Carbon 11 parts.
Hydrogen 10 parts.
Oxygen 1 part.

Oil differs from the other carbonaceous substances in food in not only supplying materials for maintaining animal heat, but in forming a part of the tissues of the body called fat.

Its action as a heat-giver is greater than starch and sugar, as it supplies hydrogen as well as carbon for burning in contact with oxygen. Its power as a heat-giver compared with these is as two-and-a-half to one. The quantity consumed in animal food is very large, constituting frequently more than half of the bulk of the food consumed. It is also found very generally present in the vegetable substances used as food. The following table gives the quantities of oil or fat in one hundred pounds of the more common articles of food :—

Vegetable Food.

Potatoes - -	0·2	Rice - - -	0·7
Wheat Flour - -	1·2	Beans - -	2·0
Barley Meal - -	0·3	Cocoa - - -	50·0
Oatmeal - - -	5·7	Lentils - -	2·0
Indian Meal - -	7·7	Buckwheat - -	1·0
Rye - - -	1·0	Tea - - -	4·0
Peas - - -	2·0	Coffee - - -	12·0

Animal Food.

Milk - - -	3·5	Mutton - - -	40·0
Pork - - -	50·0	Fish - - -	7·0
Veal - - -	16·0	Cheese - - -	25·0
Beef - -	30·0		

The action of oil on the system is not, however, confined to its heat-giving powers. It seems essential to the development of the fleshy parts of the body. Hence it is found present in the eggs of animals in that part which becomes the young animal. It is, for instance, present in the yolk of all eggs eaten as articles of food. It is probably on this account that fish oil is found so valuable in those diseases where a wasting of the flesh is present, as in consumption.

The animal system has the power of converting starch and sugar into fat. Thus animals fed on substances containing little or no fatty matter become fat. All ruminant and hybernating animals become fat in the summer and autumn.

The fat thus accumulated is consumed during the winter in maintaining the heat of the body, so that these animals are very thin in the spring of the year. Man to some extent obeys the same law, and weighs heavier during the summer than the winter months.

Although essential as an article of diet in certain quantities, oil is less digestible than other kinds of food, and those foods which contain it in large quantities are generally indigestible.

Oils vary in their chemical composition and physical properties. Some are liquid at all temperatures, whilst others remain solid at the ordinary temperatures of the atmosphere. Many vegetable oils, as cocoa-nut oil and olive oil, contain two principles, one of which is liquid and remains so at all ordinary temperatures; the other is solid when the temperature falls below 40 degrees. The former is called *oleine*, the latter *stearine*. Fats, lards, and butters are composed of the latter, or of principles having the same property.

Oleine, stearine, and other fatty principles, consist of acids combined with a base. This base is called *glycerine*, and is separated from oils in the process of soap-making. The alkali in this case combines with the fatty acids, and the glycerine is set free. (See Oils and Fats in the Animal Museum.)

The principal source of oil used as food from the vegetable kingdom is the olive (*Olea Europea*). This plant is cultivated in the south of Europe. The part of the plant which contains the oil is the fruit. The berries of the olive are pressed, and yield the oil which is so extensively employed on the continent of Europe under the name of salad oil. In countries where little butter or fat meat is employed as food, this oil is a most important ingredient in diet.

The seeds of most plants contain oil in addition to starch and other principles. Many seeds are used for obtaining oil for various purposes in the arts, as the poppy, rape, mustard, hemp, and flax seeds. The following seeds, eaten as food, contain oil, and are exhibited in Cases 22, 22 A, and 23 :—

Almonds - -	(*Amygdalus communis*).
Chesnuts - -	(*Castanea vesca*).
Walnuts - -	(*Juglans regia*).
Brazil Nuts - -	(*Bertholetia excelsa*).
Spanish and Hazel Nuts	(*Corylus avellana*).
Hickory Nuts -	(*Caryæ spec*).
Beech Nuts - -	(*Fagus sylvatica*).

The seeds of many other species of plants are eaten under the name of nuts, and the oil they contain is probably their chief recommendation.

The seeds of many of the palms yield large quantities of oil, especially the oil palm (*Elais guineensis*) of Africa. The seed of the cocoa-nut palm is used as a substantive article of diet in Ceylon and many parts of the East Indies (Case 82). It is imported into this country for the sake of the oil it contains. The milk in the interior of the seed is a bland fluid, and, when the nut is fresh-gathered, is a cool and pleasant drink. In the young state the seeds of most palms are filled with a cool fluid consisting mostly of water. This fluid is drunk by the inhabitants of the countries in which they grow. The double cocoa-nut of the Seychelles Islands (*Loidicea Seychellarum*) contains sometimes as much as fourteen pints of water, and is drunk by sailors touching on these islands with great relish (Case 24). Even the hard ivory-nut (*Phytelephas macrocarpa*) contains, when young, a fluid which is drunk by the natives of the countries in which it grows.

Many of the specimens in Case 82, consisting of edible products of the palm tribe, with the specimens in Cases 22 and 23, have been presented to the Museum by Messrs. Keeling and Hunt, Monument Yard, and Messrs. Fortnum and Mason, Piccadilly.

Amongst vegetable foods yielding oil the cocoa or chocolate plant is one of the most remarkable (Case 24). The seeds of this plant contain 50 per cent. of a hard oil or butter.

Food is sometimes preserved in oil which, on account of the small quantity of oxygen it contains, prevents animal or vegetable substances from putrefying. A familiar instance is known in this country in the case of the fish called sardines, which are thus preserved. Oil is used for this purpose in China, and some specimens will be found in the collection of Chinese food in the jars above Cases 90, 91, and 92.

GROUP III. NITROGENOUS, NUTRITIOUS, OR FLESH-FORMING SUBSTANCES.

In the tissues of all plants a substance is found which was known to chemists under the names of gluten, legumin, diastase, zymone, &c. This substance was called by Mulder *protein*, and shown to be identical with the animal substances called albumen, fibrine, caseine, &c. By this discovery it was demonstrated that the source of the substances forming the flesh of animals is the protein of plants. Whether it occurs in animals or plants, it may be divided for practical purposes into three forms,—albumen, fibrine, and caseine.

Albumen is found in plants, in the juice of cabbages, asparagus, chesnuts, wheat, rye, &c.; in animals, in the blood nerves, and the white of eggs.

Fibrine is found in plants, in wheat, barley, oats, rye, &c.; in animals, in their muscular tissue or flesh.

Caseine is found in plants, in peas, beans, lentils, and the seeds of all *Legminosœ*; in animals, almost exclusively in the milk of the mammalia.

The following label is introductory to these flesh-forming matters:—

FLESH-FORMERS IN FOOD.

All the organs of the body contain the four elements, *Carbon*, *Hydrogen*, *Nitrogen*, and *Oxygen*: and no ingredients of food can be of use in building up the wasted parts of the body unless these four elements are present. The nutritive, or flesh-forming parts of food are called FIBRIN, ALBUMEN, and CASEIN: they contain the four elements in exactly the same proportions, and are found both in vegetable and in animal food. Fibrin may be got either by stirring fresh-drawn blood, or from the juice of a cauliflower; Albumen or white of egg from eggs, from cabbage-juice, or from flour. Casein or Cheese exists more abundantly in peas and beans than it does in milk itself. Fibrin, Albumen, and Casein, whether they are got from vegetable or animal bodies, have the same composition as dried flesh and blood. The growth and support of an animal is now easily explained: when a flesh-eater, like the tiger, lives on the flesh of another animal, it eats, in a chemical point of view, the substance of its own body, and requires only to give it a new place and form. When a child receives its mother's milk, it does the same thing, eating in fact its mother, and giving her flesh a new place and form on its own body. The nutrition of vegetable feeders is precisely the same: they find in Vegetable Fibrin, Albumen, and Casein the substance of their flesh and blood actually formed, and have only to give it a place and position within their bodies. Vegetables are the true makers of flesh: animals only arrange the flesh which they find ready formed in vegetables. The *nutritive* value of food depends upon its richness in flesh-forming matter. An adult man, in vigour, wastes five ounces of dry flesh daily, and requires the same amount of flesh-formers in his food.

Case 25 contains specimens of these substances obtained from various sources, and is accompanied with the following label:—

FLESH-FORMERS.

The bodies which form the basis of flesh, or any other organized part, are included under the popular name of "Flesh-formers;" although in reality, besides these, water, fat, and mineral matter are found in flesh, and are, in one sense, necessary to its formation. A piece of clean muscular fibre, or dry blood, free from water, fat, and mineral matter, has the same composition as either ALBUMEN, FIBRIN, or CASEIN, whether they are obtained from substances of Vegetable or Animal origin. 100 parts contain:—

CARBON - -	54·0
HYDROGEN - -	7·0
NITROGEN - -	15·5
OXYGEN - -	23·5

The Case shows these *staminal* ingredients of food, or "flesh-formers." They are all probably identical in their true *organic* parts.

1. ALBUMEN, made from Eggs and from Blood. It forms about 7 parts in 100 of blood, and is always present in lymph and chyle. Liquid or soluble albumen, as shown in the white of egg, coagulates by heat and various chemical agents.

2. ALBUMEN, as found in the juices of carrots, turnips, and cabbages, and obtained by boiling their juices. It is the same body as albumen from eggs.

3. FIBRIN made by stirring blood with a rod. It is the basis of muscle or flesh. Flesh-fibrin probably bears the same relation to blood-fibrin as coagulated albumen does to soluble albumen.

4. FIBRIN made from Wheat-flour. It is identical with the fibrin found in flesh, but not exactly the same as that found in blood, and is known as *Gluten.*

5. CASEIN prepared from milk, in which it is soluble, owing probably to a little alkali: when an acid is added, the Casein curdles or coagulates, and then is known as Cheese. In 100 parts of cows' milk there are 3½ parts of Casein.

6. CASEIN or LEGUMIN as found in peas, beans, lentils, coffee, &c. The Casein of Vegetables is now supposed by most chemists to be identical with the Casein or Cheese of Milk, but a few chemists still deny this. 100 parts of peas contain above 20 parts of Casein.

The flesh-formers are most abundant in those plants which yield the substantive food of man. These plants belong principally to the group of cereal grasses and leguminous plants. Of these the most important is Wheat The following label is exhibited in the Museum :—

WHEAT.

(Species(?) of the genus *Triticum.*)

The plants yielding Wheat belong to the natural order of Grasses (*Graminaceæ*). They have never been found in a perfectly wild state, and on that account have been supposed to originate in some other form of Grass at present wild. Although surmises have been made that the wheats originate in a wild plant called *Ægilops ovata,* the fact of the conversion of one into the other has not yet been proved. The Wheat plant is grown all over the world, but flourishes mostly between the parallels of 25 and 60 degrees of latitude. It is more abundant in the northern than in the southern hemisphere.

The varieties of Wheat cultivated in Europe may be divided into those whose flowers produce awns, and those without these appendages, or *bearded* and *beardless* Wheats. The fruits or seeds of these varieties are red or white, hence a further subdivision takes place into *red* or *white,* bearded or beardless, Wheats. Amongst the red bearded varieties is the fingered Egyptian or Mummy Wheat, which presents the peculiarity of several branches bearing fruits proceeding from its central stalk. Wheat is also called hard and soft according to its consistence, and winter and spring as it is sown at those seasons of the year. The red varieties yield the largest amount of grain, but the white the whitest flour.

Wheat is preferred to the other Cereal grasses as an article of food on account of its containing a larger quantity of flesh-forming matters. The flour also may be rendered very white by separating it from the husks, or bran, and the fruit is much more easily separated from the chaff than is the case with the other Cereals. The proportion of flesh-forming matters to those which give heat are more nearly adjusted to the requirements of the system in Wheat than in any other food. Hence, probably, its very general use as an article of food amongst the populations of the hardest-working nations in the world.

The quantity of Wheat-corn grown annually in the United Kingdom has been calculated at 14,000,000 of quarters.

In 1852, 8,000,000 of quarters of Wheat were imported into this country, exclusive of flour, meal, sago, rice, and other grain.

Case 26 contains an analysis of the various constituents contained in a pound of Wheat. The Table containing the analysis is subjoined:—

WHEAT.

(*Triticum.*)

Good Wheat should give three-fourths of its weight of fine flour; but the Chemical Composition of this depends upon the greater or less quantity which it contains of the outer husks. The finest flour is not so rich in flesh-forming matter as the coarser kinds. The average composition in 100 parts may be taken as:—

Water	14·0.	or,	WATER	14·0.
Gluten	12·8.		FLESH-FORMERS	14·6.
Albumen	1·8.		HEAT-GIVERS	69·8.
Starch	59·7.		MINERAL MATTER	1·6.
Sugar	5·5.			
Gum	1·7.			
Fat	1·2.			
Fibre	1·7.			
Ashes	1·6.			

1. Wheat, of which the Chemical Composition varies according to the varieties; 21 oz. required to make 1 lb. of flour.
2. Bran, or outer and inner skins of the wheat—5¼ oz.
3. Flour, or the inner part of wheat separated from the outer parts or bran—16 oz.
4. Water from 1 lb. of flour—2¼ oz.
5. Gluten from 1 lb. of flour—2 oz.
6. Albumen from 1 lb. of flour—¼ oz.
7. Starch from 1 lb. of flour—9½ oz.
8. Sugar from 1 lb. of flour—1 oz.
9. Gum from 1 lb. of flour—¼ oz.
10. Fat from 1 lb. of flour—⅛ oz.
11. Fibre from 1 lb. of flour—¼ oz.
12. Ashes from 1 lb. of flour—¼ oz.
13. *Carbon from 1 lb. of flour—7 oz.*

Cases 27, 28, 29, and 30 contain a variety of products obtained from Wheat and Wheat-flour. In certain forms of disease it is important to administer the gluten without the starch of Wheat, and such preparations will be found in Case 29. Maccaroni, Vermicelli, Semolina, and "Farinaceous foods" are prepared from Wheat-flour.

BARLEY.

(*Hordeum distichion.*)

Next in importance to Wheat amongst the cultivated grains of this country is Barley. Its great consumption is in the manufacture of Malt (Case 54), for the purpose of making Beer. In Case 31 the results of its analysis are given, to which the following label is attached :—

Barley.

(*Hordeum.*)

In Chemical Composition, Barley and Wheat are much alike ; but Barley does not form such a fine and spongy bread as Wheat, although it is equally nutritive : 100 parts contain,—

Water	14·0.	or,	Water	14·0.	
Gluten	12·8.		Flesh-formers	13·0.	
Starch	48·0.		Heat-givers	69·5.	Carbon 40·0.
Sugar	3·8.		Mineral matter	3·5.	
Gum	3·7.				
Fat	0·3.				
Fibre	13·2.				
Ashes	4·2.				

The Case shows the quantities of these ingredients found in 1 lb. of Barley.

1. Barley containing 14 parts of water—1 lb.
1*a*. Pot Barley got from 1 lb. of barley—$11\frac{1}{5}$ oz.
2. Water obtained from 1 lb. of barley—$2\frac{1}{3}$ oz.
3. Gluten obtained from 1 lb. of barley—$2\frac{1}{4}$ oz.
4. Starch obtained from 1 lb. of barley—$7\frac{1}{2}$ oz.
5. Sugar obtained from 1 lb. of barley—$\frac{1}{2}$ oz.
6. Gum obtained from 1 lb. of barley—$\frac{1}{3}$ oz.
7. Fat obtained from 1 lb. of barley—$\frac{1}{16}$ oz.
8. Fibre obtained from 1 lb. of barley—$2\frac{1}{3}$ oz.
9. Ashes obtained from 1 lb. of barley—$\frac{1}{2}$ oz.
10. *Carbon in* 1 *lb. of barley*—$6\frac{1}{2}$ *oz.*

In Case 32 are some of the preparations of Barley. Barley Meal was formerly much used in this country for making barley cakes, and at the present day barley flour is found to be a useful, nutritious food for children, on account of its laxative action. When the outer coat is removed from the barley corn it is called Pearl Barley, and in this form it is used to some extent as an article of food.

Of all grain grown in this country, Barley yields the most certain and abundant crop. It bears the cold of this climate and yields a large crop where wheat would fail, on account of the dryness and poverty of the soil.

OATS.

(*Avena sativa.*)

This plant flourishes in the northern parts of the British Islands, and appears to originate in the wild oat (*Avena fatua*). It is not much used in England as food for man, but in Scotland it is largely consumed. In nutritive qualities it equals Wheat, but is not so agreeable or digestible. Its analysis is presented in Case 36, and accompanied with the following label:—

OATS.

(*Avena.*)

Oats, in the form of Oatmeal, are rich in flesh-formers and heat-givers, and serve as a nutritious and excellent diet, when the occupation is not sedentary. The outer husk of Oats, unlike Wheat, is poor in flesh-formers, so that oatmeal is better than the whole oat as food. In making oatmeal, one quarter of oats (328 lbs.) yields 188 lbs. of meal and 74 lbs. of husks; the rest being water. Oatmeal is remarkable for its large amount of fat. 100 parts contain:—

Water	13·6.
Flesh-formers	17·0.
Starch	39·7.
Sugar	5·4.
Gum	3·0.
Fat	5·7.
Fibre	12·6.
Mineral matter	3·0.

or,

WATER	13·6.	
FLESH-FORMERS	17·0.	
HEAT-GIVERS	66·4.	CARBON 43·0.
MINERAL MATTER	3·0.	

1. Shows 1 lb. of Oats with the usual husk.
2. 1 lb. of oatmeal of which about 57 per cent. is obtained from oats.
3. Water in 1 lb. of oatmeal—$2\frac{1}{8}$ oz.
4. Flesh-formers in 1 lb. of oatmeal—$2\frac{3}{4}$ oz.
5. Starch in 1 lb. of oatmeal—$6\frac{1}{3}$ oz.
6. Sugar in 1 lb. of oatmeal—$\frac{7}{8}$ oz.
7. Gum in 1 lb. of oatmeal—$\frac{1}{2}$ oz.
8. Fat or oil in 1 lb. of oatmeal—$\frac{7}{8}$ oz.
9. Fibre in 1 lb. of oatmeal—2 oz.
10. Ashes in 1 lb. of oatmeal—$\frac{1}{2}$ oz.
11. *Carbon in 1 lb. of oatmeal—$6\frac{4}{5}$ oz.*

Case 36 contains various preparations of oats, consisting of various forms of oatmeal and groats. The latter are employed for the preparation of gruel, a light diet much used in the sick room. The oatmeal, when mixed with water and heated, is called "Porridge," which is the form in which it is eaten by the Scotch. Oatmeal is also made into cakes, and in this form is consumed in Lancashire and Yorkshire as well as Scotland.

The Wall Cases numbered from 95 to 106 contain a series of specimens of Wheat, Barley, and Oats in the straw. These specimens represent the different varieties of these grains which are cultivated in Great Britain. They were presented to the Museum by Messrs. Peter Lawson and Co., of Edinburgh, to whom also the Museum is indebted for a series of models of cultivated roots in Case 83.

The Wall Cases also contain specimens of wheat grain from various parts of the world, exhibited at the Great Exhibition of 1851.

MAIZE, OR INDIAN CORN.

(*Zea Mays.*)

This cereal is a native of the New World, where it is extensively cultivated both in the United States and South America. It is also cultivated in the south of Europe and other parts of the world; although it sometimes ripens and attains maturity in this country, it cannot be relied on as a crop. Some fine specimens grown in England are exhibited near Case 33, which contains an analysis of the grains. It is accompanied by the following label:—

Maize, or Indian Corn.

Maize yields a large return of food on a given extent of land. It contains less flesh-forming matter than other cereals, but is rich in heat-givers, and consequently has remarkable fattening qualities. 100 parts contain:—

Water - -	14·0.
Gluten - -	12·0.
Starch - -	60·0.
Sugar - - / Gum - -	0·3.
Fat - -	7·7.
Fibre - -	5·0.
Mineral matter	1·0.

or,

Water - -	14·0.	
Flesh-formers	12·0.	
Heat-givers -	73·0.	Carbon 36·4.
Mineral matter	1·0.	

The Case shows the ingredients in 1 lb. of Maize, or Indian Corn.

1. Shows 1 lb. of Maize, or Indian corn.
2. 1 lb. of Indian meal.
3. Water in 1 lb. of Indian meal—2 oz. 105 gr.
4. Gluten in 1 lb. of Indian meal—1 oz. 402 gr.
5. Starch in 1 lb. of Indian meal—9 oz. 262 gr.
6. Sugar and gum in 1 lb. of Indian meal—21 gr.
7. Fat or oil in 1 lb. of Indian meal—1 oz. 101 gr.
8. Woody fibre in 1 lb. of Indian meal—350 gr.
9. Ashes in 1 lb. of Indian meal—70 gr.
10. *Carbon in 1 lb. of Indian meal—$5\frac{3}{4}$ oz.*

It contains a larger quantity of fat or oil than the other cereal grains. It does not, however, contain so much nutritious matter. It is consumed largely as a food in the New World. The flour is called "hommony." It is made into bread, and cooked in the same manner as the wheat flour of Europe. Cases 34 and 35 contain varieties of the Maize, with meal and flour of the same.

RYE.

(Secale cereale.)

Rye was formerly extensively cultivated in this country. It is still much grown in the north of Europe, and rye bread is a favourite diet of the people in that part of the world. It is subject to a disease which gives the grains a spined or horned appearance. These grains are produced by the attacks of a fungus, and are called Ergot of Rye. The ergot is used medicinally, and when taken as a food it produces poisonous effects. Rye yields a very nutritious flour, and when made into bread assumes à dark brown appearance. Hence it is called "black bread." Although Rye contains more starch and sugar than barley it is not used for fermentation, on account of the rapidity with which it passes into an acid condition. Rye bread is sour to the taste on this account. The following is an analysis of Rye as exhibited in Case 38 :—

Rye.

(*Secale.*)

Rye is grown much more in Germany, Russia, and Norway than in England. In composition it more resembles Wheat than either Oats or Barley. Rye, like Wheat, forms a light spongy bread. One hundred parts of Rye contain :—

Water - - -	13·00.	or,	Water - - -	13·0.
Gluten - - -	10·79.		Flesh-formers	13·8.
Albumen - -	3·04.		Heat-givers -	71·5–Carbon.
Starch - - -	51·14.		Mineral matter	1·7.
Gum - - -	5·31.			
Sugar - - -	3·74.			
Fat - - - -	0·95.			
Woody Fibre -	10·29.			
Mineral matter	4.			

1. 1 lb. of Rye.
2. Water in 1 lb. of Rye—2 oz. 35 gr.
3. Gluten in 1 lb. of Rye—1 oz. 318 gr.
4. Albumen in 1 lb. of Rye—213 gr.
5. Starch in 1 lb. of Rye—8 oz. 79 gr.
6. Gum in 1 lb. of Rye—371 gr.
7. Sugar in 1 lb. of Rye—262 gr.
8. Fat in 1 lb. of Rye—66 gr.
9. Fibre in 1 lb. of Rye—1 oz. 284 gr.
10. Mineral matter in 1 lb. of Rye—122 gr.

MILLET.

(Species of *Sorghum* and *Setaria.*)

Under the name of "Millet," the grains of various species of grasses are eaten in Europe, Africa, and Asia. The grains are very small, but this is compensated for by the abundant produce of each panicle of the plant. These seeds are very nutritious, and form the principal diet of large populations in the countries where Millet is grown. They are prepared for eating in various ways. Sometimes the seeds are simply parched and eaten; at other times they are soaked in water, and made soft before eating. The husk is also removed, and the flour prepared in various ways, as with the other cereals.

BEANS.

(*Faba vulgaris, Phaseolus vulgaris, and P. multiflorus.*)

Although the various species of Beans are more used for feeding the lower animals than as human food, they nevertheless contain a larger quantity of nutritive matter, in proportion to their weight, than any of the cereal grains. The form the protein assumes in Beans is that of caseine. When this substance is introduced into the stomach in an insoluble form, it appears to be much less digestible than either albumen or fibrine. This may account for the fact that the seeds containing this substance are not so generally used for human food as the grains of the cerealia. Case 40 contains the constituents of a pound of Beans, of which the following label gives the particulars:—

BEANS.

(*Faba.*)

Beans, like other leguminous plants, are rich in flesh-formers; they therefore require to be mixed with a less nutritious substance to make them a wholesome diet. One hundred parts of field beans contain:—

Water - -	14.8.	or,	WATER - -	14·8.	
Casein, or cheese	24·0.		FLESH-FORMERS	24·0.	
Starch - -	36·0.		HEAT-GIVERS -	57·7.	CARBON 36·0.
Sugar - -	2·0.		MINERAL MATTER	3·5.	
Gum - -	8·5.				
Fat - -	2·0.				
Woody Fibre	9·2.				
Mineral matter	3·5.				

The Case shows the ingredients in 1 lb. of Beans.

1. 1 lb. of Beans.
2. Water in 1 lb. of Beans—2 oz. 161 gr.
3. Casein in 1 lb. of Beans—3 oz. 368 gr.
4. Starch in 1 lb. of Beans—5 oz. 333 gr.
5. Sugar in 1 lb. of Beans—140 gr.
6. Gum in 1 lb. of Beans—1 oz. 157 gr.
7. Fat in 1 lb. of Beans—140 gr.
8. Woody fibre in 1 lb. of Beans—1 oz. 206 gr.
9. Mineral matter in 1 lb. of Beans—245 gr.
10. *Carbon in 1 lb. of Beans—5¾ oz.*

Cases 41, 42, 43, 44, contain varieties of beans which are eaten in various parts of the world. These specimens were exhibited at the Great Exhibition of 1851.

The bean which is mostly eaten in Europe is the white Haricot bean (*Phaseolus vulgaris*). Before cooking, it should be soaked for 12 hours in cold water. It should then be boiled till it is soft. These beans may be safely eaten in small quantities, and contain a much larger proportion of nutrient matter than bread or potatoes and other vegetables.

Beans are also eaten green. This is the case with the large broad bean, which is very properly eaten with fat bacon ; the beans supplying the flesh-forming matter, whilst the fat of the bacon supplies the heat-giving material. The fruit of the beans, when green, as in the case of the French beans (*Phaseolus vulgaris* and *P. multiflorus*), is also boiled and eaten. French beans may be preserved for winter use by placing in a vessel alternately layers of salt and beans.

PEAS.

(Species of *Pisum.*)

Peas, like beans, contain a large quantity of the flesh-forming principle, caseine, and apparently in a more digestible form.

Dried peas are more frequently used as an article of diet in this country than beans. When eaten alone and continuously they produce indigestion ; but, on account of their highly nutritive character and low price, they may be advantageously added to other kinds of vegetable diet. They are frequently added to soup, and pea meal is made into pudding, and eaten with boiled pork. A small quantity of pea meal may be added to wheat flour, whether in the manufacture of bread or puddings.

Case 45 contains an analysis of one pound of Peas, with the following label:—

PEAS.

(*Pisum.*)

Peas are rich in flesh-forming matter, in fact too rich as a simple diet, so that they are more wholesome when mixed with a less nutritive food like the potato. The flesh-former in peas is LEGUMIN, which most chemists now believe to be the same as CASEIN or Cheese. One hundred parts of Peas, air dried, contain:—

Water	14·1.	or,	WATER	14·1.
Casein, or Cheese	23·4.		FLESH-FORMERS	23·4.
Starch	37·0.		HEAT-GIVERS	60·0.
Sugar	2·0.		MINERAL MATTER	2·5.
Gum	9·0.			
Fat	2·0.			
Woody Fibre	10·0.			
Mineral matter	2·5.			

The Case shows the ingredients in 1 lb. of Peas.

1. 1 lb. of Peas.—1*a.* 1 lb. of Pease-flour.
2. Water in 1 lb. of Peas—2 oz. 112. gr.
3. Casein in 1 lb. of Peas—3 oz. 324 gr.
4. Starch in 1 lb. of Peas—5 oz. 403 gr.
5. Sugar in 1 lb. of Peas—140 gr.
6. Gum in 1 lb. of Peas—1 oz. 193 gr.
7. Fat in 1 lb. of Peas—140 gr.
8. Woody fibre in 1 lb. of Peas—1 oz. 263 gr.
9. Mineral matter in 1 lb. of Peas—175 gr.

Cases 46 and 47 contain varieties of Peas, and preparations of the common pea (*Pisum sativum*). The pea, like the bean, is eaten green, and large quantities are annually consumed in this country in this form.

The green pea contains more sugar and less caseine than the dried pea.

LENTILS.

(*Ervum Lens.*)

Lentils, like other leguminous seeds, contain much caseine. They are a favourite food in the East. The Hindoo adds

Lentils to his starch-giving rice, and obtains from them the nourishment the latter does not contain. The Lentil is not much cultivated in Great Britain, but the seeds are extensively employed on the continent of Europe. They enter into the composition of the prepared foods known by the name of "Erva Revalenta," and "Revalenta Arabica."

Case 48 contains an analysis of Lentils, and is accompanied with the following label:—

LENTILS.

(*Ervum Lens*).

Lentils are particularly nutritious, and are extensively used as food in various parts of the world. The food sold under the name of "Revalenta Arabica" is the meal of the Lentil after being freed from its outer skin, which is indigestible. The "red pottage" for which Esau sold his birthright appears to have been made of Lentils. One hundred parts contain, so far as is known,—

Water	14·0			
Casein, or Cheese	26·0			
Starch	35·0		WATER	14·0
Sugar	2·0	or,	FLESH-FORMERS	26·6
Gum	7·0		HEAT-GIVERS	58·5
Fat	2·0		MINERAL MATTER	1·5
Woody Fibre	12·5			
Mineral matter	1·5			

The Case shows the ingredients in 1 lb. of Lentils.

1. 1 lb. of Lentils.
2. Water in 1 lb. of Lentils—2 ozs. 105 grs.
3. Casein in 1 lb. of Lentils—4 ozs. 70 grs.
4. Starch in 1 lb. of Lentils—5 ozs. 262 grs.
5. Sugar in 1 lb. of Lentils—140 grs.
6. Gum in 1 lb. of Lentils—1 oz. 153 grs.
7. Fat in 1 lb. of Lentils—140 grs.
8. Woody Fibre in 1 lb. of Lentils—2 ozs.
9. Mineral matter in 1 lb. of Lentils—105 grs.

Case 49 contains preparations and varieties of Lentils.

The Chick Pea (*Cicer arietinum*) is another leguminous plant, the seeds of which are used especially in Spain as an article of diet. They are also eaten in the East. They are generally prepared simply by parching. Parched peas are as common in the shops of Eastern countries as biscuits in England.

Many other kinds of leguminous seeds are also eaten in Turkey, Hindostan, and China.

In America, a small leguminous plant, the *Arachis hypogæa*, is extensively grown. It ripens its fruit under the ground; hence it is called earth-nut, or underground kidney-bean. The seeds contain much oil. They are parched and sold in the shops within their pods. (See Case 23.)

The green pods of *Lathyrus aphaca*, called in France *Vesce cultivé*, are eaten, but they are narcotic when ripe.

BUCKWHEAT.

(*Polygonum Fagopyrum.*)

This plant is known in this country by the name of "Brank," and is cultivated for the sake of its green fodder. On some parts of the continent of Europe the ripe seeds are ground and mixed with wheat flour, and eaten as human food. Birds are exceedingly fond of buckwheat, and one of the principal uses made of the seeds in this country is to feed pheasants in the winter. Case 50 contains the ingredients of a pound of Buckwheat, from which it will be seen that it does not contain so much flesh-forming matter as the cereal grains.

Buckwheat.

(*Polygonum.*)

Although in composition Buckwheat does not rank in nutritive value so high as Wheat, Oats, or Barley, still its late sowing, rapid growth, and cheap cultivation, render it a valuable plant. 100 parts contain :—

Water	14·2.			
Gluten	8·6.			
Starch	50·0.		Water	14·2.
Gum	2·0.	or,	Flesh-formers	8·6.
Sugar	2·0.		Heat-givers	75·4.
Fat	1·0.		Mineral matter	1·8.
Woody Fibre	20·4.			
Mineral matter	1·8.			

The Case shows the ingredients in 1 lb. of Buckwheat.

1. 1 lb. of Buckwheat.
2. Water in 1 lb. of Buckwheat—2 oz. 118 gr.
3. Gluten in 1 lb. of Buckwheat—1 oz. 165 gr.
4. Starch in 1 lb. of Buckwheat—8 oz.
5. Gum in 1 lb. of Buckwheat—140 gr.
6. Sugar in 1 lb. of Buckwheat—140 gr.
7. Fat in 1 lb. of Buckwheat—70 gr.
8. Woody fibre in 1 lb. of Buckwheat—3 oz. 114 gr.
9. Mineral matter in 1 lb. of Buckwheat—126 gr.

Besides the plants above mentioned, many others contain a sufficient quantity of flesh-forming matter to nourish the human system, and form when mixed with animal diet excellent adjuncts in human food. As these have not yet been submitted to chemical analysis, it is impossible to say how far they are adapted to form substantive articles of human diet.

As it is of importance to ascertain the amount of nutritive matter contained in a given quantity of food, Cases 86, 87, and 88 have been arranged to present to the eye the quantity of commonly consumed articles of diet containing a given quantity of flesh-formers. The following label explains the contents of these cases:—

Equivalents of Food containing the same Supply of Flesh-formers.

In nutrition, the tissues of the body can only be produced by the agency of "Flesh-formers," already the same in composition as the flesh to be formed. Different kinds of food vary much in their amount of flesh-formers; some, as legumes (peas, beans, &c.), being rich in them; while others, as potatoes and carrots, are poor. An adult labouring man must have *five ounces* of flesh-formers supplied, daily, in food, to restore the waste of 5 oz. of the organic parts of his body. It becomes important to know what quantities of each kind of food he must consume to supply the normal waste of 5 oz., and what would be the cost to him of restoring the waste by the several kinds of food in common use. The different quantities of food here shown, all contain the same amount (5 oz.) of flesh-formers, and must be eaten as the day's supply to enable the labourer to do a day's work; their relative cost for restoring the daily waste of tissues is the money paid in purchasing the amount exhibited. Experience, however, has taught man that he should mix food so as to ensure a proper balance between the heat-givers and flesh-formers, and not to depend upon one kind of food for the exclusive supply of either.

Five ounces of flesh-formers, being the amount required to restore the daily waste of the body, are contained in the quantities given of each of the following vegetable substances:—

1. Wheat Flour -	2 lbs.	1 oz.	average cost	-	4½d.
2. Barley Meal -	2 lbs.	6 oz.	average cost	-	4½d.
3. Oatmeal - -	1 lb.	13 oz.	average cost	-	4½d.
4. Maize - - -	2 lbs.	9 oz.	average cost	-	7½d.
5. Rye - - - -	2 lbs.	3 oz.	average cost	-	6d.
6. Rice - - - -	4 lbs.	13 oz.	average cost	1s.	2d.
7. Buckwheat -	3 lbs.	10 oz.	average cost	1s.	
8. Lentils - - -	1 lb.	3 oz.	average cost	-	5½d.
9. Peas (dry) - -	1 lb.	5 oz.	average cost	-	2¾d.
10. Beans (dry) -	1 lb.	5 oz.	average cost	-	2¾d.
11. Potatoes - -	20 lbs.	13 oz.	average cost	-	7d.
12. Carrots - -	31 lbs.	4 oz.	average cost	2s.	6d.
13. Parsnips - -	15 lbs.	10 oz.	average cost	1s.	1d.
14. Turnips - -	17 lbs.	13 oz.	average cost	1s.	8d.
15. Cabbage - -	10 lbs.	6 oz.	average cost	-	6d.
16. Tea (dry) - -	1 lb.	11 oz.	average cost	6s.	9d.
17. Coffee (dry) -	2 lbs.	1 oz.	average cost	2s.	9d.
18. Cocoa (nibs) -	3 lbs.	2 oz.	average cost	3s.	
19. Bread - - -	3 lbs.	13 oz.	average cost	-	6d.

The construction of public dietaries is a matter of great importance. Unless a due proportion is maintained between the heat-givers and flesh-formers, disease and death may be the consequence. Cases 84 and 85 have been constructed to illustrate the quantity of food consumed in the public services and institutions of this and other countries.

The following labels explain their contents:—

Public Dietaries.

Case I.

The experience of Nations in the support of persons depending upon public diets, such as the Soldier, Sailor, Pauper, or Prisoner, gives data for determining the quantity of Flesh-formers and Heat-givers required for support under different conditions, however varied may be the substances composing the dietaries. This Case shows the amount of flesh-formers and of the Carbon (Charcoal) in the food of Soldiers and Sailors in different countries. Carbon is the element which chiefly determines the value of the heat-givers. As a general result, men in fighting condition require a daily supply of 5 or 6 oz. of flesh-formers, and 10 oz. of Carbon.

1. THE ENGLISH SOLDIER wastes, both in this country and in India, 5 oz. of his dry flesh or other tissues daily, and must have that amount of flesh-formers in food. This must also contain 10 oz. of carbon.

2. THE ENGLISH SAILOR wastes 5 oz. of his dry flesh or other tissues daily, and must receive 5 oz. of flesh-formers in food. He consumes 10 oz. of carbon daily.

2*a*. THE ENGLISH SAILOR in his Salt Meat dietary has nearly 6 oz. of flesh-formers daily, and 12 oz. of carbon. This may be necessary from the less nutritive nature of the food. The quantities appear to be too high.

3. THE DUTCH SOLDIER *when in war* wastes daily 5 oz. of flesh, and obtains that supply of flesh-formers in his food, along with $10\frac{1}{2}$ oz. of carbon.

3*a*. THE DUTCH SOLDIER *when in peace,* or in garrison, has a lower diet, in which there are only $3\frac{1}{2}$ oz. of flesh-formers, and 10 oz. of carbon. With this diet he is below fighting condition.

4. THE FRENCH SOLDIER, although his diet is of very different character from that of the English Soldier, still receives nearly the same amount of flesh-formers in his food, ($4\frac{3}{4}$ oz.) and 12 oz. of carbon. The French Soldier, unlike the Dutch Soldier, is thus always kept in fighting condition.

5. THE ROYAL ENGINEERS, now occupied in the Museum of South Kensington, are found to eat $4\frac{9}{10}$ oz. of flesh-formers and 13 oz. of carbon daily.

PUBLIC DIETARIES.

Case II.

In Case No. I. is shown the dietaries of Soldiers and Sailors when kept in fighting condition. When the Soldier returns to Chelsea Hospital or the Sailor to Greenwich Hospital for repose, he does not waste so much flesh, and therefore does not require to have such a large amount of flesh-formers in his food ; these are then reduced to between 3 and 4 ounces daily. The Carbon, however, remains high, perhaps higher than is necessary. Paupers in Workhouses, not being exposed to much labour, do not waste so much flesh ;

they require less flesh-formers in food than active Soldiers and Sailors. Boys 10 years of age, at School, receive about one half the flesh-formers of active men, and about three-fourths the quantity of carbon. Ladies, in luxurious repose, consume about the same amount as young Schoolboys.

1. Greenwich Pensioners have 3½ oz. of flesh-formers and 10 oz. of carbon in their daily supply of food.

2. Chelsea Pensioners have 4 oz. of flesh-formers and 9¾ oz. of carbon in their food daily.

3. The Old Men of Gillespie's Hospital in Edinburgh have 3 oz. of flesh-formers and 10 oz. of carbon daily.

4. Paupers. Taking the average of all the Workhouses in the Kingdom, it is found that paupers have daily 3½ oz. of flesh-formers and 8¼ oz. of carbon.

5. The Boys of the Royal Naval School at Greenwich have 2½ oz. of flesh-formers and 7½ oz. of carbon in their food daily.

6. The Boys of Christ's Hospital in London have 2½ oz. of flesh-formers and 7 oz. of carbon in their food.

Cases 119, 120, 121, 122, and 123 are intended to present a summary of the quantities of Water, Mineral Matters, Heat-givers, Flesh-formers, and Accessories contained in one pound of several of the substances the analysis of which ha sbeen previously stated.

CLASS II. MEDICINAL OR AUXILIARY FOODS.

In the mixed food of man in all nations there are certain substances which are neither employed for the maintaining animal heat or the building up of the fabric of the body. Although consumed in large quantities, they cannot be regarded as necessary to life, as the animal body can be sustained independent of their use. They act upon the system as medicines, and may be regarded as auxiliaries to the necessary foods. Such are alcohol, volatile oils, acids, the alkaloids of tea, coffee, and tobacco, and the innutritious ingredients of animal and vegetable food, gelatine, woody fibre, and gum.

They may be classed, according to their action on the system, as stimulants, alteratives, narcotics, and accessories.

GROUP I. STIMULANTS.

These include the beverages containing alcohol, and the condiments and spices containing volatile oils.

ALCOHOL.

All things containing grape sugar, or substances convertible into grape sugar, are susceptible of fermentation. By this process the sugar is converted into alcohol. The following diagram explains the change.

One atom of grape sugar contains,

Carbon.	Hydrogen.	Oxygen.
12 atoms.	12 atoms.	12 atoms.

These are converted into two atoms of alcohol, containing,

Carbon.	Hydrogen.	Oxygen.
8 atoms.	12 atoms.	4 atoms.

and four atoms of carbonic acid gas, containing,

Carbon.	Hydrogen.	Oxygen.
4 atoms.	0	8 atoms.

	Carbon.	Hydrogen.	Oxygen.
Thus	12 atoms,	12 atoms,	12 atoms (grape sugar).
	——	——	——
	8 atoms,	12 atoms,	4 atoms (alcohol).
	4 atoms,		8 atoms (carbonic acid).
	——	——	——
	12	12	12
	══	══	══

ALE, BEER, AND PORTER.

The most common form in which alcohol is employed as a beverage in this country is that of Beer. Case 54 contains the materials from which porter has been brewed, and in the jars surrounding it will be found illustrated the changes which occur in the malt during its conversion into beer.

These specimens have been supplied from Messrs. Huggins and Co., Brewery, Broad Street, Westminster. The following labels explain the specimens :—

Beers.

Beers consist of the infusions of certain plants partially fermented. In the process of making common or barley beer, the starch is first changed into grape sugar, and then into alcohol and carbonic acid. The malting, or sprouting, of barley converts a portion of the starch into grape sugar; the malt is then crushed, infused in water, and heated, a process which dissolves the soluble ingredients in the malt; a peculiar principle called Diastase, present in the malt, then proceeds in its action on the remaining portion of starch in the grain changing it into sugar: when this operation has proceeded far enough, it is stopped by boiling and the addition of hops, about 1 lb. of hops being used for a bushel of malt. The infusion or *wort*, being cooled, is fermented with yeast (which is a small growing plant or fungus), and a portion, about one quarter or one half, of the sugar passes into alcohol and carbonic acid. In common beer there is 1 per cent. of alcohol, in strong beer 4 per cent., in strong porter (stout) 6 per cent., and in the strongest ale 8 per cent.; in addition to the spirit there is sugar, starch, gum, and a little gluten. About 550 millions of gallons of beer are annually brewed in this country from malt.

Many other things besides malt are used for inferior beers, such as potatoes, beans, turnips, and other starchy foods. In Russia, rye furnishes *Quass* or rye-beer. The Tartars and Turks use *Koumis* or a beer made from fermented milk, generally mare's milk, which is richer in sugar than that of the cow; a pint of milk-beer contains about an ounce of spirit. Chica beer, largely used in South America, is chiefly made from maize, which old women chew, and when sufficiently masticated, spit into jars, where it is mashed with hot water, and fermented. Beers and beverages are also made from pine apples, rice, peas, seeds of the *Prosopis Algaroba*, &c. In the South Sea Islands, Ava, Cava, or Arva beer is made in a similar way from the intoxicating long pepper (*Macropiper Methysticum*), but only the young with good teeth are allowed to chew it, so as to prepare it for the king and nobles; it is said to taste like Gregory's Mixture. The action of the saliva, in these cases, is obviously to convert the starch of the plant into sugar; chewing in this case is a substitute for malting in England. Millet beers, made by the infusion and fermentation of millet seeds, are largely used by Eastern nations.

SPECIMENS illustrative of the means employed in BREWING BEER and PORTER.

1. Dry yellow barley for malting.

2. Dry white barley for malting.

3. Barley in its first stage of conversion into malt. The barley is placed in a cistern and wetted, which makes it begin to grow; it is then placed on the malting floor, when it soon assumes the appearance shown in this example, and is in its first stage of sprouting.

4. The malt six days old, when the sprout, or acrospire, is larger.

5. The malt ten days old, showing the still further growth of the acrospire.

6. The malt fourteen days old. It is now sufficiently sprouted, the starch of the barley being to a great extent converted into sugar by the action of a peculiar principle, called Diastase, which is present in the grain.

7. Malt in a finished state. The malt having sufficiently sprouted, as in No. 6, is dried in a kiln, and is then in a state fit for brewing.

8. Crushed malt, ready for infusion in water.

9. Brewers' grains, or the malt exhausted of its valuable ingredients. Grains are used by dairymen for fattening pigs, etc.

10. Hops from South and Middle Kent. These are added to the infusion of the malt.

11. Worcestershire hops.

12. Belgium hops used for making porter.

13. Spent hops. Hops after being boiled in the Wort are used as manure.

14. Yeast. Yeast is added to the infusion, or Wort, and causes it to ferment, and the saccharine matter to pass, more or less, into alcohol.

15. Roasted brown malt used for the darker Ales.

16. Roasted malt used as the colouring matter for porter.

17. Isinglass dissolved in sour beer, used for the fining or clearing of ale or beer.

18. Fourpenny Ale. The product of the previous processes.

19. London porter, which, when stronger, is called stout.

The following quantities are required to make three barrels of 4*d.* ale :—

1 quarter of malt.
8 lbs. of hops.
5 barrels of 36 gallons each of water.

In brewing, 1 barrel, or 36 gallons, is lost by evaporation ; half a barrel, or 18 gallons, in the fermentation and racking ; and half a barrel is absorbed by the grains.

The following analyses of Beers and Ales are presented to the eye :—

An Imperial Pint of the following beverages contains the following ingredients :—

	Water.	Alcohol.	Sugar.		Acetic Acid.
	ozs.	ozs.	ozs.	grs.	grs.
London Stout - -	$16\frac{1}{2}$	$1\frac{1}{2}$	0	281	54
London Porter - -	$17\frac{1}{4}$	$0\frac{3}{4}$	0	267	45
Pale Ale - - -	$17\frac{1}{2}$	$2\frac{1}{2}$	0	240	40
Mild Ale - -	$18\frac{3}{4}$	$1\frac{1}{4}$	0	280	38
Strong Ale - -	18	2	2	136	54

Wines.

Wines are prepared by the direct fermentation of the glucose contained in fruit. The wines of Europe are mostly prepared from the juice of the grape.

The juice before fermentation is called "Must." Wines vary according to the quantities of sugar, alcohol, and acid they contain. Wines with much sugar are called "sweet ;" those with little, "dry." Sugar is frequently added to wines to cover their acid flavour. This is the case with orange, rhubarb, and other wines made in Great Britain. Where sugar is not added, the sweetness of wines depends on the fermentation not having exhausted the sugar.

The quantity of alcohol depends on the quantity of sugar changed during fermentation. It is frequently added to wines to give them strength. This is the case with port, sherry, and Madeira. Clarets, hocks, and the light wines of the Continent will not bear the addition of alcohol, and they naturally contain less alcohol than port, sherry, and Madeira.

The acid in wines made from grapes is the tartaric. This acid forms an insoluble salt with potash, the super-tartrate of potash, or cream of tartar, which forms the tartar or lees of wine, and thus prevents the too great acidity of grape wines.

Wines made from apples and pears (cider and perry), and from oranges and other fruits, contain acids which are not thrown down; hence the necessity of adding sugar to cover their acidity.

The colour of red wines depends on very small quantities of colouring matter.

The difference of estimation in which wines are held, and their price, depends upon the development of a variety of curious chemical compounds during their fermentation and keeping, and which constitute what is technically known as their "bouquet" or flavour. Thus, independent of this bouquet, the highest-priced and lowest-priced wines are essentially the same.

The following Table gives the quantities of alcohol, sugar, and acid in some of the more commonly-consumed European wines:—

One Imperial Pint of the following wines contains:—

	Water.	Alcohol.	Sugar.		Tartaric Acid.
	ozs.	ozs.	ozs.	grs.	grs.
Port - - -	16	4	1	2	80
Brown Sherry - -	15½	4½	0	360	90
Pale Sherry - -	16	4	0	80	70
Claret - - -	18	2	—		161
Burgundy - -	17½	2½	—		160
Hock - - -	17¾	2¼	—		127
Moselle - -	18¼	1¾	—		140
Champagne - -	17	3	1	133	90
Madeira - - -	16	4	0	400	100

The beverages made from the juice of apples and pears, and known by the names of Cider and Perry, contain malic instead of tartaric acid.

An Imperial Pint of Cider contains:—

Water - - - - - -	19 oz.
Alcohol - - - - -	1 oz.
Sugar - - - - - -	400 gr.
Malic Acid - - - -	120 gr.

Distilled Spirits.

When wines or other fermented liquors are submitted to heat, the alcohol distils over, and may be collected in a receiver. The product thus obtained is called Distilled Spirits. The alcohol is not, however, pure, but mixed with water. It is difficult to procure alcohol pure; and distilled spirits always contain a certain quantity of water. A spirit having a density of 825 is called proof spirit in this country; and when distilled spirits contain more or less alcohol than this, they are said to be "under" or "above" proof. Alcohol is obtained for commercial uses in this country from malt. When employed in the arts it has no special flavour, and is called "Spirits of Wine."

Gin is obtained from fermented grain. to which the berries of the Juniper (*Juniperus communis*) are added to give it a flavour. Other flavouring substances are employed, as cinnamon, cloves, &c., for what is called "Cordial Gin." The words Gin and Geneva are a corruption of *Genièvre,* French for Juniper.

Whisky is distilled from grain, and has a slight smoky flavour which gives it its peculiar taste.

Rum is distilled from fermented sugar and molasses in the West Indies, and its flavour is given by the addition of pine apples.

Brandy is distilled from wine, and its peculiar flavour depends on the addition of peach kernels to the liquid whilst distilling.

Arrack is obtained from fermented rice or betel-nuts.

Potato-Brandy is made by converting the starch of the potato into glucose and then fermenting and distilling.

Liqueurs are spirits distilled from various substances which give their peculiar flavour, and to which a considerable quantity of sugar is added.

The following is an analysis of the quantity of alcohol, water, and sugar in Brandy, Rum, and Gin :—

	Water.	Alcohol.	Sugar.
	ozs.	ozs.	ozs. grs.
Brandy - - -	$9\frac{1}{2}$	$10\frac{1}{2}$	0 80
Gin, best - - -	12	8	—
Gin, retail - - -	16	4	$\frac{1}{2}$ 0
Rum - - - - -	5	15	—

Distilled Spirits obtained from grain contain a substance called Fusel Oil, which acts very injuriously on the human system. Potato Spirit contains an analogous oil. Brandy like wine contains œnanthic and acetic ether. Rum owes its flavour to butyric ether.

It is well known that although alcohol is taken in large quantities by the human family, that it is an agent exceedingly destructive to human health and life. When taken into the stomach it acts upon the mucous membrane, and when absorbed into the blood it acts upon the nervous system. When taken in too large quantities in any of its forms, or upon an empty stomach, it lays the foundation of diseases of the stomach and surrounding organs, which often terminate in death. Its action on the nervous system, though pleasant and agreeable, and even healthful in small quantities, becomes a source of fearful disease when carried to excess. The physical degeneracy and moral degradation attendant upon taking alcohol in excess are well known; and no language is too strong to condemn the folly and wickedness of those who thus convert one of the blessings of Providence into a curse.

Not only is the drinking alcohol to excess injurious to the individual, but it is as wasteful as it is injurious. The quantity of grain required to supply the average quantity of alcohol drunk by the population of Great Britain would supply a working man with heat-giving and flesh-forming food for forty days. The quantity of alcohol, $3\frac{3}{4}$ gallons, thus consumed, and the quantity of barley destroyed to supply it, are exhibited on the table with the beers and wines.

The ulterior action of alcohol on the system is a question of considerable physiological interest. By some it has been regarded as a heat-giver; its carbon and oxygen being supposed to be oxidised in the system and thrown out as carbonic acid gas and water. In accordance with this view it has been arranged in the Museum with the heat-givers. On the other hand, it has been maintained that it diminishes the excretion not only of carbonic acid but of the nitrogenous matters which are thrown off from the system. According to the results of a recent series of experiments,* rum has the power of increasing the quantity of carbonic acid expired, whilst brandy, gin, and whisky decrease it.

Condiments and Spices.

There is a large class of substances which are added to food for the purpose of giving it flavour, and which, on account of the volatile oils they contain, act as stimulants. When taken into the stomach, like alcohol, they excite the mucous membrane and also stimulate the nervous system. These substances are known as Spices and Condiments. They also serve as the basis of a large number of the sauces which are sold prepared for the purpose of being added to cooked foods.

The *Spices* include cinnamon, cassia, bark, cloves, allspice, ginger, nutmeg, mace, and cardamoms.

The *Condiments* include Cayenne and black pepper, mustard, mint, sage, and the fruits of the Umbelliferæ, as carraways, coriander, fennel, cummin, and aniseed.

A series of these substances have been arranged in Cases 55, 56, 57, 58, and 59.

GROUP II. ALTERATIVES.

Two classes of substances have been arranged under this head as expressive of their influence on the blood, without indicating their special action. It embraces the various

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* Dr. Edward Smith.

kinds of acids, and the alkaloids, more especially those found in tea, coffee, and chocolate.

a. Acids.

The acids most commonly used in the diet are,

Acetic acid.
Citric acid.
Tartaric acid.
Malic acid.
Oxalic acid.

As articles of diet they probably all act in the same manner on the system. They all exert a solvent power over mineral substances, and assist in carrying the alkalies and alkaline earths into the blood. There is also reason to believe that in certain states of the system they favour the development of the gastric juice in the stomach, and assist by their decomposition in oxidising the materials of the blood. In all cases they act medicinally or as auxiliaries to the first class of foods.

Acetic Acid, or Vinegar is obtained either from the oxidation of alcohol in fermented liquors, or from the distillation of wood. Common vinegar is obtained from the oxidation of the fermented wort of malt. A series of preparations illustrating the processes undergone in the formation of vinegar has been presented to the Museum by Messrs. Beaufoy & Co.

The basis of vinegar consists of acetic acid, which is composed of carbon, hydrogen, and oxygen ; the same elements that enter into the composition of alcohol. This compound is also procured from the distillation of wood. The acetic acid thus procured is called pyroligneous acid. The quantity of acetic acid in vinegar is from 4 to 5 per cent. Malt vinegar contains, besides acetic acid, water, dextrin, and frequently sulphuric acid. Wine vinegar contains, besides acetic acid, the constituents of the wine from which it is made, as tartaric acid, &c. Pure vinegar is transparent, but burnt sugar is added to give it a colour, on account of a popular prejudice in favour of coloured vinegar.

Vinegar is frequently added to sauces and food to give them a flavour. It also preserves vegetable substances from decomposition, and is used in the manufacture of what are called "Pickles." Various kinds of fruits, leaves, and parts of plants are thus preserved and added to food. Some things are used in this way which are not otherwise employed. This is the case with the caper, which is the fruit of the *Capparis spinosa;* and the sterchion, the fruit of the Indian Cress (*Tropæolum majus*). A collection of fruits and plants preserved in vinegar will be found on the shelves devoted to the exhibition of "acids."

Citric Acid is contained in many fruits, but exists in greatest abundance and purity in the fruits of the Orange tribe, the natural order Aurantiaceæ (Case 60). This order embraces the orange, the lemon, the citron, the shaddock, the pomelot, the lime, and others. All these fruits contain citric acid, and varying proportions of sugar. Citric acid can be separated from the juice of these plants in a crystalline form.

The rind of these fruits contains a stimulant volatile oil, which is used under the name of Oil of Lemons and Neroli Oil. It is also prepared with sugar in various ways, and brought to table. The flowers of the Orange yield a delicious perfume.

The edible products of the Orange tribe are exhibited in Case 60. There are also specimens of the monstrous varieties which the fruits of this tribe assume.

The juice of these fruits is employed in the Navy for the purpose of preventing scurvy amongst sailors. This effect has been attributed solely to the citric acid, but it has been found that the acid alone does not act so efficaciously as when contained in the juice of the fruit. Hence some writers have attributed the effect to a chemical compound of the acid with other ingredients of the juice.

Citric acid is also found in many fruits, but mixed with other acids, as in the Barberry, Strawberry, &c.

Tartaric Acid is found in the juice of the fruits of the Vine tribe (*Vitaceæ*), more especially of the common Vine (*Vitis vinifera*). This acid gives the acidity to the fruit of the grape, and is the acid present in wines. It forms with potass an insoluble salt, known by the name of cream of tartar. This salt is found in the lees of wine. By burning, tartaric acid is converted into carbonic acid, and thus salt of tartar (carbonate of potash) is made from the tartar of wine. Hence also the name Tartaric Acid. In Case 21 is a series of dried fruits of the Grape (*Vitis vinifera*). They are known by the name of "raisins" and "currants."

Malic Acid is contained in the fruits of the Rose tribe, natural order Rosaceæ. It has the same general properties as the other acids, and is contained alone in apples and pears, whilst in cherries, plums, &c. it is mixed with other acids.

The edible products of the natural order Rosaceæ, comprising the fruits of the Apple, Pear, Apricot, Nectarine, Peach, Cherry, Plum, Raspberry, Strawberry, are exhibited in Case 107. They are mostly preserved in sugar. Many forms of plums called Prunes contain a sufficient quantity of sugar to be dried and preserved without further preparation.

Oxalic Acid is contained in the Wood Sorrel (*Oxalis acetosella*), also in the common Sorrel (*Rumex acetosa*) and various species of Rhubarb (*Rheum*). Species of the latter genus are extensively cultivated in this country, and the petioles of their large leaves cut up and made into pies, puddings, &c. They are ready for use early in the spring, and are an excellent substitute for fruit in pies and tarts at that season of the year. Although oxalic acid is a poison when taken in large quantities, as ordinarily consumed it probably acts in the same way as other acids on the system.

Many other fruits, as the Currant, Gooseberry, Cranberry, Whortleberry, Bilberry, and Blackberry, are consumed on account of their pleasant acid and sweet flavour.

b. Alkaloids.

These substances are more especially contained in tea, coffee, and chocolate. Tea and coffee have hardly any other properties in common than the possession of an alkaolid called caffeine or theine, which is identical in the two. Chocolate contains a peculiar alkaloid, theobromine; but the only other substance used extensively for a dietetic infusion, the Paraguay tea, contains theine.

Tea.—Cases 61 and 62 contain the analysis of tea, and a large series of varieties of this extensively employed substance.

The following explanatory labels accompany this collection:

Tea.

(*Thea Sinensis.*)

Tea consists of the leaves of several varieties of a small shrub found in China and India. The leaves are gathered in the fourth year of the growth of the plant, which is generally dug up, and renewed in its tenth or twelfth year. The leaves are cropped with care by gatherers who wear gloves, wash frequently, and avoid eating things likely to affect the breath. The differences between Teas result partly from the varieties of soil and growth; but also from the mode of curing and drying the leaves. Black Tea consists of leaves slightly fermented, washed, and twisted. Genuine green tea is made of exactly the same leaves, washed and twisted, without fermentation; but commercial "green" teas are often black teas coloured with Prussian blue. Probably five hundred millions of men, or half the human race, now use tea. In the United Kingdom, above 29 thousand tons, or 65 millions of pounds, are annually used; or about 2 lbs. for every person in the Kingdom. The chief action of tea depends, firstly, on its volatile oil (less in old than in new teas), which is narcotic and intoxicating; and, secondly, on a peculiar crystalline principle, called THEINE. Theine excites the brain to increased activity; but soothes the vascular system by preventing rapid change or waste in the fleshy parts of the body, and so economises food. Four grains of *Theine*, contained in half an ounce of tea, act in this way; but if one ounce of tea, containing 8 grains of Theine, be taken in a day by one person, then tremblings, irratibility of temper, and wandering of thoughts, ensue. When the system becomes thus saturated with Theine, it is useful to resort to Cocoa as a beverage, for a few days, when the irritable symptoms subside and the use of Tea may be renewed.

Tea.

(*Thea Sinensis.*)

The Tea-leaves, which become changed in the process of drying and preparation, resemble Coffee in many points. They are rich in casein or cheese, but contain in the same weight nearly twice as much Theine as Coffee. The aromatic oil, which by itself is intoxicating, is present in greater quantity than in coffee. One hundred parts of good Tea contain:—

Water	5·00.	or,	Water	5·0.
Theine	3·00.		Flesh-formers	18·0.
Casein or Cheese	15·00.		Heat-givers	72·0.
Aromatic Oil	0·75.		Mineral Matter	5·0.
Gum	18·00.			
Sugar	3·00.			
Fat	4·00.			
Tannic Acid	26·25.			
Fibre	20·00.			
Mineral Matter	5·00.			

In an ordinary infusion of Tea, the flesh-formers remain with the leaves; but may be taken up by Soda in the water. Hence the practice of the poor of adding Soda to the water in making Tea extracts much of its nutritive ingredients. The Case shows the ingredients in 1 lb. of good Tea.

1. Water in 1 lb. of Tea—350 gr.
2. Theine in 1 lb. of Tea—210 gr.
3. Casein in 1 lb. of Tea—2 oz. 175 gr.
4. Aromatic Oil in 1 lb. of Tea—52 gr.
5. Gum in 1 lb. of Tea—2 oz. 385 gr.
6. Sugar in 1 lb. of Tea—211 gr.
7. Fat in 1 lb. of Tea—280 gr.
8. Tannic Acid in 1 lb. of Tea—4 oz. 87 gr.
9. Woody Fibre in 1 lb. of Tea—3 oz. 87 gr.
10. Mineral Matter—350 gr.

TABLE, showing the RELATIVE CONSUMPTION of TEA in different COUNTRIES.

Country.	Annual Consumption in Ounces per Head of the Population.
UNITED KINGDOM - - -	35¼
FRANCE - - - -	1
ZOLLVEREIN - - - -	½
RUSSIA - - - -	4
UNITED STATES - - -	16

In Case 63 is contained a specimen of the Paraguay Tea, with the following label :—

PARAGUAY TEA, OR MATÉ.

(*Ilex Paraguayensis.*) Nat. Ord. AQUIFOLACEÆ.

The Maté occupies the same important position in the domestic economy of South America as the Chinese Tea (*Thea Sinensis*) does in this country. The leaves of the Maté Plant, a species of holly (*Ilex Paraguayensis*), are from four to five inches in length, and are prepared by drying and roasting, not in the manner of the Chinese Teas, in which each leaf is gathered separately, but large branches are cut off the plants and placed on hurdles over a wood-fire until sufficiently roasted ; the branches are then placed on a hard floor and beaten with sticks ; the dried leaves are thus knocked off and reduced to a powder, which is collected, made into packages, and is ready for use. There are three sorts known in the South American markets: the Caa-Cuys, which is the head of the leaf ; the Caa-Miri, the leaf torn from its midrib and veins, without roasting ; and the Caa-Guaza or Yerva de Palos of the Spaniards, the whole leaf, with the petioles and small branches roasted. The method of preparing it for drinking is by putting a small quantity, about a teaspoonful, into a gourd or cup, with a little sugar; the drinking tube is then inserted, and boiling water poured on the Maté ; when sufficiently cool to drink without scalding the mouth, the infusion is sucked up through the tube. It has an agreeable slightly-aromatic odour, is rather bitter to the taste, and very refreshing and restorative to the human frame after enduring great fatigue. It contains the same active principle as tea and coffee, called Theine ; but does not possess the volatile and empyreumatic oils of those substances. It is calculated that about 8,000,000 lbs. of this substance are consumed annually in South America.

The leaves of many plants have been used as substitutes for Tea, but they do not seem to contain the same alkaloid. Some of these will be found in Case 63.

Coffee.—In Cases 64, 65, and 66, the analysis of Coffee, with varieties of the seeds, and substances used as substitutes for Coffee, are exhibited. The labels accompanying them are as follow :—

Coffee.

(*Coffea Arabica.*)

The Coffee plant belongs to the natural order *Cinchonaceæ,* which contain the plants yielding Quinine. It is an evergreen shrub with oval, shining, wavy, sharp-pointed leaves, white fragrant flowers with projecting anthers, and oblong pulpy berries which are at first green, then of a bright red, and afterwards purple. Each berry contains two seeds, which are covered over with a tough membrane called " parchment." The seeds alone are used in the preparation of Coffee. The Coffee plant is indigenous in southern Abyssinia, where it grows wild over the rocky surface of the country. In the fifteenth century it was introduced into Arabia ; in the sixteenth century, into Constantinople ; and in 1652, the first coffee shop was established in London. It is now cultivated in Ceylon, the East and West Indies, and in South America.

The Coffee plant attains a height of from ten to fifteen, or twenty feet. It is planted in nurseries, and at the end of three years bears fruits and seeds, and continues to do so for twenty years. The seeds vary in size according to the countries in which they are produced. The best seeds are obtained from the Yemen, the southernmost province of Arabia ; these yield the richest Mocha Coffee.

The separation of the seeds from the pulp and parchment of the fruit is a complicated process. The berries are first fermented, the pulp cleared away and the seed dried in the parchment ; the latter is afterwards bruised and separated from the seed, which is immediately placed in bags to render permanent the greenish colour that the unroasted Coffee bean possesses. In its unroasted condition the bean consists of a horny mass, which, after it is submitted to roasting, yields very different products from those which existed before that process. Exposure to heat develops the peculiar volatile oils, and the astringent acid, on which the flavour of coffee depends. The oil acts as a stimulant upon the nervous and vascular system, producing an agreeable excitement of the mind, and a gentle perspiration on the skin. It also tends to impede the waste of the tissues of the body, and when taken in too large quantities produces sleeplessness and palpitation of the heart. The acid called Caffeo-tannic, found in rosted Coffee, acts as a light astringent ; but in this respect Coffee does not act so powerfully as Tea. It contains a similar active principle to that of Tea, called *Caffeine*. The yearly consumption of Coffee in the world is calculated to be about 600,000,000 of pounds.

COFFEE.

(*Coffea Arabica.*)

The chemical properties of the Coffee-berry are altered by roasting, and it loses about 20 per cent. of weight, but increases in bulk one third or one half. Its peculiar aroma, and some of its other properties, are due to a small quantity of an essential oil, only one five-thousandth part of its weight, which would be worth about 100*l.* an ounce in a separate state. Coffee is less rich in THEINE than Tea, but contains more sugar, and a good deal of cheese (Casein). One hundred parts consist of :—

Water - -	12·000.	or,	WATER - -	12·00.
Caffeine, or Theine	1·750.		FLESH-FORMERS	14·75.
Casein, or Cheese	13·000.		HEAT-GIVERS -	66·25.
Aromatic Oil -	0·002.		MINERAL MATTER	7·00.
Sugar - -	6·500.			
Gum - -	9·000.			
Fat - - -	12·000.			
Potash with a peculiar acid -	4·000.			
Woody Fibre -	35·048.			
Mineral matter -	6·700.			

In the usual way of making Coffee, the flesh-formers are thrown away: the addition of a little Soda to the water partly prevents this waste. The Case shows the various ingredients in 1 lb. of Coffee.

1. Water in 1 lb. of Coffee—1 oz. 407 grs.
2. Caffeine or Theine in 1 lb. of Coffee—122 grs.
3. Casein, or Cheese in 1 lb. of Coffee—2 ozs. 35 grs.
4. Aromatic Oil in 1 lb. of Coffee—1½ gr.
5. Gum in 1 lb. of Coffee—1 oz. 192 grs.
6. Sugar in 1 lb. of Coffee—1 oz. 17 grs.
7. Fat in 1 lb. of Coffee—1 oz. 402 grs.
8. Potash, with a peculiar acid, in 1 lb. of Coffee—280 grs.
9. Woody fibre in 1 lb. of Coffee—5 ozs. 262 grs.
10. Mineral matter in 1 lb. of Coffee—1 oz. 31 grs.

Cocoa, Chocolate.—In Case 63 is exhibited the analysis of Cocoa, with the fruits and seeds of the plant. The following are the explanatory labels:—

COCOA.

(*Theobroma Cacao.*) Nat. Ord. BYTTNERIACEÆ.

Cocoa is the seed of the Chocolate Plant, a small tree with dark-green leaves, growing in Mexico, Carraccas, Demerara, and other places. It produces an elongated fruit in shape between a Cucumber and a Melon, which grows directly from the stem or main branches. The seeds or beans that afford the Cocoa are imbedded in the fruit in rows in a spongy substance, and are about twenty or thirty in number. When the fruit is ripe the seeds are taken out, cleaned, and dried, and sometimes a little fermented. The best cocoa is made from these seeds, which are shelled from the outer husks and then roasted. In the inferior kinds the shell is ground up with the seeds. COCOA-NIBS are seeds merely roasted and crushed after being shelled. COCOA-PASTE is the seed ground down, and when this paste is mixed with sugar, and flavoured with aromatics, as Vanilla, it is called Chocolate. The peculiar flavour of Chocolate is due more especially to Vanilla. This latter substance is the fruit of the *Epidendrum Vanilla*, an orchidaceous plant, a native of Mexico, and contains a volatile oil which gives the flavour to Chocolate. Soluble, Rock, Flake, and other Cocoas are the whole seeds ground and mixed with Sugar, Gum, Starch, etc. Cocoa is a rich and nutritious food, containing in 100 parts, 51 of Butter, 22 of Starch and Gum, 20 of Gluten or flesh-forming matter, and about 2 parts of a principle called THEOBROMINE, to which no doubt its peculiar character is due: Theobromine contains more Nitrogen than Theine, the active principle of Tea and Coffee. The quantity of Cocoa consumed in the United Kingdom in 1852 was 3,382,944 lbs.

COCOA.

(*Theobroma Cacao.*)

Cocoa, though drunk like Tea and Coffee as a beverage, differs from them remarkably in composition. The distinguishing feature of its composition consists in the large quantities of fat and albumen which it contains; so that Cocoa not only acts as an alternative through its Theobromine, but as a heat-giving and flesh-forming food. 100 parts of Cocoa contain :—

Water - - -	5·0.	or,	WATER - - 5·0.
Albumem - - -	20·0.		FLESH-FORMERS 22·0.
Theobromine - -	2·0.		HEAT-GIVERS - 69·0.
Tutter - - -	50·0.		MINERAL MATTER 4·0.
Woody Fibre - -	4·0.		
Gum - - - -	6·0.		
Starch - - -	7·0.		
Red colouring matter	2·0.		
Mineral matter - -	4·0.		

The Case shows the ingredients in 1 lb. of Cocoa paste.

1.	1 lb. of Cocoa nibs.		
2.	1 lb. of Cocoa paste.		
3.	Water - - - -		350 gr.
4.	Albumen and Gluten	3 oz.	85 gr.
5.	Theobromine - - -		140 gr.
6.	Butter - -	8 oz.	
7.	Gum - - - - -		426 gr.
8.	Starch - -	1 oz.	53 gr.
9.	Woody fibre - - -		280 gr.
10.	Colouring matter -		140 gr.
11.	Mineral matter - -		280 gr.

GROUP III. NARCOTICS.

The substances taken as food, and arranged under the head of Stimulants, when taken in excess affect the nervous system, more especially the brain, and then become narcotics. This is especially the case with alcohol. There is a fascination connected with the action of such substances that has in all ages and countries led mankind to indulge in them frequently to a dangerous extent. In northern climates alcohol has been especially consumed for this purpose. Besides alcohol, many substances whose stimulant effect is less, and narcotic action more decided, have been consumed. Of these, tobacco, opium, and Indian hemp may be taken as special examples.

Tobacco.—Although tobacco has been only comparatively recently introduced amongst the inhabitants of the Old World, it is more extensively employed than any other narcotic. It is the produce of various species of the genus *Nicotiana*. The practice of smoking the leaves of these plants was introduced from the New World. The species which is a native of America, and which supplies the greater proportion of the tobacco smoked in Europe, is the *Nicotiana Tabacum*. The leaves of these plants contain an active principle called *Nicotine* or *Nicotia*, which is the agent that produces the narcotic effect experienced in smoking. This narcotic effect resembles in some measure that of alcohol. Tobacco has, however, a less stimulant effect than alcohol, and produces, especially at first, a greater derangement of the general nervous system.

Species of *Nicotiana* are indigenous in the Old World, and *N. rustica* and *N. Persica*, inhabitants of the Levant and Persia, supply a limited quantity of the tobacco smoked in Europe. They contain less nicotine than American tobacco, and are used in the manufacture of the milder cigars and tobaccos.

Cases 112, 113, 114, and 115 contain a series of specimens of the leaves of species and varieties of tobacco cultivated in various parts of the world, with specimens also of the cigars and tobaccos manufactured from them. These have been presented to the Museum by Messrs. Lambert and Butler, of Drury Lane, London.

The following Table exhibited in the Museum shows the relative annual consumption of Tobacco in different countries, in ounces per head of the male population :—

	ozs.
United Kingdom - - -	65
France - - - -	88
Belgium - - - -	143
Holland - - - -	131
Denmark - - - -	127
Norway - - - -	101
Sweden - - - -	70
Russia - . - -	40
Austria - - - -	108
Zollverein - - -	155

		ozs.
Sardinia	- - - -	45
Tuscany	- - - -	40
Papal States	- - -	32
Spain	- - - -	76
Portugal	- - -	56
United States	- - - -	119

Tobacco is also consumed in large quantities in the manufacture of Snuff. For this purpose the stalks and ribs of the tobacco leaves are employed. Examples of varieties of Snuff used in this and other countries will be found in Cases 70 and 112.

Opium.—Opium is the juice of the Poppy (*Papaver somniferum*). It is obtained from the cultivated plant, by piercing the capsules and collecting the juice as it exudes. It is then dried and formed into small masses, and covered with leaves of various kinds, or other thin substances, as mica, &c.

The Poppy is cultivated extensively for this purpose in Turkey, Egypt, and the East Indies. It has also been introduced into Europe, but the opium is not so powerful.

Opium is indebted for its active properties to a principle called *Morphia* or *Morphine.* Besides morphia, it contains other active principles, which are also narcotic. These are exhibited in Case 68, which has been presented to the Museum by the General Apothecaries' Company, Berners Street, London.

These active principles are combined with caoutchouc, gum, and other vegetable matters in the opium of commerce.

Opium is used extensively as a medicine, on account of its power of alleviating pain and inducing sleep. In small doses it acts as a stimulant. On account of this latter property and its subsequent soothing influence, it has been indulged in by man, and is consumed largely in China and other parts of the world as a dietetical luxury. When taken for this purpose it is smoked, and is generally consumed with tobacco or some other leaf in a pipe. Pipes used for this purpose in China are exhibited in Case 90, with a collection of Chinese tobaccos, most of which appear to contain opium.

The practice of "Opium eating," as it is called, exerts a most prejudicial effect upon the system; and although not rapidly destroying life, the victim of this habit is after a time rendered perfectly miserable if not able to procure this indulgence. As is the case with alcohol and tobacco, the system becomes accustomed to the use of this narcotic, and prodigious quantities have been consumed by those who have addicted themselves to the practice of taking it for the sake of its effect on the system. The history of its effects upon the mind has been described by two distinguished literary men in this country, Samuel Taylor Coleridge and the "English Opium Eater."

Case 69 contains, besides opium, specimens of other narcotic agents. Of these only two are indulged in extensively by man as narcotics.

The *Cannabis sativa,* common Hemp, when grown in tropical or sub-tropical climates, yields a narcotic principle which produces effects more analogous to those of alcohol than to those either of tobacco or opium.

In South America, under the name of Coca, the leaves of the *Erythroxylon Coca* are consumed as an intoxicating agent. The plant grows wild in the woods, and the victim of this indulgence seeks it in the wild solitudes of the forest. Its stimulant effects are said to be very remarkable and permanent, enabling persons under its influence to perform great feats of strength and agility.

In Kamchatka, a species of fungus, the *Amanita Muscaria,* is employed by the natives for the purposes of narcotic indulgence. It acts first as a stimulant, and then deranges the brain, producing in large doses entire loss of consciousness. Its effects are oftenludicrous. "If," says Langsdorf, "a person under its influence wishes to step over a straw or small stick, he takes a stride or jumps sufficient to clear the trunk of a tree; a talkative person cannot keep silence or secrets; and one fond of music is perpetually singing."

Of the other narcotics in Case 69, some are used medicinally, as the Stramonium or Thorn Apple (*Datura Stramo-*

nium); others, as the Nux Vomica (*Strychnos Nux Vomica*), containing Strychnine and Cocculus Indicus, are used for adulterating intoxicating beverages. The Betel Nut (*Areca Catechu*) is chewed in India with long pepper (*Piper longum*), and it is probable that its alleged narcotic effects are due to this agent. The Betel Nut contains a large proportion of tannic acid, and the astringent effect of this substance may render it agreeable to the natives of hot countries. Enormous quantities of Betel Nuts are consumed as a masticatory in the countries of the East.

The fruits of narcotic plants are often consumed by mistake in this country, and produce fatal effects. Specimens of the Deadly Nightshade (*Atropa Belladonna*), Woody Nightshade (*Solanum Dulcamara*), and Garden Nightshade (*Solanum nigrum*), preserved in Goadby's solution, will be found in the Museum. The berries of all these plants are poisonous.

There is another British plant containing a poisonous narcotic principle, the root of which has been occasionally mistaken for Horseradish, with fatal effects. This is the Aconite or Wolf's Bane (*Aconitum Napellus*). The roots of these two plants are exhibited in the Museum for the purpose of indicating their difference.

Many plants belonging to the order Umbelliferæ, to which Hemlock (*Conium maculatum*) belongs, contain a poisonous narcotic principle analogous to that found in Hemlock. The leaves of these plants, especially the Marshwort (*Helosciadium nodiflorum*), are often mistaken for Watercresses (*Nasturtium officinale*).

GROUP IV. ACCESSORIES.

Under this head are placed certain substances very common in all kinds of food, but which do not appear either to enter into the system and form a necessary part of the food, or to act in any way as the preceding group of auxiliary foods. The most prominent of the substances are Woody Fibre, Gum, and Gelatine. The two first occur in most kinds of vegetable foods, and have been frequently regarded as heat-givers, whilst the latter is a constant constituent of animal food, and has been regarded as a flesh-former.

Woody Fibre, or *Cellulose,* forms the walls of all kinds of vegetable cells. Wherever vegetable food is eaten whole or solid it is taken into the stomach. In experiments upon animals it has been found that little or none of this substance is digested, but it passes through the body unchanged. In the vegetable world it is sometimes converted by the growth of the plant into starch, and this can be effected by the action of sulphuric acid away from the plant. Thus if a piece of wood or paper is touched with sulphuric acid, and iodine afterwards added, the characteristic blue of starch will be afforded. But it does not appear that the stomach of man can effect this change to any extent. Hence Cellulose in the food must be regarded as a mechanical agent serving to make up the bulk, and afford a larger surface for more easily digestible substances to be acted on.

Gum is soluble in water, and found generally present in the juices of plants. It may be regarded as a fixed condition of dextrin. It is incapable of the change into sugar which takes place in dextrin, and is thus unused as a heat-giving food.

The quantities of Cellulose and Gum in one pound of different kinds of food will be seen in the following table:—

	Cellulose.		Gum.	
Potatoes -	0 oz.	327 grs. -	0 oz.	27 grs.
Rice -	0	218 -	0	87
Wheat -	0	109 -	0	109
Barley -	2	146 -	0	146
Oats -	2	0 -	0	218
Maize -	0	350 -	—	
Rye -	1	284 -	0	371
Beans -	1	206 -	1	57
Peas -	1	263 -	1	193
Lentils -	2	0 -	1	153
Buckwheat -	3	14 -	0	140

The quantities of these substances in food are presented to the eye in Case 122.

Gelatine is in the animal world what cellulose is in the vegetable. All animal food contains gelatine. The cells of which animal tissues are formed are composed of gelatine. This substance is soluble in hot, but not in cold water· It is the basis of soups, jellies, and other articles of diet. It can be dissolved in hot water, purified, and reduced to any degree of consistence. In consequence of this, it is used extensively in the arts for modelling and ornament. (See the Animal Product Museum.) It abounds in the sinews, tendons, skin, and bones of animals, and from these sources it is obtained for making soups and jellies. It is most prized when obtained from the sound or swimming bladder of the sturgeon (*Accipenser Sturio.*) This part of the fish is prepared and brought into the market under the name of Isinglass. It is chiefly imported from Russia. The manufacture, quality, and varieties of this substance are illustrated in Cases 77 and 78.

Although popularly regarded as a highly nutritive substance, there is every reason to believe that gelatine, like cellulose and gum, never enters into the composition of the blood, or takes part in the nutrition of the body. It is absent from the egg that forms the young chick; it is absent from milk that nourishes the young animal; it is absent from the blood that feeds every tissue; hence it may be concluded that its presence in the tissues arises from the decay of fibrine and albumen, and that it is one of the forms which the nitrogenous substances take before they are entirely eliminated from the system.

The greater proportion of the flesh of our animal food consists of Gelatine, as will be seen from the following table.

One pound of the following meats contain of gelatine :—

	oz.	grs.
Veal - - -	1	82
Beef - - - -	1	62
Mutton - - -	1	52
Pork - - -	0	85

There are many other facts that show that Gelatine is not a nutritious article of diet. It should therefore be recollected that, in supplying jellies and soups, it is not the substance which thickens and gives richness to the soup that acts as food, but the other things which accompany it.

ANIMAL FOOD.

The substances used as food derived from the Animal Kingdom have at present been separated from those obtained from the Vegetable Kingdom. This department of the Museum is not so fully developed as that of the food derived from the Vegetable Kingdom. Animal food is composed of the same materials as vegetable food. It is formed of the same elements, and presents the same proximate principles. It contains water and mineral matters of the same kind as plants. Its heat-giving substances appear in the form of fat, and its flesh-forming substances in the form of fibrine and albumen.

Of all animal foods, Milk is the most important, as it may be regarded as the type of human food. Case 71 contains an analysis of several kinds of Milk, and is accompanied with the following labels :—

MILK.

Milk is a substance formed in the animal body as the food of the young of the Mammalian class of animals. As it nourishes the young animal for so long a time it must contain all the elements necessary to the nutrition of the body, and Milk is consequently regarded as the type of the food of animals. It consists of *Water* in which are suspended, or dissolved, *Butter*, *Sugar*, *Caseine* or *Cheese*, and various *Salts*. The Water and the Salts represent the *Mineral*, the Sugar and the Butter the *Carbonaceous* or *Heat-giving*, and the Caseine the *Nitrogenous* or *Flesh-forming* principles of food.

The milk of the Cow is extensively employed as an article of diet in Europe. In Sweden and Denmark, Sheep's milk is used; in Switzerland, Goats' milk; in Lapland, Reindeers' milk; and in Tartary, Mares' milk. In England the milk of the Ass, on account of its resemblance to Human milk, is frequently employed for young Children as food. When milk is allowed to stand, the butter rises to the surface in the form of "cream." Butter is formed from cream by the process of "churning." The caseine is held in solution in the milk by the aid of certain salts; when these are removed by acids the caseine coagulates, and forms "curds." When the curd is removed with the butter and pressed, it forms cheese. The best and highest-priced cheeses are those in which there is most butter. The caseine without the butter is hard and indigestible.

The Sugar of Milk is called *Lactose*. It is sometimes separated for dietetical or medicinal purposes. It is readily converted into an acid called *Lactic acid*. This acid forms in milk which has been kept, and from this cause the milk becomes curdled. The sugar of milk may be fermented, and in some parts of the world they make alcoholic beverages from milk. Milk is preserved in various ways so that it may be taken on long voyages, or otherwise employed as a diet where living animals cannot be kept to produce it. It is preserved both in a liquid and solid state. The latter mode of preparation appears to have the advantage.

MILK.

Milk is one of the most important articles of diet. The young of all the Mammalia are fed entirely upon it during the first period of their life. Its composition may be therefore taken as the type of food. It varies in composition in different animals. In the Cow it consists in 100 parts:—

Water	86·0.	or,	WATER	86·0.
Casein	5·0.		FLESH-FORMERS	5·0.
Butter	3·5.		HEAT-GIVERS	8·0.
Sugar of Milk	4·5.		MINERAL MATTER	1·0.
Salts	1·0.			

The composition of Human milk and Asses' milk, as contrasted with Cows' milk, may be seen as under,—

	Cows' milk.	Human milk.	Asses' milk.
Water in 100 parts	86	89½	90
Flesh-formers, Casein	5	3	2
Heat-givers { Butter	3½	3	1½
Heat-givers { Sugar of Milk	4½	4	6
Salts	1	½	½
	100	100	100

In the Case are exhibited,—

1. 1 lb. of Cows' milk, which contains—
2. Water - - - 13 oz. 333 gr.
3. Casein - - - 350 gr.
4. Butter - - - - 245 gr.
5. Sugar - - - - 315 gr.
6. Mineral matter - - - 70 gr.

1. 1 lb. of Human milk, which contains—
2. Water - - - 14 oz. 41 gr.
3. Casein - - - - 210 gr.
4. Butter - - - - 210 gr.
5. Sugar - - - - 280 gr.
6. Mineral matter - - - 35 gr.

1. 1 lb. of Asses' milk, which contains—
2. Water - - - 14 oz. 76 gr.
3. Casein - - - 140 gr.
4. Butter - - - - 105 gr.
5. Sugar - - - - 420 gr.
6. Mineral matter - - - 35 gr.

The Flesh of Animals.

Cases 72 and 72A contain the analysis of a pound of various kinds of flesh. These analyses have been founded on the large table exhibited in the Museum, and which is as follows:—

Assumed Average Composition of Entire Carcasses of Butchers' Meat.

[Lawes and Gilbert.]

Animals as fattened for the Butcher.	Composition per cent. of Carcasses, excluding head and feet.					Actual weight and composition of Carcasses in lbs.					
	Mineral Matter.	Dry Nitrogenous Substance.	Fat.	Total dry Substance.	Water.	Total Weight.	Mineral Matter.	Dry Nitrogenous Substance.	Fat.	Total dry Substance.	Water.
						lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Calf - -	4·5	16·5	16·5	37·5	62·5	150	$6\frac{3}{4}$	$24\frac{3}{4}$	$24\frac{3}{4}$	$56\frac{1}{4}$	$93\frac{3}{4}$
Bullock -	5·0	15·0	30·0	50·0	50·0	900	45	135	270	450	450
Lamb -	3·5	11·0	35·0	49·5	50·5	45	$1\frac{1}{2}$	5	$15\frac{3}{4}$	$22\frac{1}{4}$	$22\frac{3}{4}$
Sheep -	3·5	12·5	40·0	56·0	44·0	90	$3\frac{1}{7}$	$11\frac{1}{4}$	36	$50\frac{2}{5}$	$39\frac{3}{5}$
Pig* - -	1·5	10·0	50·0	61·5	38·5	160	$2\frac{2}{5}$	16	80	$98\frac{2}{5}$	$61\frac{3}{5}$

* In the "Carcasses" of Pigs, the head and feet are generally included ; but here, for comparison with the other animals, they are excluded.

The label containing the analysis of the meats is as follows :—

Flesh used as Food.

These Cases are intended to illustrate the quantities of flesh-forming, heat-giving, and mineral matters in the most common forms of animal food. Although the flesh of animals does not in many instances contain bulk for bulk more nutritive matter than vegetable food, its flesh-forming constituents are found to be more easily digestible. The following table gives the composition in 100 parts of Veal, Beef, Mutton, and Pork.

	Mineral matter.	Gelatine.	Fibrin & Albumen	Fat.	Water.	Total.
Veal - - -	4·5	7·5	9·0	16·5	62·5	100·0
Beef - - -	5·0	7·0	8·0	30·0	50·0	100·0
Mutton - -	3·5	7·0	5·5	40·0	44·0	100·0
Pork - - -	1·5	5·5	4·5	50·0	38·5	100·0

	Veal. 1 lb. contains.		Beef. 1 lb. contains.		Mutton. 1 lb. contains.		Pork. 1 lb. contains.	
	oz.	grs.	oz.	grs.	oz.	grs.	oz.	grs.
Water - - -	10	—	8	—	7	16	6	69
Gelatine - -	1	82	1	62	1	52		385
Fibrin and Albumen -	1	199	1	122		385		315
Fat - - -	2	281	4	340	6	176	8	—
Mineral matter		312		350		245		105

The quantities of gelatine put down here must be regarded as only approximative, as further experiments are needed to determine the exact quantity of gelatinous matter in different kinds of flesh.

The animal food has at present been arranged according to a natural classification.

VERTEBRATE ANIMALS.

1. *Mammals.*—This includes the Ox, Sheep, Pig, Deer, and other animals which are eaten as food. It is intended

to exhibit in this department all the products of this class of animals which can be exhibited, and which will in any way illustrate the history or economy of food.

2. *Birds.*—Under this head the various creatures of this class which are eaten, as well as their eggs, will be exhibited.

3. *Reptiles.*—The Turtle, the Frog, the Terapan, the Iguana, and the eggs of the Crocodile, fall under this head for exhibition and illustration.

4. *Fishes.*—The Isinglass series before mentioned as the product of the Sturgeon is exhibited under this division. Several fish dried, stuffed, or put up in glycerine, are also exhibited. The following labels accompany some of the more common fish:—

THE COD.

(*Morrhua vulgaris.*)

As an article of food, the Cod is perhaps the most important of all fish brought to our markets. It has a wide geographical range extending from Iceland to very nearly as far south as Gibraltar; and, on the shores of the American Continent, from the 40th to the 60th degree of latitude: it does not occur in the Mediterranean. Cod is found in considerable quantities round the coasts of England, Scotland, and Ireland. The London market was formerly supplied from the Dogger bank, but of late years the fish have increased on our own coast to such an extent that the London market is now almost entirely supplied from the coasts of Lincolnshire and Norfolk.

The Cod inhabits deep water, and is fished for with lines and hooks at a depth of 150 to 300 feet from the surface; it is a very voracious fish, and easily taken, biting greedily at almost everything offered to it. The baits used are generally pieces of fish, limpets, whelks, etc. Its natural food is small fish, worms, and various species of Crustacea and Mollusca. On the coast of Newfoundland, where the fish are very plentiful, as many as 400 and 500 are occasionally taken in a single day's fishing by one man. The Cod is in its highest perfection during the months of October, November, and December; it spawns in February, and is wonderfully prolific: as many as 9,000,000 of ova have been found in the roe of one female.

The Herring.

(*Clupea Harengus.*)

The Herring, leaving the deep sea towards the end of the summer months, is attracted to our shores by the increased temperature of the shallow waters, for the purposes of spawning. It is a curious and bountiful provision of nature that forces the Herring, and other fish usually distributed through the deeps, to congregate together and visit our shores in such immense abundance, at a time when they are in their highest perfection, and when most fitted for human food. The Herring sheds its roe about the beginning of November, and is then, as an article of diet, worthless; the shoals then disappear from our coasts, though individual specimens are occasionally taken all the year round.

The young fry are very numerous on the Yorkshire coast during the summer months. They are the favourite food of the dog-fish, and are frequently driven on shore in large quantities, pursued by troops of those voracious fishes. During the autumn and winter months the mouth of the Thames is a great resort for the young Herrings, where numbers of them are taken by fishermen in the nets used for sprats. The usual mode of fishing for Herrings is with the drift-net; a dark night with a smart breeze is considered the most favourable time for catching them. Great care is requisite in casting the net; and the direction of the wind and currents have to be taken into consideration. The fish strike the net, and in endeavouring to force their way through the meshes, get fixed by the head and gills, and in this state are drawn into the boats by thousands.

Red Herrings are prepared by salting and soaking in brine for several days, and then drying in rooms heated by wood fires; Bloaters are Herrings only slightly cured. The annual supply of Herrings at Billingsgate Market is estimated at upwards of 120,000 tons, valued at about 1,200,000*l.* sterling.

The Sprat.

(*Clupea Sprattus.*)

The Sprat was formerly considered by naturalists to be the young of the herring as well as that of the pilchard; it is now generally admitted to be a distinct species. The Sprat comes into season in November and continues so all the winter months, affording to the poorer classes a cheap, relishing, and wholesome food. The quantity sold in the London markets during the season is immense. About 500 boats are annually employed in the Sprat fishery; occasionally so great is the take of these fish, that thousands of tons are sold to farmers, at from 6*d.* to 8*d.* per bushel, as manure for the land. Most fish are caught on dark and foggy nights. In the spring the Sprat retires to the deep waters round our southern coast, and continues there during the summer months.

In addition to these are exhibited the following fish:—

Sole - - -	(*Solea vulgaris*).
Red Mullett - -	(*Mullus surmuletus*).
Mackerel - -	(*Scomber vulgaris*).
Trout - - -	(*Salmo Fario*).
Perch - - -	(*Perca fluviatilis*).
Smelt - - -	(*Osmerus eperlanos*).
Sapphirine Gurnard-	(*Trigla Hirundo*).
Lemp-sucker - -	(*Cyclopterus Lumpus*).
Haddock - -	(*Morrhua æglefinus*).
Lamprey - -	(*Petromyzon marinus*).

INVERTEBRATE ANIMALS.

1. *Articulate.*—To this group belong the Insects and Crustacea.

Insects are not extensively eaten. Nevertheless they form occasionally articles of diet, as the White Ants in Case 126. The Bee, it is well known, collects sugar from fruits, and deposits it in the form of honey. A hive of living Bees is to be seen working in the Food Museum. The uses of the wax of their cells are exhibited amongst the animal products applied to the arts. The following label accompanies them.

Bees.

Domestic Bees come originally from Greece. They live in colonies of ten to thirty thousand *Neutral Working Bees*, or Nymphs as they are called, from six to eight hundred Males, called drones, and of a Single Female, the Queen or Sovereign of the hive. The female does no work, being treated with the utmost respect and care, and allowing no rival in the hive. When she moves out, the bees form in line for her accommodation and never turn their backs upon her. A few days after her birth, if the weather be fine and warm, she leaves the hive in company with the drones, ascending in the air with them out of sight. Forty-six hours after her return she begins to lay eggs. In her first summer the eggs are few, and produce working bees. During winter she rests, but in spring becomes very active, laying 12,000 eggs in three weeks. In the eleventh month of her age she lays eggs producing males or drones along with those of nymphs or working bees. A few days after the laying, a little helpless white larva is hatched from the eggs. The larvæ are fed with a sort of *bouillie* varying in quality according to the age and sex of the insect, by nurses set apart for them. By varying this food the nurses can change a working bee or neutral nymph, into a Queen. When a new female has gnawed through her cell, the hive becomes much agitated, many bees trying to keep her in the cell, while the Sovereign bee rushes with fury to destroy the new claimant for royal honours, obstructed respectfully by the bees of the hive. In apparent rage the old Queen leaves the hive, or *swarms*, attended by most of her subjects, both neutrals and males, whilst the young bees remain and create the new female their Sovereign. No strangers are allowed in the hive ; if one comes, it is uniformly destroyed and its body dragged out.

Working bees collect bee-bread and wax from flowers, the wax chiefly from the poplar tree, although they also can secrete it. Brushing the pollen from the stamens they place it in little baskets on their limbs. They also take a resin called *propolis* from the flowers with which to plaster up chinks, &c. in their hives.

The combs or cells for the young and for storing the honey as food are made of wax. Openings are left between them for passages. The cells are hexagonal and nearly alike in size, except the cells for the Queen, which are much larger and cylindrical.

The *Crustacea* afford several species of edible animals, belonging to the groups of Lobsters, Crabs, Prawns, and Shrimps. Some of them are exhibited in Case 126.

Molluscous Animals.

These creatures, embracing the shell-fish of our rivers and oceans, and the snails of our shores, afford a large number of edible forms. They may be divided for dieteticalpurposes into two groups,—those with one shell, and those with two shells—univalves and bivalves. Amongst the latter the most important is the Oyster (*Ostrea edulis*). In Case 79 is an interesting series illustrating the growth of the Oyster; from which it will be seen that the young Oyster is at first a locomotive being, and only subsequently comes to rest, and gradually grows, and is not fit to eat until it is five or six years old. Shells of the different varieties of Oysters brought to the London markets are exhibited in the same Case. In Case 80 is exhibited the Mussel (*Mytilus edulis*), the Pecten or Scallop (*Pecten maximus*), and the Cockle (*Cardium edule*).

In Case 81 is a series of univalve mollusks, which include the Whelk (*Buccium undatum*), and the Periwinkle (*Littorina littorea*) from the sea, and the common Snail (*Helix aspersa*) and the Roman Snail (*Helix Pomatia*) from the land. The latter is very abundant on the Chalk Downs of this country, and is at the present moment a favourite article of diet in France.

MISCELLANEOUS.

In the preceding description some Cases in the Museum, which either on account of their miscellaneous character, or their exhibiting a new preparation rather than a new substance, have been omitted. The first of these Cases demanding attention is the collection of food from China. As this collection has a unity and completeness of its own, it was thought desirable not to separate it. It is hoped that other collections of the same kind, and illustrating national peculiarities of diet, may be formed, and presented to the Museum.

The Chinese collection is contained in Cases 90, 91, and

92. They were forwarded to this country through His Excellency Sir John Bowring, and collected under the direction of Mr. Cane, the British Consul at Shanghae. The following is an extract from the letter of advice received from Mr. Cane, relating to this interesting collection :—

MEMORANDUM.

Case No. 1 contains a box with nine varieties of Chinese wine. These are the ordinary kinds in use in this part of the empire, as will be seen from the statement they are chiefly distilled from different kinds of rice. The strongest and most common, Kow-liang, is procured in large quantities from Min-chwang, the port in Manchuria to be opened by the treaty of Tiensin. Nos. 3 and 5 are perfumed with the Kwei-hiva and Moh-li-hwa, which flowers are also greatly used in the scenting teas and various kinds of preserves. Nos. 7, 8, and 9 are mixed with some medicinal preparations, and may be regarded more as liqueurs. No 8, mixed with Gen-sing, is considered as very strengthening. The same box also contains a specimen of native soy, and four bottles of various kinds of oil. The first is vegetable oil in ordinary use here, both for culinary purposes and lamps; the second, made from the same bean that is used in the manufacture of soy; the third is rather expensive oil, made from a pea, and only used in culinary purposes; and fourth, the tea-seed oil, greatly used, amongst other things, by women for dressing their hair. Further particulars of these, with districts from which they come, and wholesale prices, will be found in the statement. Also a tin box containing fourteen varieties of Chinese cakes: these are perishable; but as they are very inexpensive it was thought advisable to send a selection of them, as calculated to give a very good idea of the style of light confectionery amongst the Chinese. All particulars procurable relating to them will be found in the statement. Various preserved fruits and vegetables in thirty-one sealed canisters; of these the Chinese have almost every possible variety, preserves of all kinds forming a great item in all their feasts. Here are fruits, flowers, roots, and vegetables preserved with sugar, salt, and treacle, many of them having no analogy to English preserves; in such cases only the Chinese name has been given. The San-cha and Yang-mei are very piquant and pleasant fruits, greatly used in confectionery and preserves, both by Europeans and natives here. With these are also six sealed canisters of sweatmeats, different preparations of sugar, treacle, and butter, not at all unlike those of England, either in manufacture or taste. Case No. 2 contains sixteen different Chinese tobaccos, numbered consecutively. These are from all districts, but most of them are procured from Han-kow, the new treaty port on the Yangtsze Keang, about 200 miles above Ninking. Many of them are native to that district; but Nankow also seems the emporium at which those of others are collected, and then distributed to the ports on the Yangtsze, almost every kind in Shanghae being procurable from there. The native names of all these varieties have been given, also the wholesale price per pecul at the largest tobacconists in this city. The pipes sent are all specimens of those in common use, indiscriminately by men and women. Sundry dried fruits and grains in boxes numbered from 1 to 15; amongst these will be found the Lichee and Longan, also several others from Tokien and Shantung provinces. No. 8 is the bean used in the manufacture of soy, and No. 13 the arrowroot from the root of the water-lily, large quantities of which are brought here from the Tae-hoo lake districts.

Teas, and the Flowers for scenting them.

This is not the season for procuring these. Mr. Fortune, who was last month in Shanghae, has promised his assistance in getting what is required at the right time. Amongst the few sent, numbered from 1 to 6, will be found three slabs of the brick tea. This principally comes from the province of Sze-chuen. It is not used, and scarcely known, in the southern parts of China. The lie or false teas are from the Canton province, and cannot be procured here at all. Nos. 5 and 6 are dried specimens of the Kuei-hwa and Môh-li-hwa, already mentioned, and greatly used for scenting teas. The flowers that are chiefly used for this purpose are the

Kwei-hwa,
Che-lan-hwa,
Môh-li-hwa (*Jasminii sp.*),
Mei-kwei-hwa,
Chang-kwei-hwa, and
Mei-hwa.

Gelatinous Substances.

Amongst these will be found three kinds of prepared seaweed, extensively used in Chinese cookery. Specimens of three kinds of glue (two being edible), fish-maws, Trepang, Beche-de-mer, and shark's fins are also here, and their wholesale prices at the large native dealers.

Sundries used as Food.

A few samples have been placed under this head. Nos. 1 and 2 are specimens of cinnamon and cassia buds from the Chekiang province. Nos. 3 to 7, various condiments, chiefly seeds used by Chinamen with their tea. Nos. 8, 9, and 10 are samples of the bamboo shoot, raw and preserved as a vegetable, in which form it is much used by the Chinese as a relish with their basins of rice.

Sundries not used as Food.

Chop-sticks: those of red wood and ebony are in the commonest use, the ivory being used by the higher classes; whilst in the north especially, a pair of chop-sticks in a case with a knife is often suspended from the girdle. Of sandal wood two specimens are enclosed. These are all imported from Singapore and the Straits, and much used by Chinamen for making the incense stick required for service in the temples. The sawdust, mixed with some chemical preparation, is also often used in scent bags, which hang as charms to the women's dresses.

British Consulate, Shanghae,
5th November 1858.

Chemical Principles contained in Vegetable and Animal Food.

Case 94, presented by Messrs. Hopkins and Williams, chemists, London, contain a series of chemical products obtained from plants used as food, as well as from animals. These substances are well worth examining, as exhibiting in a separate condition many of the active principles possessed more especially by the auxiliary foods.

Compressed Vegetables.

The art of compressing vegetables so as to enable them to keep for a length of time, is now recognized generally as a valuable means of transporting vegetable food, both for soldiers and sailors. In Cases 93 and 93*a* are exhibited a variety of vegetable substances thus prepared. All that is necessary in order to render them ready for use is to put a certain quantity in boiling water, and when they become heated they are fit for use without further preparation. The vegetables in these Cases are principally exhibited by M. Cholet.

Preparations of Flours and Starches.

In Cases 124, 125, and 126 are exhibited a series of preparations of flours and starches. These preparations are remarkable for their purity and adaptation for the dietetical purposes for which they are intended. Each article is accompanied with a label descriptive of its composition and uses.

Vegeto-Animal Foods.

In Case 76 *a* will be found meat, biscuits, and vegeto-animal foods. These are compounds in which both animal and vegetable substances are combined, and are found useful in travelling where cooking cannot be employed.

Adulterations.

The extensive employment of various substances for the adulteration of food has led to the formation of a collection of those more commonly employed. In cases 108, 109, and 110, these substances are arranged according as they have been obtained from the animal, vegetable, or mineral kingdoms. They have been selected principally from the results obtained by Dr. Hassall, and made known in his work "On the Adulteration of Food." The following is a list of these substances, and the fraudulent purposes to which they are applied :—

Substances used in the Adulteration of Food.

Animal Substances.

	Used in Adulterating
Bone-dust - - -	Pepper, Sugar, &c.

Vegetable Substances.

	Used in Adulterating
Annatto - - -	Cheese and Milk.
Bay-leaves - -	Tea.
Beans (roasted) - -	Coffee.
Burnt Sugar - -	Porter, Stout, Vinegar, &c.
Capsicums - - -	Porter and Gin.
Cardamoms - -	Porter and Gin.
Catechu - - -	Tea.
Cayenne Pepper - -	Mustard and Pepper.
Chamomile Flowers -	Beer.
Chicory - - -	Coffee.
Cocculus Indicus - -	Beer.
Coltsfoot - - -	Tobacco.
Coriander Seeds - -	Porter.
Dandelion Roots - -	Chicory.
Gamboge - - -	Confectionery.
Gluten - - -	Tea.
Grains of Paradise -	Beer.
Lentils - - -	Farinaceous food.
Linseed Meal - -	Pepper.
Liquorice - - -	Porter and Stout.

Logwood - -	Port Wine, Tea, &c.
Lupins (roasted) - -	Coffee.
Nux Vomica Seeds -	Beer.
Opium - - -	Porter.
Pea-flour - -	Pepper.
Potato Starch - -	Arrowroot, Cocoa, Honey, &c.
Quassia Chips - -	Porter and other Beers, Snuffs, &c.
Radish Seed - -	Mustard.
Rice (" Paddy ") - -	Tea.
Rice-flour - -	Pepper, Mustard, &c.
Roasted Corn - -	Coffee.
Sago Meal - -	Cocoa, &c.
Sawdust - - -	Coffee.
Starch - - -	Coffee.
Sugar - - -	Coffee.
Sumach - - -	Snuff, &c.
Tobacco - - -	Beer.
Treacle - - -	Porter and Stout.
Turmeric - - -	Tea.
Wheat-flour - -	Confectionery.

Mineral Substances.

	Used in Adulterating
Acetate of Copper -	Pickles.
Alum - - -	Bread.
Antwerp Blue - -	Confectionery.
Armenian Bole - -	Cocoa, Anchovies, &c.
Blacklead - -	Tea.
Blue John (Fluoride of Calcium) - -	Confectionery.
Brickdust - - -	Chicory, Cayenne Pepper, Cocoa, &c.
Brunswick Green (light) -	Confectionery.
Brunswick Green (middle)	Confectionery.
Brunswick Green (deep) -	Confectionery.
Burnt Umber - -	Confectionery.
Carbonate of Ammonia (" Pop ") - -	Bread.

Carbonate of Copper -	Tea.
Carbonate of Lead -	Tea.
Carbonate of Lime -	Confectionery and Snuff.
Chalk - - -	Sugar.
Chromate of Potash -	Tea.
Chrome Green - -	Confectionery.
Chrome Yellow - -	Confectionery.
Daff, or "Daft" - -	Confectionery.
Dutch Pink - -	Tea.
Emerald Green - -	Confectionery.
Felspar - - -	Tea.
Fuller's Earth - -	Tobacco.
Marble - - -	Sugar.
Pipe-clay - - -	Honey.
Prussian Blue - -	Tea.
Raddle or Reddle - -	Tea.
Red Lead - -	Cocoa, Anchovies, &c.
Red Ochre - - -	Cocoa.
Common Salt - -	Beer, Tea, &c.
Silica (ground glass) -	Snuff.
Smalts - - -	Confectionery.
Steatite - - -	Tea.
Sulphate of Copper -	Pickles.
Sulphate of Iron - -	Tea.
Sulphuric Acid - -	Gin, &c.
Ultra-Marine - -	Confectionery.
Venetian Red - -	Tea.
Verdigris - - -	Confectionery.
White Clay - -	Mustard and Confectionery.
Water - - -	In almost everything.

MICROSCOPES.

The microscope has been found a useful instrument in the detection of the adulteration of food. In the Food Museum will be found two microscropes, one for opaque and the other for transparent objects, constructed by Mr. Ladd, Optician, Chancery Lane. These microscopes are fixed and adapted for the exhibition of objects in museums generally. The objects are also placed in moveable slides attached to the microscope, so that no derangement of the action of the instrument can occur from persons ignorant of its use. The objects exhibited are especially the microscopic structure of starch, with various substances used in the adulteration of food.

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