An Essay on Diet

By

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Introduction

It is unnecessary for me to offer any apology of having selected diet as the subject of this essay, seeing that it is an important auxiliary which can frequently be used with great success by the physician for the prevention, alleviation and cure of disease.

In the prevention of disease diet acts as a prophylactic agent, and as such I may quote its beneficial application in warding off the morbid changes incident to persons who unfortunantly possess either the phthisic, scorbutic, or venereal diseases, in preventing scrofula and the many functional and organic diseases of the digestive apparatus. In the alleviation and cure of disease diet exercises its influence as a remedial or therapeutic agent and as such is used in many pathological states depending upon, and resulting from a diseased condition of the body; further, I may mention its use in controlling the progress of many acute, and accelerating that of many chronic diseases. In palliating if not entirely removing not a few of those disorders constituting dyspepsia. Having made the above remarks upon the importance of dietetical knowledge to the practical physician, it remains for me to consider the means of obtaining such information as will be of service to the medical practitioner while performing these duties.
which the nature of his profession entitles upon him. Such information can only be gained by the study of two sciences, viz., Chemistry and Physiology. The rapid advance which chemical science has made within the present century, and especially animal chemistry, has added greatly to our knowledge both of the nature of food and of the changes it undergoes after reception into the body until it is finally ejected from it, in the form of various excretions. Since the theory of the Alchemists has been abandoned by scientific men, chemical investigators have reaped a rich reward in the grand discoveries they have made, and since the day that a true philosophy spread its brilliant rays upon that science which has had for its investigators eminent men of almost every civilized nation, facts have been elicited which would have for ever been buried in obscurity, had not alchemy been taken from its foundations and a monument of truth, the truth more precious than silver and gold, erected upon its shattered remains. Such researches have had important bearings upon many very thousand functions performed in the animal economy; they have shown that processes before reckoned as vital are in reality but chemical phenomena of the simplest
description, as have those likewise dispelled the veil of mysteries which shrouded the chemical inspection of food and its relations to the organized textures of the body; moreover they have clearly demonstrated the composition of these textures themselves and the metamorphoses they are subject to while under the dominion of the vital actions of the human frame.

Physiology has also marched upon the stage of progress and unraveled the confused mass of theories with which it was encumbered. The devoted adherents of that science have within the present century successfully investigated many of the functions performed by animated beings, and shown that the views held formerly concerning them were very erroneous. We have by these researches gained interesting and important concerning digestion, nutriment, development of heat £c. a study of which processes has greatly improved the diestetical department of medicine.

It is then only by reasoning upon the data furnished by chemistry and physiology that we can arrive at legitimate conclusions concerning the food best adapted for man in the various circumstances under which he is placed; it is by taking into consideration the amount of waste which the fibrous tissues are subject to that we can regulate the supply of the albuminous or plastic materials.
in his meals or that on rich or coarse food in producing plethora or the one hand or Asthenia on the other, in like manner we may adjust the consumptin, leucinious and saccharine substances so that death may be prevented while the oxidation of the albuminous tissues for want of a due supply of calorific agents may be guarded against.

The Physiology of Digestion.

The remarks which I intend to make upon the physiology of digestion must be brief, not because the subject itself is of little importance, but for the simple reason that, entering into crotchets, I would be wandering from the subject of this essay. As a correct knowledge of digestion is however to valuable an aid in gaining a right understanding of dietetics, I could not pass the subject over in silence. First of all I will speak of mastication and inactivation. Man being an omnivorous animal possesses different kinds of teeth admirably suited for cutting, tearing and grinding the various substances of which his food is composed. The teeth by one or all of these methods reduce the food to a state of comminution and minute division, by which a large extent of surface is exposed. After the action of the
Saliva and secondly, of the gastric secretions. If the
meals are not sufficiently acted upon by the teeth increased
work is thrown upon the stomach, which labours to pul- 
verise and dissolve its contents, but this organ never
being designed for such a mechanical function, presents
the presence of the coarse materials and dyspepsia follows.
Hence it is necessary to remember that the first step of
digestion begins in the mouth and not in the stomach as
some people would lead one to believe, from the hasty
manner in which they consume their food. The food
is not merely subjected to reduction in the mouth, certain
ingredients of it are chemically changed, or at least mixed
with a fluid secreted by the glands whose ducts open into
the buccal cavity, which ultimately produces chemical
actions upon it. This fluid is called the saliva, it possesses
an alkaline reaction i.e. it turns vegetable bluest ink
green, and according to the Analysis of Freiheit and
Jacobowitz it is composed of water holding in solu-
tion phosphates, soda, lime and magnesia, chlorides
of sodium and potassium with sulphogranules of mucin
and a peculiar soluble matter called Trypsin. It
suspended it epithelial scale and viscous. The amount
of saliva secreted bears a certain relation to the movements
of the jaws in mastication being more abundant in
proportion to their greater action. The active property of the saliva depends upon the substance termed phyalin, concerning which various opinions have been held, but I believe that it is merely epithelial scales in a state of decomposition and therefore capable (as will hereafter be explained when treating of fermentation) of acting as a ferment, for the essential change produced upon the food by saliva is the conversion of its starchy particles into dextrine and grape sugar. This process does not only proceed in the mouth, but also in the stomach, according to the researches of Bence Jones, Lehmann and others. It is not known whether the other ingredients of the salivary secretion have any action upon the food or not, but it would appear from the constant presence of belladonna and other that it performs some part in the digestive process (Bentley). Saliva has no action upon the proteinie or digested compounds.

Digestion in the Stomach. When food is introduced into the stomach, its secretion before Alkaline speedily becomes acid. This Acidity depends upon the secretion, by the gastric follicles of a fluid called the gastric juice concerning the action and Chemical Composition of which various opinions and theories have been held.
by Chemists and Physiologists. It is now very generally believed that the fluid contains Muriaetic Acid in a free state, Catic, Butyric and Phosphoric Acids, either free or combined with such salts as are usually found in secretions. There is however a substance contained in it concerning the nature of which we are almost if not entirely ignorant, but without which digestion would either be imperfectly performed or not at all, for according to the experiments of Beaumont, when Alimentary Substances are placed in water acidulated with Hydrochloric and Acetic Acids, the changes are neither so rapid nor so perfect (Experiment 104) as in the gastric juice out of the stomach, in which they are complete, dissolved as if they had taken place in the stomach, while in pure water no change whatever takes place until ordinary chemical decomposition commences (Exp. 33). It would appear that pepsine, for such is the name of the substance in question, is an animal actinogenised substance, probably it is like the Cytolytic (the salt) epithelial cells in a state of change, capable of exerting an influence upon organic matters brought into contact with it and so altering their molecular arrangement that the hydrochloric acid can by its solvent power readily reduce the Alimentary Materials into the soft semisolid Chyme. But the Chyme is not merely a mechanical
solution of the food, but a solution altered in its chemical properties, for the special tests employed for the detection of the nitrogenous compounds, can no longer recognize the individual substances. Ornt believes that the digested constituents (Fibrine, Albumen, Caseine and Gelatine) by entering into combination with water are all converted into one substance—Albuminose, a species of vital Chemistry performed in the laboratory of the Stomach. This Albuminose is absorbed, but before it reaches the blood, it is raised in its chemical composition by pasting with its water, under the agency of vital forces. Be this as it may, we know from actual experiment that animals can live upon a combination of one of the digested constituents of food (gelatine excepted) and gelatinous matter, showing that if Albumen alone be used as nitrogenised food, it will nourish (according to Dr. Prontu's view, by means of its conversion into the other two) textures composed not only of Albumen but of fibrine and fluids into which caseine enters as a constituent. If fluid Albumen is injected into the veins of an animal, it does not remain in the blood but is eliminated from the system by the kidneys, a fact which tends to support Prontu's theory or at all events to prove, that Albumen
must undergo some change, either molecular or chemical, before it mingleth with the blood. The gastric juice only acts upon organic substances, but even then, it is only in part entirely dissolved in the stomach; what remains undissolved is passed into the intestines and there undergoes the changes preparatory to absorption. Starchy matters are not affected by the special secretion of the stomach; their transformation however proceeds in that viscera by reason of the presence of the salivary secretion, carried down with the food. The soluble non-organic substances such as sugar are either absorbed directly by the stomach or pass into the duodenum with the chyme. The gastric juice has a great power over and generally dissolves the membraneous envelopes of fat cells.

Having described in as brief a manner as possible the general principles of digestion, I proceed to mention,

The circumstances affecting digestion in the stomach

(a) The quality of the food has a great effect upon the rapidity with which it is digested; soft and tender substances being more easily dissolved than hard and tough materials. Vegetables from the toughness of their fibrous tissue are not as readily digested as flesh, nor is the latter so soon as rice and other farinacous foods. Fatty substances as well as meals composed of articles very opposite.
in their degrees of digestibility are with difficulty reduced into chyme. It is necessary to remember that large quantities of fluids, by diluting the gastric juice, impair its solvent power. Hence foods, otherwise very digestible, may become offensive, even to powerful stomachs on account of the large quantity of water incorporated with them. Dr. Beaumont has given a table of the time required by various kinds of food for digestion, which I think may be with propriety inserted here, as it will often be referred to while treating of various subjects in this thesis.

<table>
<thead>
<tr>
<th>Articles of Diet</th>
<th>How prepared</th>
<th>Mean time of Chymification in the Stomach</th>
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<tbody>
<tr>
<td>Rice</td>
<td>Boiled</td>
<td>hrs. 1 0</td>
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<tr>
<td>Pig's feet, toasted</td>
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<td>1 30</td>
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<tr>
<td>Pigeon, toasted</td>
<td>&quot;</td>
<td>1 35</td>
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<tr>
<td>Eggs, whipped</td>
<td>Raw</td>
<td>1 45</td>
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<tr>
<td>Trout, salmon, fresh</td>
<td>Boiled</td>
<td>2 0</td>
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<tr>
<td>Oat, barley</td>
<td>Boiled</td>
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<tr>
<td>Apples, ripe</td>
<td>Raw</td>
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<tr>
<td>Venison, Steak</td>
<td>Boiled</td>
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<td>Brains Animal</td>
<td>Boiled</td>
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<td>Eggs</td>
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<td>Milk</td>
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<td>Liver, fresh</td>
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<td>Codfish, cured, dry</td>
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<td>18</td>
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<tr>
<td>Cabbage with vinegar</td>
<td>2</td>
<td>25</td>
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<tr>
<td>Boiled</td>
<td>2</td>
<td>30</td>
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<td>Roasted</td>
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<td>Raw</td>
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<tr>
<td>Eggs, fresh</td>
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<td>Turkey, wild</td>
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<tr>
<td>Domestic</td>
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<tr>
<td>Gelatin, boiled</td>
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<tr>
<td>Turkey, domestic</td>
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<td>Goose, wild</td>
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<td>Pig, suckling</td>
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<td>Lamb, fresh</td>
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<td>Fresh meat and vegetables</td>
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<td>Beans, pod</td>
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<td>Sake, sponge</td>
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<td>Parsneps</td>
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<td>Potatoes, Irish</td>
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<td>Cabbage, head</td>
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<tr>
<td>Chicken, full-grow</td>
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<td>Custard</td>
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<td>Beef, with salt on</td>
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<tr>
<td>Apples, sour, hard</td>
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<tr>
<td>Oysters, fresh</td>
<td>Raw</td>
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<td>Eggs, fresh</td>
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<td>Bass, striped, fresh</td>
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<tr>
<td>Beef, fresh, lean</td>
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<td>Mutton, fresh</td>
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<td>&quot;</td>
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<tr>
<td>Fish, lean</td>
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<tr>
<td>Chicken soup</td>
<td>Baked</td>
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<tr>
<td>Oysters, fresh</td>
<td>Roasted</td>
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<tr>
<td>Pork, recently salted</td>
<td>Broiled</td>
<td></td>
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<tr>
<td>Mutton, fresh</td>
<td>Roasted</td>
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<tr>
<td>Bread, corn</td>
<td>Baked</td>
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<tr>
<td>Carrot, orange</td>
<td>Boiled</td>
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<tr>
<td>Sausage, fresh</td>
<td>Broiled</td>
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<tr>
<td>Oysters, fresh</td>
<td>Fried</td>
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<td>Flounder, fresh</td>
<td>Stewed</td>
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<tr>
<td>Beef, lean, fresh</td>
<td>Roasted</td>
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<th>hrs.</th>
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<td>30</td>
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</tbody>
</table>
Beef with mustard
Butter
Braised, old strong
Soup, mutton
Oyster Soup
Bread, wheat
Furnish, boiled
Potatoes, Irish
Eggs, fresh
11 fresh
Green corn & beans
Beef
Salmon, salted
Beef
Beef, fresh
Lords, domestic
Ducks, domestic
Soup, beef, vegetable
& bread
Heart, animal
Beef, old, hard, salted
Pork, recently salted
Cartilage
Boiled
Melting
Raw
Boiled
Boiled
Boiled
Boiled
Boiled
Hard boiled
Boiled
Boiled
Fried
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Boiled
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<tr>
<th>Pork, recently salted</th>
<th>Boiled</th>
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<td>Veal, fresh</td>
<td>Fried</td>
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<td>Ducks, wild</td>
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<td>Mutton, boiled</td>
<td>Boiled</td>
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<td>Cabbage</td>
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<tr>
<td>Pork, fat and lean</td>
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<td>London, boiled</td>
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<tr>
<td>Beet, beef, fresh</td>
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**Total:** 11:15

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(2) The quantity of food and the time since the last meal was taken both exercise important influences on digestion. There are few habits more common and still fewer more pernicious than overloading the stomach, the consequence of which is great distention of the walls of that viscus by which uneasy sensations are produced not only in the organism itself but in others more remote. As a result of this excessive dilatation of the muscular walls of the stomach, it is unable to contract powerfully and effectually on its contents and could otherwise do it is as if it were paralysed. The motatory movements of the food (which are very essential for good digestion) being thus interfered with, it does not become as strongly secreted as if the quantity had been more restricted, and moreover the quantity of the gastric secretion poured forth is in proportion...
The nutrient material required by the system whether these be pounds or ounces. When the gastric juice becomes saturated it refuses to dissolve more and if an excess of food has been taken, the residue remains in the stomach of passes into the bowels in a crude state and frequently becomes a source of nervous irritation, pain and disease for a long time, or until the vis medicatrix naturae restores the vessel of this viscus to their natural and healthy action—either with or without the aid of medicines (Bacon’s on Digestion p. 77). One intermittent meal may produce stomatitis and duodenitis and as an inevitable result of the latter jaundice occurs from narrowing or total occlusion of the biliary duct by the exudation of plastic lymph. Too concentrated food by not affording a sufficient stimulus to the digestive organs is perjudicial to the action of these organs.

The stomach like most other members of the animal frame is subject to that law of nature which ordains that when a part has been performing its functions with activity for a time, it shall rest for a certain time to at to regain its tonicity; if, however, the stomach is kept constantly crammed with food or if the meals are taken too soon after one another, it cannot possibly perform its appropriate functions and malassimilation is the result, hence it is of the utmost importance to remember
that one meal ought to be completely removed from the stomach before another is introduced and that it is even advisable especially in dyspeptics and those abnormal habit to allow a period more or less prolonged, according to circumstances, to elapse between the final emptying of the stomach and the next repast.

(c). The nervous system exerts an influence upon digestion. From the close connection between the stomach and the nervous centres any sudden emotional excitement acting upon the latter organs, reacts injuriously upon the former; thus joy, fear, and grief are often the exciting causes of a state of morbidity symptoms. Persons under the latter, dyspepsia, do individuals with a quiet and uninterrupted mind digest their food much better and quicker than those who are continually in a state of depression and excitement either concerning their domestic or their social affairs. No one ought to commence his usual occupation, more especially if it is sedentary, immediately after partaking of a full meal.

There yet remains one or two conditions upon which healthy digestion depends, but as these are merely accessory, I will only give a few remarks upon each without entering into details.

(d). Temperature has a marked effect upon the dis-
gestive process, for Beaumont found that gastric juice at the temperature of 100° F. acted with far greater energy upon food than gastric juice allowed to cool down to 34° F., indeed the latter scarcely produced any change upon the substances submitted to its action, hence large draughts of ice cold water are injurious to proper digestion over and above even the immediate shock to the nervous system which they occasionally produce.

(c). Exercise. Gentle exercise after a meal is beneficial to its perfect and more rapid digestion. I am of opinion that a considerable number of the unfortunate beings, labouring under dyspepsia might greatly alleviate, if not entirely cure, their complaint by moderate exercise instead of lounging in bed or on a sofa after dinner, bewailing their unhappy condition.

(f). The different epochs of life influence digestion, it being quicker in young individuals than those debilitated by age. We have before seen that the gastric juice is secreted in proportion to the nourishment required by the system, hence during the period of infancy, not only is food needed for the remodelling of worn out tissues, but also for the formation of new tissue as digestion is rapid. On account of the quantity of gastric juice poured out, the contrary is the rule of old age, adults life holding an
intermediate position.

(5) Barometric changes have an influence upon digestion, the stomach participating with other organs in the languor occasioned by damp and dull, and in the activity caused by dry and clear, weather.

(6) Disease also greatly alters and sometimes suspends digestion, but as it would be premature here to enter into details concerning diet during the persistence of morbid actions in the body, I will refrain from doing so until I have described the \textit{Material Alimentaria}.

\textbf{Digestion in the Intestines.} The food having been partially, if not wholly, reduced to the state of Chyme in the stomach, passes out of that organ, through its pyloric orifice into the small intestines, there the fine molecular and the more fluid parts of it are absorbed by numerous villi and then carried directly into the venous system through the thoracic duct or indirectly through the portal vein and liver. The substances which have not been completely dissolved in the stomach are further acted upon by the secretions poured into the intestinal canal, some of which are elaborated by neighbouring glands, others by the appendages of the mucous membrane of the intestines themselves.

The Biliary Secretion or Bile is selected by the hepatic cells for the most part from the venous blood.
conveyed from the intestine by the portal vein and its ramifications. The bile is composed of an acid rich in Carbon, Hydrogen and Oxygen, united to two very remarkable compounds, viz. Glycine (a sugar of gelatine), a nitrogenised substance and Taurine, also a nitrogenised substance, but differing greatly from the former by containing a large supply of Sulphur. These two compounds, by combining with the acid (Cholic Acid) form Glycholic and Tauro-
cholic Acids (the conjugated acids of Schumann) which unite with Soda form Glyccholic Glycocholate and Taurocholate of Soda. Bile also contains potash, Ammonia, Cholesterol and a Carbonaceous pigmen-
tary matter.

The action of the biliary secretion upon the food is still subject to judgment and consequently very little is known upon the subject. When Hardy and Albuminous substances are saturated with it in vessels (no change takes place until it begins to decompose) then ordinary chemical phenomena display themselves. With oil it is said to form an imperfect emulsion. Beaumont (page 112) hints that the gastric juice is neutralized by the biliary Alkali — soda. Bernard says that the bile prevents (for it is a powerful Antiseptic) the decomposition of the food and therefore the generation of gases and the production of flatus.
It is further believed that the bile, by irritating the intestines, accelerates their peristaltic contractions and mucous secretions. Such is the amount of our knowledge concerning the influence of the bile on food, notwithstanding the experiments and researches of many eminent physiologists.

The bile after having mingled with the food and aided in the digestion (for we must admit that it performs some part in the digestive process) is not all evacuated from the system, but absorbed and carried into the circulation, there to be oxidized into carbonic acid and water. Nature economical in all her work, doubtless foresees the waste of valuable heat forming materials which would accrue from the direct excretion of the bile and caused it to be again taken up after having performed one function so that it might serve another of great importance in the animal economy.

Action of the Concentrated Fluid. The pancreas, in analogous to the salivary secretion in chemical composition except that it contains no alkaline enzymes and is identical with it, in its action upon the farinaceous articles of food, converting their starch into grape sugar. But from the fact that carnivorous animals, both quadrupeds and bipeds, possess a pancreas, it would seem that its func-
Liver secretion has some influence over the digestion of other alimentary ingredients besides the amylaceous. Bernard believes that fat is rendered amenable to absorption by being formed into an emulsion with the secretion, but whether this is the case or not is not sufficiently known to warrant us in attributing such a function to the pancreatic fluid; it is however certain that fat is but imperfectly absorbed when the secretion is prevented from entering the intestine, either by experiment or by any morbid change occurring in the duct or gland. 

Intestinal secretion. As the remains of the food pass along the intestine, they are saturated with secretion poured out by numerous glands embedded in the mucous membrane. The nature of these individual secretions has not and possibly never will be ascertained. They appear to resemble in their action, the salivary, gastric and pancreatic fluids, converting bread into sugar, chemically dissolving nitrogenous compounds, and emulsifying oleaginous matter.

The remarks under this head must necessarily be very general in their nature; not because the subject itself is of little importance in a practical point of view, but because I would be doing a very great injustice to the subject under my consideration were I to enlarge upon another which of itself would require more time and space than I have at my disposal; at the same time however any amount of statistical knowledge would not only be uninteresting, but almost altogether useless, unless the practitioner had some general ideas concerning the chemical constitution of the human frame, which it is the object of the present chapter to supply.

All organic and inorganic bodies found upon the face of the globe can be resolved into some two or more of the fifty-two elementary substances recognized by chemists; the probable number of those entering into the composition of the structures of the human body is fourteen, some of which are under the definition of Metals, viz. Oxygen, Hydrogen, Nitrogen, Carbon, Chlorine, Fluorine, Sulphur, Phosphorus, and Silicon. These are classified as Metals, viz. Potassium, Sodium, Calcium, Magnesium and Iron. By the combination of two or several of these primary elements all the materials of which the fluids and solids of the body are composed, derive their origin. Some of these products are
of an organic, others of an inorganic, nature.

1. Organic Animal Compounds (may for all practical purposes be divided into two classes viz.: those containing nitrogen - nitrogenised or azotic (for Azote is the name given to nitrogen), and those having carbon as their most prominent and important ingredient - non-nitrogenised or Carbonaceous).

(a) The nitrogenised Animal compounds are generally very highly endowed with vitality and serve useful and necessary purposes connected with the locomotive and hydraulic functions performed in the animal economy; they are moreover, by reason of the equilibrium of their component elements being exceedingly unstable, readily acted upon by ordinary chemical decomposing agents, and hence it is desirable that all aliments should contain a sufficient of nitrogenised materials for the renovation of such textures as muscle, skin, tendon, ligament, cartilage.

The nitrogenised constituents are the following:

Albumen is found in the bile, lymph and blood, saliva, intestinal and other abdominal secretions as well as in the neural lemma of nerves and in nervous matter generally. It is said by Chemists that it never occurs in the free state, but either in mechanical or Chemical combination with some of the other ingredients of the above mentioned fluid.
Fibrin constitutes the bulk of the muscular structure, a small quantity of it is also present in the blood, chyle and lymph.

Casein enters largely into the constitution of milk, but as it is only a temporary secretion of one of the chief principles by the cell walls and not a permanent constituent of the body, it will be spoken of hereafter.

Gelatin is universally diffused throughout the body, being found in the skin and other organs derived from the mesoderm layer of the embryo, and in the bones as a connective material into which their earthy matter is infiltrated. It forms nearly the whole substance of the parenchymatous tissues, ligaments, tendons and cartilages in the latter of which it is present a peculiar compound isomerous with gelatine named Thorin.

The first three of these esterized substances are collectively denominated albuminious from the fact that albumen stands at their type; they have also been called by Paulin protein compounds for a reason that will hereafter be mentioned when treating of their chemical and physical properties which I propose to do when I come to consider them as animal alimentary materials.

(47) The carbonaceous animal compounds are found in many of the organs and textures forming man's corporeal frame; their quantity is subject to great variation, not only
during the different epochs of life, but at different times within the same epoch. As they are not so intimately connected with the vitality of man as the nitrogenised compounds seem to be, they do not so constantly occupy any definite locality being discoverable in one situation at one time, while at another they are either entirely gone or but a remnant remains. By reason of their oily or fatty nature they have been denominated oleaginous compounds. Carbon, Hydrogen and Oxygen are the only elements entering into their composition, one of their essential characteristics being their freedom from nitrogen. Such substances occur in animated beings in three distinct and well defined forms, namely, saponified, unsaponified, and unsaponifiable; the meaning of these terms is obvious. The chemistry of the fats themselves will be spoken of in another part of this essay, all I need say is that the semisolid contents of the adipose cellular tissue found beneath the skin on the surface of membranes and in various hollows and cavities of the body are compounds of maragarine and olein. Although the oleaginous are the most evanescent compounds which the body contains, yet they are essential to the development and formation of bone, texture and several fluids. The blood and chyle always contain small quantities of fat.
Cholesterol, a peculiar non-digestible fat, is found in considerable abundance in the bile and nervous substance, traces of it have also been detected in the blood. The content of nervous tissue, besides other ingredients, two fatty acids—the cerebros and oleophosphoric, neither the one nor the other has been much examined. And consequently with a little doubt it exists as to their real nature.

Fatty matters seem to be concerned with, either directly or indirectly, the production of the various colours and tints observable in the eye, skin &c. Pigment cells, actuated into their interior carbonaceous matter, which under the influence of the solar rays, are like the chlorophyll of plants, chemically changed in some way or other, not yet sufficiently understood so as to justify any explanation from one.

2. The Inorganic Compounds found in man may be conveniently divided into two classes—the Non-metallic and Metallic.

(a) The Non-metallic. By far the most important compound, which by its chemical relations, comes under this head is Water. Water, a compound of hydrogen and oxygen, plays an important part in the animal economy, by its agency various soluble materials are conducted into the blood from without, preserved in a fluid state.
while within the organism and carried out by means of the many secretory surfaces when they have performed their mission and are no longer required. Absorption, circulation, secretion and excretion would come to a stand still if there was not a sufficiency of that fluid in the system, in short, life would become extinct.

Carbon, besides occupying a prominent place in the composition of organic compounds, also unites with oxygen to form Carbonic Acid and enters as such into combination with some of the metallic oxides to as to form Carbonates.

Chlorine occurs very abundantly in the body united to Potassium and Sodium, converting these substances into Chlorides.

Fluorine has lately been detected in dentine and bone, but the quantity being so excessively small no importance can be attached to this element in considering the value of different kinds of food. The same may be said of Silicon, which some chemists believe to exist in the blood as a normal constituent.

Phosphorus exists in two of the named compounds, Albumen and Fibroin and in one of the carbonaceous-oil phosphoric acid. The greatest quantity of phosphorus found in the body is oxidized into phosphoric acid by these compounds unites with several of the metallic oxides, which are present
in the blood, urine, bile and other fluids; in muscles, bones, tendons and other textures.

(6) Metallic iodine in the form of chloride, and phosphate, and carbonate of the basic oxide is very generally distributed throughout the system. The chloride of iodine is found in the blood, the chyle and lymph, saliva, bile and semisolid fluids. It has also been found in bone. The carbonate of iodine has been proved to exist in the blood by various chemists and appears to be a very necessary ingredient of that fluid, for according to Carpenter it is decomposed by phosphoric acid and sulphuric acids, its carbonic being set free and exhaled from the blood by the pulmonary organs, while the sulphates and phosphates (now formed) are eliminated by the kidneys. The phosphate of iodine exists in the blood and there exercises a special influence on the absorption of Carbonic Acid, the whole of which it rapidly gives off when exposed to the atmosphere in the lungs.

The oxide of Ostreiius—Ostrea, occurs in the body under two forms, as a phosphate largely in the bones and muscles, in a more limited quantity in blood and some other organic fluids; and as a Carbonate in bones.

The Oxide of Calcium. Pay for the greater portion of the bony skeleton of man is composed of this salt, combined with phosphoric and carbonic acids; the
former (phosphate of lime) occurring very extensively, the latter (Carbonate of lime) not so much for its abundance as for its constancy in the bones and teeth. Some besides being deposited in the solid form, is also found in a state of solution in various fluids of the body.

Magnesium after being oxidized into Magnesia, unites with phosphoric acid to form phosphate of Magnesia, which is present as a normal ingredient in bone, the quantity however is small, and the same remark may be applied to the magnesian salt present in the semisolid substance of the nervous tissue and the still more aqueous contents of the blood vessels.

Iron is always present in the blood and hair. Various speculations and theories have been professed by chemists concerning its chemical condition in the blood, but none have as yet met with anything like universal approbation.

Other substances besides those mentioned above have been detected in the human organism, but in such small quantities that no importance can be attached to their occurrence even if that was constant. Iodine, Boronine, Arsenic, Lead, Aluminum and Manganese may thus be summarily disposed of.

Such is the concise but very imperfect outline of the chemical composition of that wonderful being—man which
I offer as preparatory to a correct understanding of these materials, the necessity to afford nourishment to his organic and inorganic textures; the chemical nature of the former ought always to be held of paramount importance. Whilst judging of the food best adapted for the requirements of his system, such considerations as these need not so imperatively demand our attention concerning the inorganic compounds for they are generally present in sufficient abundance in almost all the articles commonly used by man at his meals, unless he has artificially removed those ingredients which nature's unerring laws ordained as necessary, appropriate and wholesome constituents.

Having now detailed with as much brevity as consistent with clear conception, the physiology of digestion and the chemical composition of the human body, I now proceed to offer a few remarks upon the necessity for the reception of food into the system.

The child as long as it remains in utero is nourished by materials derived from the maternal vessels; whilst its temperature is maintained, partly by the continual transformation of its infantile tissues and partly by the heat of its own body. But when it is expelled from the cavity of that hollow muscle in which it had been accommodated for nine
short months, it has new functions to perform, a new life to lead: before it was supported by food ready prepared, now the reduction and assimilation of that food in an office consigned to its tender organs; before the heat of its body was mostly absorbed from its mother, now it must produce calorif its own, even independent of artificial covering.

For the performance of these two most important functions, several conditions are necessary: 1st. The introduction of alimentary materials into the stomach. 2nd. The digestion and absorptions of their fluid products—the chyme. 3rd. The conveyance of the chyle into the blood. 4th. The circulation of that fluid and its capillary distribution throughout even the minutest structures. 5th. The abstraction, by an attractive and selective force, of plastic materials from the blood, which are assimilated under the guardians care of the tissues themselves, by a kind of inherent vital agency, concerning which we are totally ignorant. As a result of this fact, formative molecules (for physiologists are inclined to believe that the materials acted upon possess a molecular form) is deposited as a normal portion of the human frame, either in a situation not before occupied by any other organic atom or in one which has before been the seat of a pre-existing molecular entity, exactly similar in chemical and histological characteristics to its successor.
So long as this continual formation and disintegration of organic particles harmoniously proceed, health and the normal properties of the textures are preserved. As long as growth exceeds decay, the infant increases in bulk, strength, and weight, until at last the weak defenseless child is transformed into the stout, resisting man.

These tissues thus formed are all of the nitrogenized class and require (as will be hereafter shown) food containing nitrogen for the purpose of repairing their waste, for which reason alimental substances to their nutrition are denominated nitrogenized.

But while the blood is thus incessantly carrying edible materials to the laboratories of vitality, it has mingled in its purple streams substances which do not partake of that high state of organization peculiar to the nitrogenized compounds. I mean the hydro-carbonaceous ingredients of the food, these are either directly acted upon by the respiratory oxygen inhaled in respiration and converted into carbonic acid and water or they are lodged for a season in the various vacuities and interstices of the human frame, to await the call of absorption to be conveyed into the blood, and there burnt off. During the combination of Carbon and Hydrogen with Oxygen to form their respective compounds considerable heat is developed and this, together with the small quantity evolved during
The metamorphosis of the alimentary and gelatinous tissues preserves the temperature of the body. As it is the special function of the hydrocarbonaceous substances to supply heat, they have been very appropriately called Calorific or heat-giving foods, and as such they will be particularly spoken of in this part of this thesis.

We have now seen that food is indispensable for the preservation of the human species in whatever climate they are situated, whether under the scorching rays of a tropical sun or under a sky almost unknown in the art of day. While neither be out of place nor uninteresting to devote a few lines of this essay to any inquiry concerning the sources from whence the food of man is derived, these may be said to be two - the vegetable and animal kingdom.

As to the vegetable: the human being since first he walked in this fair world upon the fruitful earth and knew, has oftentimes appeased his voracious hunger by devouring those vegetable productions which, almost everywhere, decorate by their green mantled robes, the surface of this planet, the surface of this earth. Evaporation upon which the light of civilization has dawned, has learned the importance of cultivating at least some herb adapted to the wants of the population. The great aim of the science and art of agriculture is the preparation of the soil, the sowing of seeds, the culture of plants and the
manufacture of their produce into food for the people.

As animal organisms are incapable of forming organic compounds from the air itself or the nitrogenized ingredients (ammonia and nitric acid) contained in the atmosphere, it follows that their existence would be of short duration unless there was a never-failing fountain from which they could obtain one class of aliments suited to their wants. But there is generally speaking, oleaginous substances required by animals for the maintenance of their vital activity and as these alas cannot be formed from their primary elements by an physiological or chemical process performed within the economy, they must be derived from some source in which they already exist or in which there are ingredients capable of being transformed into fatty compounds. Both the alimentary materials in question are abundantly found in the roots, stems, leaves, and fruits of vegetables.

It appears to me that an opportunity is here offered for taking a brief survey of the Chemistry of Vegetation.

During the respiration of animals Carbonic acid and water are exhaled, both are diffused through the air and serve as will be hereafter shown an important part in the performance of some of the most mysterious processes in
the arcana of Nature. There is, however, another way in
which vast quantities of Carbonic acid and water are pro-
duced. I allude to the putrefactive changes which organic
matters undergo when exposed to heat and moisture. Putre-
faction differs from fermentation (a chemical process which will
be explained when speaking of sugars and starch) in this, that in
the former, the bodies decomposing are always compounds
of nitrogen and the products of their rearranged elements pass,
an offensive odour, while in the latter the fermentable bodies
are devoid of nitrogen and the products of their fermentation
have no disagreeable smell. But besides the formation of
CO₂ and H₂O during putrefaction other compounds originate
and whatever intermediate forms these may assume they are
ultimately resolved into Ammonia, Sulphuretted and Phosphuret-
ted Hydrogen. I mean that these gaseous products are formed
when the substance decomposing to that highly organized
group of compounds denominated the Albinum, for there
are nitrogenized substances, such as live, which during their
metamorphosis give rise only to carbonic acid and ammonia.
Combustion and fermentation also contribute their quota of Car-
bonic acid and water to assist in the nutrition of plants.

All these gaseous, volatile and aqueous products emanating
from the different sources above mentioned, are rapidly dif-
fused over the surface of the globe, some of them as Carbonic
acid and water are absorbed by the stomata and sponges of plants as such. These before they are received into the vegetable vessels and cells are subject to further changes in nature of which I will shortly advert to. The elementary atoms of the sulphuretted hydrogen are acted upon by oxygen, their chemical affinity for each other is overbalanced and their separation is the result. The sulphur now freed from its hydrogen, unites with oxygen and forms sulphuric acid (SO₃) which in its turn enters into combination with mineral salts such as potash, soda, magnesia etc.; these act in an eminent degree as fertilizers of the soil. The hydrogen of the original compound has a great affinity for oxygen with which it forms water (H₂O). Thus then sulphuretted hydrogen is finally resolved into sulphuric acid and water. In like manner phosphuretted hydrogen splits up into new compounds in the shape of phosphoric acid which also unites with alkalies to form salts and water.

Some have supposed that ammonia is directly absorbed by plants, this and I think more correctly hold that this is not the case, but that the ammonia is oxidized into nitric acid (HNO₃) and water, the former of which either enters the plant in its free state or combines with alkalies and earths. But ammonia is not the only
source of nitric acid, for it seems to be constantly formed from the nitrogen and oxygen of the air by the electrical currents continually traversing the ethereal space.

From those simple inorganic substances, plants, by means of their inherent chemico-vital powers create organic compounds of a very complex nature which bestow characteristic properties upon certain parts of their organised structures. Those compounds may be advantageously divided into two classes: those containing nitrogen and therefore nitrogenised and those constituted without the presence of that element and hence called non-nitrogenised.

The late Prof. Gregorj in his Handbook of Organic Chemistry has minutely described the formation of the most important vegetable products existing in the solids and fluids of plants. I could not have resisted the temptation of tracing the passages relative to the production of vegetable compounds had they not been rather too long and involved as I intend only to speak of those substances which will come under our notice as articles of diet. I would be admitting a numerous host of organic bodies totally uninteresting in a dietetical, whatever they may be in a medicinal, point of view. I shall however closely follow Dr. Gregorj's lucid and instructive description of those chemical processes, which were formerly hidden in the
dark labyrinths of obscurity.

I shall first consider the formation of the non-oxygenised or hydro-carbonous compounds. It will be necessary to proceed from the more simple to the more complex as the former can readily yield the latter by a very simple process viz—de-oxidation.

Oxalic Acid. Under the influence of solar light (this is an indispensable and requisite condition) four equivalents of Carbonic Acid (\( \text{CO}_2 \)) and six of water (\( \text{H}_2\text{O} \)) give rise to one equivalent of oxalic acid thus:

\[
\begin{align*}
4 \text{ equivalents of } \text{CO}_2 &= 4.0.8 \\
&= 6.8
\end{align*}
\]

Subtract 2 eqs. of oxygen (exhaled by the plant):

\[
\begin{align*}
4 \text{ eqs. of } \text{O}_2 &= 2
\end{align*}
\]

1 eq. of Oxalic Acid

(Malic Acid (\( \text{C}_4\text{H}_6\text{O}_6 \))). For the production of this acid 8 eqs. of Carbonic Acid and 6 eqs. of water are needed:

\[
\begin{align*}
8 \text{ eqs. of } \text{CO}_2 &= 8.9.6 \\
6 \text{ eqs. of } \text{H}_2\text{O} &= 6.6
\end{align*}
\]

Subtract 12 eqs. of oxygen:

\[
\begin{align*}
12 \text{ eqs. of } \text{O}_2 &= 12
\end{align*}
\]

1 eq. of Malic Acid

I have already said that the higher compounds may be produced from the lower and since we have now got...
two vegetable Acids formed let one point how the former
(light Acid) may be converted into the latter (Malic Acid)
the one a violent poison, the other an innocent ingredient
of poisonous fruits.

2 3eqs. of Light Acid (C₁₄H₂₄O₂) = 8. 12. 24
subtract 3 eqs. of water, = 6. 6

18
8 eqs. of Oxygen
1 eq. of Malic Acid 8. 6. 10

There are but other two Acids which will come under our
observation while treating of the Materie Alimentaria, as
it would occupy too much space to describe these and
many other compounds by tabular views, I will content
myself by merely stating that

Tartaric Acid (C₈H₄O₇) requires 8 eqs. of Carbonic
Acid and 6 eqs. of water for its production; 10 eqs. of Oxygen
being given off.

Citrine Acid (C₇H₄O₇) is composed of 12 eqs. of
Carbonic Acid and 8 eqs. of water, 18 eqs. of Oxygen being
returned to the atmosphere.

Passing from the organic Acids we encounter a
very interesting and important class of compounds, con-
prising the sugars, gums, starch, &c. Malt, hore eulcar, will
come under our consideration in a very short time,
it will suffice to say, that they are all compounds of Carbon, Hydrogen and Oxygen, the two latter being always in the proportion to form water.

Cellulose and Starch, Lichen and Inulin, all represented by the symbol C₂ H₂ O₂, are each produced by the union of twelve equivalents of Carbonic Acid and ten of water. The twelve cgs. of Oxygen are evolved from the Carbonic Acid, but the elements of the water remain unchanged.

Cane sugar and gum C₂ H₂ O₂ are both formed in the same way, except that one cgs. of water less is required for their production.

Grape sugar C₂ H₂ O₄ owes its origin to the combination of 12 cgs. of Carbonic Acid and 14 cgs. of water, the 24 atoms of Oxygen in the Carbonic Acid being disengaged.

Oleate, a substance found in nearly all plants and fruits, does not chemically speaking, come under the group of compounds I have just been describing, but as it is unessential to the vegetable principles than to any of the other non-organised bodies, I shall here mention that it is made up of the Carbon of 28 cgs. of Carbonic Acid and the elements in its ingredients 72 cgs. of water, 3 cgs. of Oxygen (got from Carbonic Acid) being retained. Its composition is consequently C₂₈ H₂₁ O₂₄.

There are many other organic vegetable compounds, such as Acetic, Margaric and Stearic Acids, whose production might...
explain, but as the process is essentially similar in every case to the formation of the substances mentioned above, I will refrain from doing so and enter at once into some remarks upon the manner in which the nitrogenised compounds are elaborated by plants.

In this class of vegetable compounds Carbon, Hydrogen, Nitrogen and Oxygen are required for the construction of the less complex, Sulphur and Phosphorus for the more complex, of its members. Dr. Gregory has expressed the Nitrogen as derived from Ammonia, but as I have before hinted that Ammonia is converted into Nitric Acid and water before it enters the plant, I will look upon Nitric Acid as the source from whence vegetable plants obtain their supply of Nitrogen.

The substances belonging to the nitrogenous group of vegetable principles are by no means numerous. The most important among which will come under our notice as dietary agents are Caffeine (theine) Albumen, Fibre, Lignum and Glute.

Caffeine C₁₆ H₁₀ N₄ O₄. The formation of this substance will be best understood by means of the following table:

<table>
<thead>
<tr>
<th>Substance</th>
<th>C</th>
<th>H</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>16 eqv. of CO₂</td>
<td>16</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.05 eqv. of H₂O₅ (Nitric Acid)</td>
<td>4.20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 eqv. of H₂O</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>10</td>
<td>4.20</td>
</tr>
</tbody>
</table>

0.58 eqv. of O. segregated | 5.8 |
1 eqv. of Caffeine        | 16  | 10  | 4  | 4
The formation of vegetable Albumen and Lecithin may be thus explained:

\[
\begin{array}{c|c|c|c|c}
\text{C. H. N. O. S} & \text{Co}_2 & \text{NO}_5 & \text{H}_2\text{O} & \text{SO}_3 \\
216 & 216 & 27 & 36 & 2 \\
27 & 135 & 169 & 169 & 6.2 \\
169 & 169 & 27 & 74.2 & 2 \\
2 & 2 & 67.4 & \\
\end{array}
\]

Deduct 67.4 cgs. of Oxygen

216 169 27 74.2 2

Vegetable Albumen and Lecithin

Leguminous (Vegetable Caseine) C_288, H_228, N_36, O_90,
S requires for its production 288 cgs. of \text{Co}_2, 228 of \text{H}_2\text{O}, 36 of \text{NO}_5 and 2 of \text{SO}_3; 900 cgs. of Oxygen being liberated.

Gluten is much allied to Lecithin and is produced in the same way as that highly complex substance. It consists of Lecithin and a nitrogenised principle called glutenine.

Plants derive their inorganic constituents from the Soligenous, terrigenous, and Calcareous substances naturally present in the soil or artificially added to by the industry and wisdom of man. As these inorganic compounds will not be found in vegetables will not come under our observation while speaking of the different kinds of diet, it will lead to a close inquiry into the chemistry of vegetation to be concluded. But before leaving the subject allow me to remark that the mineral ingredients of plants are not only...
useful but essentially necessary for the maintenance of the normal condition of the animal frame, so that their presence in articles of diet prepared from the vegetable kingdom, is beneficial rather than deleterious.

Such appears to be the manner in which nature constructs the tissues subservient to vegetable life. Chemical processes of a like description have been in operation ever since the Universal Being clad the wide spread valleys with verdant herbs and the mountain ridges with gigantic forests. Grazing quadrupeds, after having assimilated the nutrient principles of plants and passed through the different stages of their existence, arrive at that period when their vital powers can no longer sustain that condition (the adaptation of the various parts of their organism to each other) necessary for the preservation of health. After the occurrence of that event which must inevitably ensue sooner or later, the highly complex and (for that very reason) unstable animal compounds become subject to the action of disintegrating and decomposing agents. The elements entering into the composition of these organic atoms having but a feeble affinity for each other when removed from the regions of vitality separate and reunite into simpler compounds (more stable under existing circumstances), these products have been before (mentioned [page 35]).
They are absorbed by plants, and again transformed into vegetable compounds; these in their turn are devoured by animals, and the elements returned to the atmosphere, either during the life or after the death of those animated beings.

2. Animal Diet. The flesh of animals has formed part of the food of man ever since the Patriarchal ages; the first time we read of it being prepared for domestic use is in the 17th Chapter of Genesis 7 and 8 Verses, "And Abraham ran into the herd and fetched a calf tender and good and gave it to a young man and he hasted to dress it. And he took butter and milk and the calf which he had dressed and set it before them; and he stood by them under the tree and they did eat." A certain class of persons in this and other countries called vegetarians have entertained the idea that animals ought not to be devoured by man, they have endeavoured to found their views upon scriptural and physiological arguments. I will shortly give a few proofs which I think will be sufficient to satisfy any reasonable and unbiased person that their opinions are erroneous.

Scriptural Arguments. The adherents of vegetarianism loudly proclaim that it is against all divine command to use the flesh of animals as food and that the custom
has originated with man himself on account of his corrupt nature. They bring forward the following words of the Scripture to prove their assertion (Gen. 1:29). And God said, Behold, I have given you every herb bearing seed which is upon the face of all the earth, and every tree in the which is the fruit of a tree yielding seed; to you it shall be for meat. Certainly, the text quoted undeniably states that herbs are to be eaten by man, but it leaves the question in regard to animal diet wholly unanswered. Nor am I inclined to believe that the passage has a figurative as well as a literal meaning and that the words to you it shall be for meat imply that the human being may either subsist directly upon vegetable productions or indirectly upon them after they have contributed to the growth and nutrition of animals, i.e., upon the animals themselves.

Another portion of Scripture which vegetarians claim as affording positive proof for the support of their doctrines is "And thou shalt eat the herb of the field" (Gen. 3:8). I cannot so grant that these words permit the use of vegetables, but I utterly deny that they prohibit man from indulging in meals prepared from the flesh of the lower animals. I go further, for I believe they are also metaphorically applied and admit of being construed in the same way as the sentence before alluded to. Man, when he departed from
that state of innocence in which he had been originally created and pronounced upon him by the sovereign of the universe this awful curse, "in the sweat of thy face shall thou eat bread till thou return into the ground." The soil—a wilderness of thorns and thistles—was to be laboriously cultivated by the vigilance and industry of man before it would yield herbs for the use of cattle, whose flesh I presume formed part of the materia alimentaria of the antedeluvian races, for we read (Gen. 4. 2. 2) that Abel was a keeper of sheep and doubtless such flocks would not be kept for mere amusement; it is certain that animals were slain for sacrificial purposes at a very early period of the earth's existence, but whether they were eaten or not I cannot positively affirm, although it is highly probable.

I have mentioned the two most important scriptural proofs advanced by vegetarians in support of a diet consisting entirely of fruits, roots, leaves and other parts of plants. I have also pointed out some arguments obtained from the sacred writings which appear to me to militate against the principles of vegetarianism.

We read (Gen. 9. Verse 3. 2) that God when blessing Noah and his sons said: "Every moving thing that liveth shall be meat for you; even as the green herb have I given you all things;" and I consider not only settle the question
render discussion, but also directs that a mixed diet ought to be used.

We also read (John 6:11) that our Saviour sanctified the use of animal food, and Jesus took the loaves and when he had given thanks he distributed to the disciples and the disciples to them that were set down and likewise of the fishes as much as they would.

I have next to advert to Physiological Arguments. The proselytes to vegetarianism have further endeavored to impress upon the minds of men that the structure of these teeth is totally unlike that of the carnivorous beasts. For any part I have failed to discover any great dissimilarity between the cuspid teeth of man and the flesh eating animals. The only appreciable distinction which can be made is that the human canine occupy a slightly lower position in the scale of development and this they do for two very obvious reasons: 1st man was not designed to live upon animal food alone, so the teeth were fashioned for tearing muscular and fibrous structures, were only intended to perform a minor part in the process of mastication whilst in most carnivorous animals the canine teeth have to prepare the whole of the nutrient materials required by the system; 2nd man by the assistance he derives from cookery, bestowed such
tenderness with the tough flesh of animals, that it requires but little effort to separate its component parts and reduce them to a pulpy mass. Such is the manner in which I dispose of the argument obtained by examination of the teeth.

Another argument brought forward by vegetarians is that the structure of the human digestive system (by this I mean the primary assimilating organs—the stomach and intestines) bears no resemblance to that of the carnivorous quadrupeds; they are certainly anatomically right but as assuredly comparatively wrong. They hold that the human stomach and alimentary canal approaches very closely to that of the omnivorous creatures; this assertion is totally unfounded for man has neither the complicated stomach of the cow and sheep nor the enormous cecum of the horse. There is also a disparity between the length of the intestines of man and those animals, those organs being shorter in the former than in the latter. But the alimentary system of man does not approximate that of the carnivorous class of animals for they have very rudimentary digestive organs. Thus then the human being appears to again placed between the herb-devouring animals on the one hand and the flesh-eaters on the other, so that he may
last sake of the food of the one or of the other as circumstances may require.

The vegetarians do not exclude milk, cheese and eggs from their dietaries although all these articles are of animal origin. If they rigidly adhered to their creed they would, if necessity, have to prohibit the newborn infant from suckling its mother's breasts and obtaining that food provided for it by nature herself and in lieu thereof cram its tender stomach with artificial food, to the almost certainty of deranging its infant liver. But even allowing that they are justified in using milk and cheese for the minute reason that those articles can be always got without destroying any living creature, it appears to me that they are altogether unpardonable when they consume the products of bipedous animals seeing that every egg contains the germ of a future being whose life is dormant, but yet capable of being roused into existence upon the application of an appropriate stimulus—heat.

I think I have now satisfactorily proved that vegetarianism neither accords with the dictates of Scripture nor Physiology and I now pass on to inquire into one of the most important subjects con-
connected with Dietetics, namely:

The quantity of food daily required by man for the support and nourishment of his body.

This problem can only be solved by taking into consideration the amount of waste daily occurring in his carbonaceous and nitrogenous textures, his occupation, season of the year, age etc.

We can only arrive at a clear idea regarding the waste to which his tissues are subjected by calculating the amount of Carbon exhaled and not carried out of the system by the secretory organs in 24 hours. The following tables will sufficiently illustrate such physiological changes,

Carbon exhaled by the lungs in 24 hours,

<table>
<thead>
<tr>
<th>Age</th>
<th>Carbon Exhaled</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>3991.2</td>
</tr>
<tr>
<td>26</td>
<td>4003.6</td>
</tr>
<tr>
<td>46</td>
<td>3880.8</td>
</tr>
<tr>
<td>76</td>
<td>2227.6</td>
</tr>
</tbody>
</table>

To these add to one of carbon excreted by other channels.

* I am unable to say by whom these calculations were made, so I have taken them from my notes of Dr. Macleayard's lectures.
Loss of Nitrogen by Excretion in 24 Hours

Children, age 4: 69.55 gns. -- Equivalent in tissue to 21.92 gns.

8-207.99 gns. -- 630.76 gns.

Man, adult: 431.13 gns. -- 1313.71 gns.

Women: 293.15 gns. -- 1035.11 gns.

Men, age 84: 125.22 gns. -- 379.75 gns.

Feces

Adult 107. solid 82.5 gns. of Nitrogen equivalent in tissue to 536.00 gns.

Total Waste in Active adult in 24 hours.

Carbon in respiration: 399.12 gns.

15 added for exercise: 399.1 gns.

15 for other exertions: 399.1 gns.

Total Carbon: 1789.4 gns.

Loss by Urine: 1313.71 gns.

Loss by Feces: 536.00 gns.

Total Nitrogen: 1849.71 gns.

By therefore taking these numerical calculations into consideration when drawing up tables of dietaries, we can, with considerable accuracy, adjust the quantity of Carbonaceous and Nitrogenous elements of food required by man for the nutrition of his animal frame and the maintenance of his temperature. For the sake of con-
penience we might in a rough way, say that the latter
stands to the former in the same ratio to the former
as 1 does to 2 1/2 or 3.

But as I have before stated, the amount of waste is
not the only subject to bear in mind, we must also di-
rect attention to the age of the individual whose diet
we are going to prescribe. In children destruction of
structure goes on very rapidly on account of their great
activity, consequently they require a large quantity of
reparative materials to sustain that waste. They are
also continually growing and therefore an additional
quantity of food becomes necessary.

The season of the year has a great influence over
the kind of food taken: much carbonaceous food
being required during the cold months of winter
than during the hot months of summer.

Laborious exercise, by causing an increased waste
of tissue, imperatively demands a quantity of food in
proportion to that increase; so on the contrary idleness
and repose, by contributing to prevent the destruction
of texture, necessitates the diminution in the quantity of
food.
The Materia Alimentaria - Introduction.

Before entering upon the description of the Alimentary substance which it is the particular province of this section to investigate, it will be expedient, if not necessary, for me to offer some explanation of the manner in which I intend treating of the different articles of food, to wit, the classification I mean to adopt. This labour, simple though it may seem, is beset with many and great difficulties on account of the unsettled and imperfect state of Chemistry and Physiology. Alimentary principles have been variously grouped, divided, and subdivided by systematic authors, so that their works seem more like theoretical curiosities than practical treatises. It appears to me that a physiological classification would supersede all these, but in the present state of that science, it is impossible to obtain such a designation. I must therefore content myself with an arrangement based upon chemical and physiological reasonings. I have before said (page 31) that the human body has to great processes to sustain 1st. The Nutrition. The simple textures, 2nd. The maintenance of Animal heat; I also mentioned that the one was closely connected with the reception of nitrogenised, the other of Carbonaceous food into the system. We thus obtain a very natural division of Alimentary materials into those having for their aim the support of the Animal temperature - Calorificants, and
those required for the preparation of the muscles and other fibrous textures. Carnofaciens; these are respectively called by Liebig, non-nitrogenised or respiratory elements and nitrogenised or plastic elements of nutrition.

The illustrious German Chemist holds that the respiratory elements are alone used for the production of Calories and that they serve no other purpose in the animal economy; this is a very beautiful theory viewed chemically but physiological doctrines are totally at variance with it, for it is an ascertained fact that carbonaceous respiratory or Carnofaciens matters are necessary for the perfect development of cells and consequently for the formation of all tubular and fibrous tissues. But after fat has assisted in constructing these physiological elements, it by its oxidation contributes in a high degree to generate heat within the body, so that it acts ultimately not primarily as a Carnofaciens; some carbonaceous substances are however at one carried into the circulation and burnt without entering into any relation with Albue in the formation of cells. Accordingly, we may commence our arrangement with a class of dietetical agents which are essentially designed for the production of animal heat – essential Carnofaciens.

The same Chemist (Baron Liebig) asserts that the plastic elements of food (which I propose to call Carnofaciens) only
contribute to the development and nutrition of the fibrous tissues; this is certainly the major part of their office, but I have before mentioned (Page 33) that during the chemical changes which they undergo in the body a small quantity of heat is evolved, so that we are not justified in adopting his views and restricting their use to the performance of one function. Accordingly we may divide the organic aliment into a second class, namely, those which have for their essential purpose the renovation of the nitrogenised tissues—essential Carminatives.

As the human frame contains a very large quantity of inorganic constituents we will be forced to admit the necessity of a third group of simple aliments, including water and mineral ingredients under the head of Inorganic Alimentary principles.

Such are the primary groups under which I think we can conveniently place all the simple elements of food without being obliged to divide them into innumerable heads, each represented by a typical substance as the saccharine group, liponigras, the amylaceous by starch, &c. However philo-

philical the latter mode of classification may seem, it is quite unnecessary for practical purposes. After having considered these three classes in detail, I will direct attention to the compound aliments formed by the combination of two
or more of the simple carbohydrates ingredients.

Simple Organic Aliments

Class I. Essential Calorifics.

The Carbohydrates, (non-nitrogenous or respiratory food substances.)

Starch. There are several vegetable products, differing from each other rather in physical properties than chemical composition, which may be included under the general designation of starch. But as only two of these require the consideration dietetically, I will pass the others over in the most cursory manner.

Echevine is a variety of starch found in many lichens. Its composition is C_{12} H_{70} O_{16}. A solution in boiling water in which it readily dissolves, is not coloured blue on the addition of iodine. This transformed by long boiling with sulphuric acid into glucose sugar and gum.

Inulin has the same composition as Echevine and yields like compounds when acted on by weak acids. Its solution in boiling water is turned brown by iodine. It is found in the Fufu helенium, Falacia, and other plants.

Gum which occurs pretty abundantly in various parts of plants may be mentioned here. It exists in two conditions, in one of which it is soluble in water, in the other it is insoluble in that fluid. Both kinds of gums are analogous in composition to starch and like that body may be converted
into grape sugar by digestion with dilute acids. Gum is
transparent, almost devoid of colour when pure and in-
soluble in alcohol and ether. The most important gum
substances are gums Arabic found in various plants of the
Acacia tribe, and mucilage obtained from linseed. They
are sometimes used as demulcents in inflammatory af-
fections of the guttial and intestinal canal and are easily
digested.

Woody fibre is found in many vegetable textures. It
appears to consist of two varieties namely, Cellulose which
forms the walls of cells, and Lignin or Sclerogen which
deposits itself in and around those cells in successive layers.
The composition of woody fibre has not been minutely ex-
camined but it seems to be C_{2} H_{10} O_{6} and therefore isomeric
with the organic substances before mentioned. When acted
upon by the combined agency of heat and sulphuric acid
it gives rise first to starch, then dectinum and lastly glucose
sugar. As almost all vegetables contain more or less of
these substances it must frequently be received into the stomach,
but whether any appreciable quantity of it is digested or not
is very questionable. It is certain that a very large proportion
of it is ejected with the excrements unaltered as regards
taste and chemical characters, and not unfrequently
its presence has created great alarm both to patients and
and physicians. The skins of fruits, bulbs, roots &c. contain much fibrous matter and for that reason prove very irritant to the gastric intestinal mucous membrane and are frequently the cause of much annoyance, diarrhea, pain and general lassitude during autumn more especially in children and those of an irritable constitution.

Starch, commonly called is abundantly found in some vegetables, while in others the quantity is more restricted; it is generally stored up in the seeds of plants, but is found in many other parts. It can be very generally washed out of vegetable tissues in which it exists in connection with fibrine, gluten, cellulose &c by exposure to a stream of water; when the milky liquid is allowed to rest for a few minutes the starch granules mechanically suspended in it settle in the form of a fine powder to the bottom of the containing vessel. This precipitant deposit, by being subjected to various manufacturing processes, assumes characteristic forms each known by some technical or popular name.

Starch from whatever source it is derived possesses very peculiar and well defined properties by which it can easily be recognised. It is of a white colour, reflects the rays of light feebly creases when rubbed and remains unchanged when cold water or alcohol is poured upon it, but boiling water makes it swell up and agglutinates the particles to
Each other, so as to form a thick tenacious jelly capable of presenting a beautiful blue appearance when a solution of iodine is added to it. By boiling starch with dilute sulphuric acid it is readily converted into dextrine and by continuing the ebullition glucose or grape sugar is produced. Malt, as well as putrescent animal matter, are endowed with the same transforming power; I shall return to this subject by and by. In the mean time I wish to proceed with the different varieties of granular starch. I say granular, because the vegetable principle under consideration is not amorphous and structureless but bounded by curved lines and possesses a definite form. When these granules are examined microscopically, they are observed to bear the following structural composition:—internally concentric layers of starchy mass covered externally by a loose membrane thrown into transverse rugae; this integumental envelope, by the physical law of endosmosis imbibes moisture when placed in hot water and unfolds itself so that the granule not only contains the aforesaid starchy mass but also a certain quantity of water. There is generally a small aperture called the hilum situated at one end of the granule, the presence, size and shape of which materially assist the microscopist in determining any given variety of starch. The size of the granules likewise varies exceedingly; some of the Canna or tobacco.
being about \(\frac{2}{3}\) of an in. in diameter, those of the potato are somewhat smaller, but the grains become larger as the plant increases; those of the arrow root do not exceed \(\frac{3}{4}\) of an inch, those of the wheat starch are more circular and about \(\frac{3}{4}\) of an in. in diameter and do not exhibit rings, those of rice are angular and often adherent to each other, they do not usually exceed the \(\frac{3}{100}\) of an inch, while those contained in the root of the best are smaller.

(Miller's organic chemistry)

The different varieties of starch, their physical properties, adulterations and uses.

Maranta arrow root. This variety of starch is prepared from the subterranean stem (Rhiizome) of the Maranta arundinacea and the M. indica - native trees of America and the West Indian islands. It is a snow white, light and glistening powder and is generally brought to this country packed in tin cannisters. When the granules are examined with the microscope, they are found to be usually more or less oblong or oval, but sometimes mussel shaped, or even almost triangular; they vary considerably in size, but each of the larger granules is marked by a number of delicate concentric lines, at the broad or larger extremity of each a distinct spot is visible, ordinarily considered to be a cavity and denominated the hilum.
spot is sometimes circular, but most frequently is seen as a short sharp line running transversely across the granule; it furnishes a most distinct feature by which Maranta arrow root may be at all times very readily identified. (Note)

Potato starch, wheat and rice, canna and tapioca starch and Arrowroot Arrow root are either substituted for genuine arrow root (Maranta arrow root) or are fraudulently mixed with it in various proportions. Potato starch or as it is sometimes called in the market "potato arrow root" can only be detected by an optical examination. The granules vary greatly in size and shape; some are very small and circular, others large, oval or oyster shaped. The larger granules exhibit numerous very distinct concentric rings, and the hilum which is small but well defined is situated in the broad extremity of each granule; not unfrequently granules may be observed of an oval form, divided by a fine line into two portions or segments each of which is provided with a hilum. We have noticed the same form of granule in some of the other arrow roots particularly the Tacca species. (Note) The granules of wheat and rice may be detected as follows: the former by their circular shape and above specified diameter, the latter by their angular shape, adherence to each other and small size (500 if min.) Taro granules are described at page 63. Cannatstarch, arrow root or Tousles moirs is a variety of starchy matter
exported from the West Indian Islands, it is obtained from the Canna coccinea. Its microscopic appearance is similar to that of potato starch, but the granules are generally somewhat larger.

Tapioca. When the crushed tubers of the Manihot esculenta are placed in water, the contained starch is washed out. It is then exposed to heat on iron plates and converted into irregular masses resembling dried curd; this is tapioca. Most of its granules are ruptured while undergoing the drying process, but when unbroken they may be distinguished by their size, form and other characters which resemble those of Taccia arrow root but are considerably smaller, with a larger proportion of granules which exhibit a circular outline as seen in the field of the microscope. The hilum is usually fissured. Even tapioca is often manufactured from, or adulterated with, potato starch.

Portland Arrow root is a variety of starch obtained from the tubers of the Drum. In calculation the granules are very small—smaller even than those of Taccia and are almost if not wholly destitute of concentric rings.

There is a variety of Arrow root prepared by the South Sea Islanders from the rhizome of the Taccia Americana, or is a white starch-like powder, having a slight gummy action. The granules resemble somewhat those of Taccia.
meal, but are very much smaller; when viewed sideways they are smaller-shaped with truncate or dihedral bases and when seen endways they are circular and occasionally angular or polyhedral. The rings are few and indistinct and the hilum circular, sometimes fissured in a stellate manner. This kind of arrow root is not usually met with in this country. (Lanceet)

Cicumca or East Indian arrow root is the produce of the curcuma angustifolia; under the microscope the granules appear elongated and are irregularly ovate, being flat they present but little lateral shading; the lines which mark the surface are tolerably distinct but they describe segments of circles only; and the hilum which is usually very indistinct and sometimes invisible is placed at the narrow extremity of each granule; in size the particles vary considerably, but many of them much exceed the largest contained in Naranjito arrow root. (Lanceet).

Sago. This amylaceous substance is principally procured from the pith of the Sago palm, G. gigantea, and G. Pumilii; some of those trees when full grown yield as much as 500 or 600 lbs. of sago meal; for such is the name given to the starchy matter separated from the fibrous structures forming the medulla. The granules of sago meal are of considerable size; they are either ovate or
somewhat mullet-shaped, rounded at one extremity, the other being truncated or else terminating in a conical summit. The hilum is placed in the larger and rounded part of the granule, is usually surrounded by a distinctive ring and is circular, cracking frequently in a radiate manner (Lancet 1857). From this meal two varieties of pearl sago are manufactured, one consists of small faintly yellow, the other is brown or fawn-coloured, grains, both of which emit a peculiar musty odour. The finer kind of pearl sago is not un frequently adulterated with granulated potato starch, this sophistication may be readily proved by means of a microscope examination.

Dietetical uses. Arrow root, sago and tapioca are all valuable as food and agreeable to the palate when cooked, but at the same time it ought ever to be remembered that none of them have the power of producing vitalized animal tissues, so that they are incapable of taking the place of foods more immediately connected with the formation of muscular-fibrous textures. They are very easily digested, but it is necessary that they should be boiled long enough to burst the starch granules or the latter may traverse the whole alimentary canal without being acted upon by the fluids (saliva and pancreatic juice) secreted for the special purpose of aiding their absorption. When intended for recently weaned children, they ought to be prepared with
milk and a little lime water should be added; the latter has three very obvious benefits attending its use; first, the prevention of diarrhoea, which is not an unfrequent attendant upon a change of diet; second, the correction of acidity depending upon fermentation of the food; and third, the introduction of the salts of lime into the system. For invalids, convalescents, and those predisposed to, or actually suffering from, gastric, intestinal irritation, inflammation, ulceration and other acute affections, they are very serviceable not only as demulcents, but digestive agents. Dr. Beaumont found that boiled sage was digested in 1 hr. 45 min. and tapioca in 2 hrs. Whilst passing along the alimentary system, starch is converted into soluble grain sugar, and as such absorbed; the purposes which it afterwards serves in the economy will be alluded to when I come to speak of the employment of sugar dietetically.

Sugar. Of this alimentary principle three varieties are usually described viz. cane sugar, grape sugar, glucose and treacle or uncrystallizable sugar.

Cane sugar. This term is not restricted to that variety of sugar obtained by the evaporation of the juice expressed from the sugar cane as its name would seem to imply, for it occurs as a constituent of the juice of the cassava, turnip, beet root, maple, cereal and other graminaceous
plants. Cane sugar consists of hexagonal oblique prisms soluble in water and alcohol. It is converted into grape sugar when exposed to the action of boiling sulphuric acid (diluted) or diastase. A strong heat reduces it to the state of a fine powder called caramel—a substance used for bestowing colours upon beer, porter &c. The chemical composition of cane sugar is C_{12} H_{22} O_{11}, so that 3 eqs. of water are required for the production of grape sugar (C_{12} H_{14} O_{11}). It is met with in the commercial world as raw and loaf sugar, each of which is frequently much adulterated especially the cheaper sorts.

The adulterations of sugar and their detection.

Water is often present in greater or less abundance; it may be very readily detected by tying up the suspected sugar in several sheets of bibulous paper, the moisture is attracted from the sugar which consequently loses weight in proportion to the quantity of water extracted. This adulteration chiefly occurs in raw sugar. Grape sugar is almost invariably present in raw, and even occasionally in loaf sugar, but in neither case is it to be looked upon as an intentional adulteration for a small quantity of cane sugar is converted into glucose while undergoing the manufacturing processes necessary for its preparation. It is however often purposely added by unprincipled
dealers, being extensively prepared from potato starch for that unlawful and nefarious practice. A proximate idea may be formed of the quantity of glucose present by the bulk of the precipitate thrown down or the depth of the colour produced by Fronmier's test, compared with some other adulterated specimen of sugar in which the amount of glucose is known. Granules of starch, when such a means of purification has been adopted, can be ascertained to exist with great certainty by means of the microscope. When a large quantity of starch is present iodine affords an infallible test. Portions of the sugar cane, wood fibre are usually met with in raw sugars, they can only be detected by the microscope under which they appear as representatives of vegetable structures.

A minute animalcule (Acarus sacchari) is always present in raw sugars, sometimes they are in great multitudes; a microscopical examination can only satisfactorily detect these little creatures. Lead is sometimes present in loaf sugar, sulphured hydrogen gives a black precipitate in the solution and Hydride of Potassium throws down a rich yellow precipitate of the iodide of lead. Lime being used in the manufacture of sugar, occasionally occurs in some specimens; it may also be in the form of Carbonate or Sulphate. Silicious substances are very generally added to the lower priced sugars to
fraudulent merchants, they may be recognised by their excessive insolubility in most reagents.

Grape or Fruit sugar—glucose—is the sweetening principle of honey and of fruits. It is produced by the action of diastase or diluted sulphuric acid on starch, cellulose, through the instrumentality of a certain number of equivalents of component water, thus starch and cellulose (C₁₂ H₂₀ O₁₀) enter into combination with 4 equivalents of water and form glucose (C₁₂ H₂₂ O₁₁). Glucose is a crystallizable compound, but the crystals are neither so well formed nor so distinct as those of cane sugar, though it is much less sweet to the taste. It is soluble in water and alcohol and converted into a brown pasty mass (if not dissolved) by the caustic alkalies. These characters will not however permit by distinction glucose from other kinds of sugar, so that we are compelled to search for a confirming test upon which more reliance can be placed. Frommer's test admirably suits this purpose; it is performed as follows:—

Dissolve a little grape sugar in water and to the saccharin solution add 1st a small quantity of solution of copper and 2nd caustic potash in excess which redissolves the precipitate. Then boil the mixture when a beautiful, ruby red colour is produced in the liquid; this is a test elegant not only for its simplicity, but for its delicacy. There is a sugar found in
milk (sugar of milk or lactone) which stands in a state of isomerism to glucose and therefore deserves no further notice.

Treacle - a fluid which drops from the casks mouldose in which raw and refined sugars are prepared - remains in a fluid state by reason of its resisting all the laws of crystallography. It has the colour of tar, is clammy to the touch and sweet to the taste.

Diethylcine uses of sugar. I have already stated that all the starchy elements of our food are converted into cane sugar or glucose before they can enter the lacteals. I have only to add that the cane sugar which we consume undergoes a like metamorphosis.

All the varieties of sugar are easily digested with the exception of treacle and for this reason brown sugar whose grains are always covered over with a layer of that uncrystallizable substance, proves more burthensome to the digestive organs of some persons, and is more apt to damage them than the finer kinds of sugar.

Early decay of the teeth, to which some individuals are subject, has frequently been attributed to the too free use of sugar, but this is merely a popular error - the offspring of a device employed by parents as a terror to children. The belief has however gained ground and children are deterred from taking partaking of an article not only not deleterious, but absolutely beneficial to their
nutrition and growth. As a proof that sugar does not tend to spoil the teeth, I may mention that no one has whiter and sounder teeth than the native negroes who consume vast quantities of that which European mothers pronounce as a dangerous and destructive article. We cannot however assert that sugar at any time produces any bad effects, for certain it is, that reason of its unstable nature, it may undergo fermentation in the stomach, where every condition favourable to the occurrence of that process exists, and produce annoying and distressing symptoms. The compound resulting from that fermentation is generally lactic acid, but alcohol and acetic acid are liable to be generated.

After grape sugar is received into the circulation it may serve two purposes, viz.: It may either be directly oxidized and burned, or it may be transformed into fat; when a moderate quantity has been received into the system, the former result takes place, but when more than that which is sufficient to sustain the respiratory function has entered the body, the excess is formed into fat and deposited in the cellular tissue until required for the formation of heat at some future period.

The manner in which glucose produces animal heat is very easily explained. It is first reduced to the state of lactic acid (C\(_6\)H\(_{12}\)O\(_6\)) by undergoing a kind of intravascular fermentation. This acid is nothing more than a compound of 12 equivalents of Carbonic Acid, each equivalent of which has
one equivalent of oxygen replaced (according to the laws of sub-
stitution) by one of hydrogen. Hydrogen, having a much
greater affinity for oxygen than carbon has is acted upon
by that element (oxygen) in preference to the carbon of the lactic
acid; one atom of oxygen entering into combination with one
of hydrogen forms an equivalent of water, while anther atom
goes to occupy the place which the hydrogen has just vacated.
24 cgs. of oxygen will thus be required to convert 1 cgs. of
lactic acid into 12 cgs. of Carbonic acid and 12 cgs. of water.
During the performance of these chemical processes as much
heat is evolved as if lactic acid was subjected to the same
reducing operation in the laboratory, lecture room or in
our parlour fires.

We must now turn our attention to the formation of
the oleaginous compounds from sugar. We must admit that
this takes place for the negroes during the sugar harvest
become very fat (notwithstanding their severe labour);
animals also when well crammed with starchy matters
become loaded with adipose tissue, but as this has been
already spoken of I need not here enlarge upon it. I
will only add that it has been experimentally proved by
gyandlack that bees when fed on nothing but pure sugar
secrete about 1 lb. 17 oz. wax (an oleaginous substance) for
every 20 lb. of sugar consumed.
Human fat consists of as will be hereafter shown (page 168) of margaric acid \((C_{34} H_{33} O_5)\) united with oxide of glycerine \((C_3 H_2 O_3)\), the compound being called margarine. It is formed from sugar by a process of decrystallization, thus:

\[
17\text{ eqs. of grape sugar } (C_2 H_4 O_14) = C_{204}, \ #38 \ 238 = \\
6\text{ eqs. of marginic acid } + 34\text{ eqs. of water } + 180\text{ eqs. of oxygen*} \\
6\text{ eqs. of sugar } (C_2 H_4 O_14) = C_{72}, \ #84 \ 084 = \\
12\text{ eqs. of oxide of glycerine } + 36\text{ eqs. of water } + 60\text{ eqs. of oxygen*} \\
\]

Stearine another animal fat chiefly found in the ox and sheep is composed of stearic acid \((C_{36} H_{35} O_7)\) and oxide of glycerine. Its production may be explained in the following manner:

\[
6\text{ eqs. of grape sugar } (C_2 H_4 O_14) = C_{72}, \ #84 \ 084 = 2\text{ eqs. of stearic acid, } \\
+ 12\text{ eqs. of water } + 64\text{ eqs. of oxygen*} \\
1\text{ eq. of grape sugar } (C_2 H_4 O_14) = 2\text{ eqs. of oxide of glycerol } + \\
+ 6\text{ eqs. of water } + 6\text{ eqs. of oxygen*}. \\
\]

* The oxygen is not expelled from the body but enters into combination with carbon and hydrogen or assists in transforming the nitrogenous compounds into uric acid etc.

Now pass on to a very important subject, namely.
The fermentation of sugar and the compounds which
that fermentation gives rise to.
Before proceeding to speak of fermentation it is necessary
for one to state, that the cereal grains as well as all other seeds
are compounds of starch, sugar and gluten with a small quan-
tity of salts, the latter of which may be altogether discarded
as they play no part in the chemical process to which I am
giving direct attention.

When a seed is deposited in the earth and covered over
with mould, changes take place in it by virtue of which the
rudiments of the future plant are stimulated into action,
and proceed to the formation and development of a perfect
organism and independent organism; we here very
naturally ask ourselves two questions: how is this
marvellous phenomena brought about, and what change
have been produced in the field by its occurrence? After
the inanimate seed has been in the ground for a certain
period exposed to the heat of the sun, and surrounded by
abundance of moisture, (conditions favorable to putrefac-
tion), the gluten, being a nitrogenised compound and
therefore very liable to undergo decomposition, is con-
verted into diastase, now as this compound is hasten-
von to ulterior changes, its atoms are in a state of
motion and capable of communicating a like motion.
to the atoms of other complex and unstable compounds. I have mentioned that starch is a constituent of all seeds. It is the principal substance acted upon by the fermenting gluten. Dextrase gives such an impulse to the atoms of the starch that cause them to enter into combination with 4 cogs. of water and produce grape sugar thus:

1 cog. of starch $\ldots\ C_{6}H_{10}O_{5}$

4 cogs. of water $\ldots\ C_{4}H_{4}O_{4}$

1 cog. of grape sugar or glucose $C_{6}H_{12}O_{6}$

Before however this final change is effected an intermediate white, tasteless, and gummy substance is formed, termed Dextrine, it is merely starch masked with peculiar and new properties, and readily passes into glucose. The reason for such changes, as I have described as occurring in the germinating seed, is very obvious, for until the starch is rendered soluble in water it cannot contribute to the nourishment of the embryo-plant, but the moment it assumes the form of soluble sugar, the cells of the plant readily absorb it and make it available for their growth and development. The chemical changes which occur in 100 parts of barley during malting are the following, according to Dr. Thompson:
<table>
<thead>
<tr>
<th></th>
<th>Unmalted barley</th>
<th>Malted barley</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resin</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Gum</td>
<td>4</td>
<td>15</td>
</tr>
<tr>
<td>Sugar</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>Gluten</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Hordei</td>
<td>32</td>
<td>56</td>
</tr>
<tr>
<td>Hordein (a peculiar)</td>
<td>55</td>
<td>12</td>
</tr>
<tr>
<td>Kind of Hordei</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Brewers and distillers take advantage of the method for obtaining glucose—vast quantities of which are required to carry on their respective trades. They steep barley, wheat, oats, or any other grain greater small in water for a certain time. They then spread the swelled and moistened seeds upon a floor and allow them to commence germination during which period the gluten, having been attacked with putrefactive decomposition, converts almost the whole of the starch into glucose; but as this soluble material would be assimilated by the vitalized soul, the manufacturer cognizant of the fact, applies heat to the sprouting seeds and thereby puts an end to all absorption and other functions inherent in the tender plants by which they might destroy the sugar and thus rob him of that which he has obtained as a reward for his labour and diligence. The dried grain is denominated malt; it is crushed and in
fused in boiling water, which dissolves out various matters including sugar and a little dextrine. Yeast—a fluid containing gluten in a decomposing state—is now added for the purpose of effecting the fermentation of the sugar. Sugar is a compound not liable to undergo any kind of decomposition when pure, but when brought into contact with the moving particles of yeast, the equilibrium of its component atoms is readily overbalanced, and its elements separate from each other to unite into compounds of a simpler and more lasting composition. Alcohol (C₂H₅OH), Carbonic Acid (CO₂), and water (H₂O) are the derivatives thus produced, their formation may be easily understood by the assistance of the following table:

<table>
<thead>
<tr>
<th>1 Eq. of grape sugar or glucose</th>
<th>C₉H₁₄O₇</th>
<th>8.12.4</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Eq. of Alcohol</td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>yields</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>2 Eq. of Carbonic Acid</td>
<td></td>
<td>4.8</td>
</tr>
<tr>
<td>2 Eq. of water</td>
<td></td>
<td>2.2</td>
</tr>
<tr>
<td>Grape sugar</td>
<td>12.14.14</td>
<td></td>
</tr>
</tbody>
</table>

Much Carbonic Acid is evolved during the time that the fermentation is proceeding in the vat; the Alcohol and water are on the contrary diffused through the infusion, the former on account of its volatility can be distilled from the other liquid, but a quantity of water passes over even with the first portions from which it is


alcohol) can be separated by saturating the products with quicklime and repeatedly distilling them. The spirit thus obtained is called Absolute alcohol. It is a mobile, transparent and colourless fluid with a fragrant peculiar smell and a strong acid taste. Its specific gravity is 0.796 according to the Edinburgh pharmacopoeia and 0.795 according to that of Dublin. When this liquid is diluted with about 30 parts per cent. of water it constitutes proof spirit of density 0.920; when only 15 or 20 parts of alcohol and water are added it is termed rectified spirits. As these preparations do not come under the category of aliments I may pass them over without any further remarks.

Alcohol however forms the active principle of many aperient aliments (for I am compelled to call them aliments for reasons which will be hereafter adduced) some of which have been in use since the days of patriarchal boast. The proportion of alcohol in the different alcoholic liquors in common use is subject to great variation not only in different samples but according to Prof. Christian in the same sample at different times. Some consist almost entirely of alcohol and water, others have combined with these principles colouring matters and flavouring ingredients which confer peculiar and characteristic impresions upon the liquors containing them; but in either
case the alcohol is the active alimentary agent and for this reason I will describe wine, porter ale in this place rather than among the compound aliments.

I may conveniently divide the alimentary products of fermentation into two classes viz. The strong alcoholic and the weak alcoholic liquors.

The strong alcoholic liquors.

Definition. Those liquors which contain not less than 50 per cent of alcohol of density 0.825 at 60°, including Gin - Whiskey - Rum - Brandy -
Percentage of alcohol of gr. 0.825 at 60°. contained in each by measure according to Brandy.

Gin, 57.60 per cent.
Whiskey (Average), 54.11 "
Rum, 53.68 "
Brandy, 53.39 "

Gin is merely an alcoholic solution containing as a flavouring ingredient oil of Juniper; the presence however of this latter substance confers upon gin marked diuretic virtues which render its use advantageous in persons of fusions depending upon function derangement of the renal organs, but on no account should its administration be attempted or persisted in, in albuminuria and other organic diseases, for not only
would its employment not be productive of beneficial results, but would be found with manifest and irretrievable damage. Pereira states in his treatise on diet, that gin has emmenagogue properties insofar as it favours the catamenial flow, but I doubt very much whether it has such effects upon the uterus and its appendages for no class of the community is more addicted to its use than the denizens of our Close and waists and certainly there is no class more subject to amenorrhoea.

Adulterations. Genuine gin as was formerly manufactured in Holland only contained alcohol and oil of juniper, but(48,81),(893,937) the pots made in this country are extensively adulterated with flavouring and aromatic materials, most of which are harmless but some few may be reckoned as poisonous and dangerous to the life of the consumer; of the former, I may mention sugar, the active principles of coriander seeds, angelica root, grains of paradise and orange peel, cinamon and cinamom, of the latter the active principle of almonds (Prussic Acid) sulfate of ginie and acetate of lead. The means of detecting the last three sophistications need only be given as the others are comparatively innocent.

Prussic Acid may be detected in the following manner:—To a quantity of gin add an excess of caustic potash which
combines with the Acid if it be present, and forms cyanide of Potassium, evaporate the mixture down to one half of its original bulk, and add Muriatic Acid in sufficient quantity to liberate the Prussic Acid from the Potassium. Then add a drop or two of Oxylavide of Ammonium and heat the fluid until it becomes clear, during this manipulation Sulpho-cyanide of Ammonium is produced, which when acted upon by a solution of here chloride of iron instantly becomes blood red. Mitchell in his work on the Titration of Food (page 143) describes another process by which prussic acid may be detected, but I have not been able to obtain such satisfactory results by following his directions in attempting to test a specimen of gin which I intended by adulterated.

Sulphate of Zinc. This salt may be detected by pouring a small quantity of the suspected gin into a test tube and adding caustic to which precipitates the zinc as a white hydrate soluble in an excess of the caustic solution; the cleared solution add sulphuretted hydrogen and a white flocculent precipitate is instantly thrown down. Caustic potash of gin. To another portion of gin in a similar tube add Chloride of Barium, a heavy white powder falls down which resists the action of boiling nitric acid and the decomposing influence of heat.
Lead is occasionally present in gin as well as other spirits.

liquors, it may be detected by the heated hydrogen giving a black precipitate and iodide of mercuric a rich yellow one, when the latter deposit (iodide of mercuric) is dissolved by the aid of heat, it reappears on cooling in the form of beautiful glistening crystals which are very liable to allostronic modifications.

Whiskey is prepared from an infusion of malt by distillation. Its peculiar flavour and odour depend upon the presence of aromatic volatile oils which distil over with the spirits. Whiskey exerts on special effects upon the system, therefore any remarks made upon alcoholic liquors in general will likewise apply to it.

It is rarely adulterated with any deleterious poison but frequently contains pungent acid substances similar to those mentioned as being added to gin; they may be detected in a rough way by evaporating the liquor to dryness and ascertaining by the sense of taste whether the residue (if any is left) possesses the characteristic flavour of any of these substances.

Rum is distilled from molasses and the uncrystallizable saccharine solutions. It besides producing the general physiological and pathological effects of alcohol, acts more decidedly upon the cutaneous capillary circulation.
causing perspiration, and a pleasant glow over the surface of the body. Rum is said to be difficult of digestion and particularly liable to derange the hepatic organs. The last assertion appears to be supported by facts, for persons who have habitually taken large quantities of rum very commonly complain of biliousness; however, put very little faith in that epithet which is indiscriminately used to designate every variety of vomiting, attended with a blackish or bronchial appearance of the matter ejected from the stomach. On the contrary, attach great weight to the term when a physical examination clearly demonstrates hepatic disease and this have observed in some few cases which have come under my observation.

Brandy is distilled from the fermenting juice of the grape. It contains besides alcohol, water and ethereal ether (upon which its fragrant odour depends) "methylic, pro-phylic, butyric, anhydride, and some capric alcohol." (Gregory); acetic and tannic acid are also present in it; the former is produced by the action of a minute quantity of alcohol and the latter is dissolved out of the staves of the casks in which the brandy is preserved.

Brandy is very frequently adulterated with quinoline, caramel, lead, copper, hydrocyanic acid, and vegetable substances of a similar nature to those used for the con-
temination of the other strong Alcoholic liquors; moreover since the failure of the wine or its Brandy is sometimes artifically made by adding venemous ethereal or corn spirits. When Alcohol obtained from corn has been intentionally added to brandy or when the brandy itself is of British manufacture the fraud may be detected by testing for the oil of grain which such spirits almost invariably contain. The test given by the Edinburgh Pharmacopoeia is the following: four fluid ounces treated with 24 parts of nitric acid for 24 minutes, of solution of nitrate of silver (one grain to 24 grms of water) exposed to bright light for 24 hours and then passed through a filter purified by weak nitric acid, so as to separate the black powder which forms, undergo no further change when exposed to the light with more of the test. Caramel is added to new brandy or the manufactured varieties to give them a brown colour in imitation of the hue derived from the tannin of the cask; the latter when acted upon by sulphate of iron instantly becomes of an indegustable while the former has no such reaction upon the iron. The tests for ascertaining the presence or absence of the other impurities have been before mentioned.

Brandy by common consent is allowed to be more easily digested than any of the other Alcoholic spirits, why it is so I am unable to say nor am I aware of any explanation
Having been offered upon the subject. It is of great service in flatulent colic, vomiting, and other function derangements of the stomach for the cure and prevention of which it is much more preferable to either whisky, gin or rum.

The Weak Alcoholic Liquors.

Definition. Those liquids which contain less than 60 per cent of alcohol if sp. gr. 0.825 at 60°. Including Wines and Beers.

Percentage of Alcohol if sp. gr. 0.825 at 60°. Contained in various liquids coming under this division by measure, according to Brande.

- Port wine (average) ... 22.96 per cent.
- Madeira (do.) ... 22.27 "
- Red (do.) ... 20.57 "
- Cape (do.) ... 20.35 "
- Sherry (do.) ... 19.17 "
- Claret (do.) ... 15.10 "
- Burgundy (do.) ... 14.57 "
- Champagne (do.) ... 12.61 "
- Rock (do.) ... 12.08 "
- Gooseberry (do.) ... 11.84 "

Cider (highest average) 9.87 "
- (Sweet do. 5.21 "
- Perry (average strength) 7.26 "
Wines are prepared by fermenting the expressed juice of the grapes and other fruits. During the process much carbonic acid is evolved; in some wines (Champagne for example) a portion of this gas is retained in the liquid so that they effervesce when exposed to the air. The alcohol after it is generated dissolves out the chlorophyll and astringent vegetable principles contained in the skins of the fruits and thus produces coloured wines; but when the husks are removed from the fermenting vats little or no colour is given to the product and it is termed a white wine. The quantity of alcohol present in wines greatly depends upon the locality from whence the wine is produced, the period of the vintage, state of the weather and also in some cases upon the age of the wine itself. The characteristic bouquet of wine is due to the quantity of vanillin and ether contained in it. Acids are always present in greater or less abundance in all wines some of them are combined, others free. If the former is greater than the latter, the wine is termed a claret; if the latter is greater, the wine is termed a sherry.
in which vinous liquors are manufactured and season-
ed, it is termed arséot and is a fruitfat source of Tartaric Acid; if the latter is considered Acetic Acid formed by the oxidation of Alcohol, Malic Acid derived from the fruit and Carbonic Acid from the decomposition of Sugar. Astringent principles such as Tanoric Acid and Gallie Acid are for the most part confined to coloured wines, upon which they bestow a rough taste, Sugar is another constituent of some wines, its occurrence is due to the conversion of Sugar into Alcohol and Carbonic Acid.

The foreign substances which ought not to be ranked among the normal ingredients of wine are numerous. Those which are likely to fall under the observation of the physi- cician and which he ought to be prepared to detect are Lead, Arsenic, Copper, Alum, and various vegetable colouring principles, to each of these I propose to direct attention and first of all of Lead. Lead is occasionally added to wine for the purpose of correcting its acidity when part of its Alcohol has passed into Acetic Acid. The alcohol, after combining with the acid becomes stable and is swallowed by every unfortunate who partakes of this doctored wine. The constitutional effect of Lead—saturnian colic, and paralysis of the extensor muscle of the hand—soon manifest themselves.
and place the individual's life in jeopardy unless the exciting cause is speedily removed. Lead may also occur accidentally by being derived from the leaden apparatus in which sometimes are prepared. It may be detected by the following process: Evaporate a quantity of wine to dryness, put the residue into a crucible and heat it until the organic matters are charred, after which it is to be mixed with about twice its weight of nitrate of Potash and again strongly heated. Dissolve the contents of the crucible in weak nitric acid and filter the solution, after which divide it into 5 portions, each of which gives the following reaction with different reagents.

**Test**

<table>
<thead>
<tr>
<th>Test</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Hydrochloric Acid</td>
<td>A white, curdy precipitate, soluble in a large quantity of water, a little blackened and dissolved by caustic potash.</td>
</tr>
<tr>
<td>2. Diluted Sulphuric Acid</td>
<td>A white precipitate.</td>
</tr>
<tr>
<td>5. Iride of Muriatic Acid</td>
<td>A beautiful yellow precipitate.</td>
</tr>
</tbody>
</table>

Arsenic when present is always fraudulently added for the purpose of conferring a specific taste upon wines more especially port. An extensive and perhaps for that very reason a trustworth merchant in the eye of the public, confessed upon his death-bed that he had seen many of his customers die a premature death from the poisonous effects of the
arsenical compounds with which he had drugged his much-loved wines. This sophistication may be detected by treating a quantity of wine in a similar manner as for the detection of lead, until the precipitate comes to be dissolved when instead of sulphuric acid, caustic potash is used. The solution is divided into 3 portions and treated as follows:

Test:

1. Sulphur Test:—\[\text{Just coloured on the addition of sulphuric acid, but upon the addition of a few drops of hydrochloric acid a bright yellow precipitate is thrown down soluble in caustic nitre.}\]

2. Silver Test:—\[\text{Ammoniac nit. & silver produces a white yellow arsenite of silver readily soluble in caustic ammonia.}\]

3. Copper Test:—\[\text{Ammoniac sulphate & copper gives Scheele's green, soluble in caustic ammonia.}\]

Besides these tests there are Marches and Reinschs processes for the application of which I must refer to toxicological works.

Copper may be easily detected in wines by first acidulating by first it with hydrochloric acid and then immersing a plate of clean iron into the suspected liquor, if copper be present a coating of that metal will be deposited upon the iron plate. The test may be further confirmed by decolorizing a quantity of wine with animal charcoal, evaporating the clear solution, dividing it into 3 portions and testing as follows:
Test:

Sulphuret of Ammonium

Ammonia

Yellow Prussiate of Potash

Alum. For the detection of this salt a portion of wine is decolorized and evaporated to about one-fourth of its original bulk; the liquid, after being poured into test glasses, is treated with the following reagents:

Sulphuret of Ammonium

Ammonia

Test:

Sulphuret of Ammonium

Ammonia

Divide the liquid cleared by excess of potash into 2 portions and proceed with the following tests:

Sulphuretted Hydrogen

Chloride of Ammonium

Vegetable colouring matters which are added to darken natural wines to give them colour and to artificial wines to make them resemble the best red wines may be detected according to Mr. Nees van Esenbeck by preparing two solutions: one of one part of alum in eleven parts of distilled water, and the other, one part of Carbonate of potash in eight parts of water. The wine to be tested and the solution of alum are to be mixed in equal bulk and the solution of Carbonate of potash gradually poured in, taking care to decompose the
whole of the alum. The alumina, during precipitation unites with the colouring matter of the wine and furnishes with that which is normal a dullish grey, but having a more or less decided red tinge. An excess of alkali re-dissolves a portion of the precipitate rendering the remainder ash-grey. In new wines, the precipitate formed under the before-mentioned circumstances receives a greenish tinge with excess of potash. According to M. Nees von Essenbeck, red wines artificially coloured present with the same agents the following characters:

Wine coloured with red hollyhock petals gives a brownish grey precipitate which becomes black by an excess of alkali.

Wine coloured by privet berries gives a brownish violet precipitate.

Wine coloured by elder-berries, a violet precipitate; hydrazil wood a greyish violet; and logwood a rose coloured precipitate (Mitchell)

Dietetical uses of wine. "Wine, when used in moderate quantities, as to the extent of two or three glasses daily, proves a very grateful and in those who have been accustomed to it an almost indispensable stimulant. It quickens the action of the heart and blood vessels, diffuses an agreeable warmth through the system..."
promotes the different secretions, augments the muscular force and activity, excites the mental powers, and banishes unpleasant ideas and reflections (Pereira).

In all cases of languor following severe exertion wine is very beneficial (more especially in those whose vital powers are below par); effects are produced by wine similar to those which follow the use of other alcoholic liquors. Some individual wines however possess peculiar properties. Champagne on account of the large quantity of Carbonic Acid contained in it, has a soothing action upon the Mucous membrane of the stomach in virtue of which it arrests and prevents vomiting— it is a tonic; it also contains less organic insoluble matters than the other wines, it is therefore more easily digested and better suited for those who are troubled with dyspepsia and a natural weakness of the digestive organs; it is also very valuable in gastric fever. Port wine on the contrary is apt to cause loathing, sickness, and vomiting; it by containing a large quantity of Tannin does not only has an astringent effect upon the mucous membrane of the stomach, but coagulates and precipitates the active albuminous principle of the gastric juice, by which digestion is seriously interfered with. I have found it very useful in atomic infantile diarrhea which have fallen
under my notice. Sherry, Càrlet and Madeira are all very digestible when pure and unadulterated.

Beer (including under this term Porter and Ale) is prepared by fermenting an infusion of malt impregnated with the bitter ingredient of hops. This is of a pale or dark brown colour; according to the degree of roasting to which the malt has been subjected. Beer contains a smaller quantity of alcohol than any of the other intoxicating liquors and that its narcotic properties are much inferior to those of either wine, whisky, brandy, rum or gin. It however possesses superior aromatic and tonic qualities on account of the volatile oil and lupulins derived from the hop. A considerable amount of extractive matters consisting of unfermented sugars, gluten, Albumen and fats exist in beer, and according to the nature of the malt and to which it is subjected, they make it more or less diastatic. Carbonic Acid is present in most beers, but its quantity is liable to great variation.

Adulterations. Common Salt (Chloride of Sodium) is generally to be found in most kinds of beer, it can readily be detected by adding a solution of nitrate of silver to the suspected liquor, when a heavy, curdy, white precipitate is formed. This precipitate is insoluble in Caustic Ammonia, but is not acted upon by heat nor dissolved by dilute nitric acid. Iron in the form of sulphate is frequently added to beer for the purpose of giving it a dark colour and making it frothy. It may be detected
by decolorizing, filtering, dividing the fluid into portions and applying the following tests:

**Test**

1. Add nitric acid and boil the precipitated liquid, after which
   - Result: Russian blue
2. Barstic Ammonia
   - Result: a dirty green precipitate upon standing and turning yellow becomes reddish.
3. Sulphured Hydrogen
   - Result: no precipitate, but a thin deposit of sulphur.
4. Sulphide of Ammonium
   - Result: gives a blackish precipitate.
5. Carbonate of Potash
   - Result: a white precipitate which becomes reddish on standing

Copper and lead are sometimes contained in beer, their detection may be accomplished by following the rules herein.

Opium and Opiotoxin (the poisonous principle of Conium cicuta intoxicans) are occasionally added to beer to increase its intoxicating properties, unfortunately they are difficult to detect, which renders the sophistication of giving frequency than would otherwise be practiced by unprincipled dealers.

**Dietetical Uses of Beer.** Beer, besides producing the usual stimulating and intoxicating effects of alcohol, gives tone to the digestive organs by virtue of its tonic principle — sulphite. It is a well-known fact that those who drink beer in moderation grow fat, this can either take place
from the alcohol, sugar or fatty matters held in solution. The unfermented saccharine principles are very apt to commence fermentation when they are received into the stomach; on this account beer often disagrees with those suffering from turgid digestion. In no case should it be prescribed where marked dyspepsia reigns paramount, as it, by containing indigestible substances will not only greatly aggravate the maliy, but will counteract the good effects of medicinal preparations and well arranged dietetical regulations.

Dietetical uses of Alcohol. When a moderate quantity of alcohol, well diluted, is received into the stomach it stimulates it to a certain degree, producing hyperaemia of the mucous membrane, now as this congestive state of the blood vessels is requisite before the secretion of gastric juice can commence, it follows that the gently irritating effects of the alcoholic solution are beneficial rather than otherwise. But some will say that the alcohol does not only induce a hyperaemical state but true inflammation and that the stomach needs no other stimulus except a good hearty meal. I would certainly admit the first objection if Alcohol—pure Alcohol—were the stimulus employed; it would inevitably excite an inflammatory process of no ordinary description, and
perhaps give such a sudden shock to the large nervous
 ganglia in the immediate neighborhood of the stomach
 as to occasion instantaneous death. It will however be
 observed that I did not say pure alcohol, but alcohol well
 diluted and in moderate quantity; it might be with equal
 reason be urged that an individual ought to take no
 salt, pepper, mustard, or vinegar for they are all singu-
 larly and individually powerful and corrosive irritants.
 As to the second objection I am aware that the presence
 of food in the stomach stimulates its capillary vessels to
 increased action, but in many cases where the food is
 a bland and non-irritating nature, the effect produced
 passes off in a very short time, before a due quantity of
 the proper digestive solvent has been secreted; now as a
 remedy for this defective secretion I think stimulating
 condiments amongst which I would class alcoholic
 liquors, should be taken so as to increase the quantity
 of blood in the walls of the stomach - a state favorable
 to the secreting process. I may add that spirituous
 liquors when taken in excess disturb and ultimately
 destroy the digestive process, but this baneful property
does not belong to them alone for many other substances
 yea even the food itself, produce similar results when
 gluttony overrules moderation.
Does Alcohol (diluted) assist digestion by acting upon the food? I am of opinion that it does for it dissolves many of the alimentary principles, viz. vegetable compounds, gluten, and resins; it is also a powerful anti-septic and may assist in preventing the decomposition of organic substances whose comparative indigestibility requires them to remain long in the stomach and alimentary canal.

Alcohol as food. Total Abstainers deny that alcohol possesses any nutritional properties, they remove it from the Materia Alimentaria and assign it a place on the list of poisonous drugs. They arrive at this conclusion by reasoning after this fashion: If a quantity of alcohol is injected into the stomach of an animal it excites morbid actions which destroy the life of that animal; therefore a dose of alcohol, however great, however small, whether taken by the gallon or measured by the scrupulous hand of a homoeopathic publican, is poisonous. By adopting this system of logic we might arrive at the following very strange and startling conclusions: that tea is dangerous and poisonous because it contains its active principle, accelerates the action of the heart, occasions tremors, and marasmos and produces abortion; that beef...
and motion ought to be dephlegmated because when an excessive quantity is received into the system, phlegmon and all its fatal sequels occur; that oxygen is known because the life of a poor unfortunate rabbit continually kept in an atmosphere of that gas is speedily extinguished; that water is poisonous because when taken because taken in enormous quantities it is apt to prove deleterious, by laying the foundation of debile maladies; that in short everything we eat, drink or breathe is poisonous because when taken without any respect to moderation they induce disease.

I don't mean to deny that alcohol has no bad effects when taken in large quantities; far from it, I think that it possesses poisonous properties of its own description, but what I wish to be understood is that it is not poisonous when taken in moderation. If it was as sharp and violent an instrument of death as its opponents would have us believe, our bills of mortality would increase tenfold. Hundreds of men drink five or six glasses of wine after dinner for the greater part of their life and yet live to a hale old age. "Bread and wine constitute a diet resembling milk in chemical constitution" (Bennet). "The quantity of wine consumed upon the Rhine by persons of all ages without perceptible injury to their
mental or bodily health is hardly credible. Gout and calculous diseases are as rare there more rare than in the district of the Rhinegau. In no part of Germany does the apothecaries' establishments bring as low a price as in the rich cities on the Rhine. For there wine is the universal medicine for the healthy as well as the sick. It is considered as milk for the aged (Baron Liebig).

As food alcohol serves three purposes. 1st. It is a stimulant. 2nd. It maintains animal heat. 3rd. It is convertible into oleaginous compounds.

First as a Stimulant Alcohol acts very beneficially, it excites the circulatory system, bestows strength upon the mental faculties, raises the whole frame from the languor and exhaustion following severe corporeal exercises and imparts tone and vigour to the nerves under whose control is placed the whole function of nutrition. As a restorative and as a means of refreshment when the powers of life are exhausted, of giving animation and energy whose source has to struggle with days of sorrow, as a means of correction and compensation where mis-proportion recurs in nutrition and the organism is deranged in its operations and as a means of protection against transient organic disturbances wine is superseded by no product of nature or of art." (Baron Liebig). It is however held by the pr-
ponents of Alcohol that no such stimulant is necessary and that it is prejudicial to health. To this answer that as a certain degree of nervous stimulation is requisite to support the vital powers and to enable the body to perform all its physiological functions with that exactness required by nature for the maintenance of health, Alcohol may as well be used in moderate doses as any other general stimulant. Everyone knows the good effects it has after a severe day's labour whether that labour be more immediately connected with destruction of the nervous tissue or with the disintegration of muscular fibre. After partaking of the daily beverage the whole frame receives as it were a second life and is so much invigorated by the stimulating effects of the tonic, hence that it is able to sustain and endure work for the performance of which it was before incapacitated. No one attributes any ill consequences to such a stimulation although it is certainly not a phenomena brought about by the unaided efforts of nature. A small quantity of Alcohol would as it is well known produce results similar in kind but different only in degree, the excitement caused by the tea being of longer duration than that caused by the Alcohol; it ultimate plunger the body into a state of depression bordering upon perfect narcotism.
2 Alcohol as a heat producer. The chemical composition of Alcohol is, as before stated, C₂H₅O₂, it is therefore rich in uncombined carbo-hydrates and is somehow the more valuable for the production of animal heat. For its oxidation, 32.87 lbs of water are necessary, the products of its decomposition being 4 lbs. of Carbonic Acid and 6 lbs. of water. Teetotallers assert that the heat produced by a certain quantity of Alcohol can be obtained by the employment of food of a more harmless nature, I admit it, but at the same time I cannot conscientiously declare that Alcohol ought not to be used in lieu of a portion of the so-called harmless and innocent aliments—sugar, fat, etc. If an individual feels inclined to take a glass of wine or a tumbler of beer either occasionally or daily, provided that the draught be taken as the part of a meal not as an addition to it.

3 The formation of fat from Alcohol. This is a theory which I believe has not been before propounded, indeed Alcohol has rather been viewed in an opposite light and condemned as an agent which interferes with that process. Certainly an excess of spirits deranges the whole function of the primary and secondary digestion; but what holds good of an excessive quantity cannot
with justice be applied to a moderate dose. We see that those who daily consume a little beer not only become fat but sometimes enormously fat. It may be said that the fatty matters, sugars in the beer contribute to the production of that fat, but I consider that the quantities of these ingredients are too small to account for all the fat deposited in the subcutaneous areolar tissue and internal organs. Those who live almost exclusively on alcoholic liquors sometimes have extensive accumulations of fat in the abdominal walls and visera. Such a case is related by Robertson in his work on diet, page 272. The manner in which I chemically explain the derivation of fat from alcohol is the following:

\[
\begin{align*}
1 \text{ eq. of Margaric Acid} & \quad C_{37} \quad H_{37} \quad O_{6} \\
10 \text{ eqs. of Alcohol} C_{4}H_{6}O_{2} & \quad 2\text{'' of Beides of Copal} \\
= C_{40} \quad H_{50} \quad O_{28} & = 12 \text{ eqs. of water} \\
& = 8\text{'' of Hydrogens} \\
& = 40 \quad 60 \quad 20
\end{align*}
\]

The liver appears to be the seat of this transformation for it is generally loaded with fat in habitual dram-drinkers, and even has its share when beer has been the liquor consumed and besides it has been experimentally proved that the eight equivalents of Hydrogens when in the nascent state are readily acted upon by 8 eqs. of Oxygen and converted into water.
that hydrogen gas is given off by the hepatic organs of animals although it is during the completion of another process viz., the production of fat by the fermentation of sugar.

Alcohol indirectly facilitates the deposition of fat in the body by being more readily oxidized than fat or lactic acid, so that where a sufficiency of alcohol has to be given to compensate for the production of animal heat, the fat or sugar which would have been compelled to produce that heat is not consumed but stored up in various tissues and organs.

Before I have done with alcohol, there yet remains for one one subject to consider and that is, the scriptural arguments against total abstinence. Nowhere in the Bible do we find that wine is denominated a poison nor can we discover that its use was ever prohibited by divine commands. On the contrary, we pretend that our Blessed Saviour attended a marriage feast where wine was drunk and therefore by his presence sanctioned the moderate use of that alcoholic stimulant. Everybody is also aware that when he instituted the holy Eucharist he commanded that wine should be received as an emblem of his meritorious death. Is it likely that he would have pronounced wine to be
necessary and indispensable element of that heavenly feast if it is as the advocates of Abstinence call it, a violent poison. Prof. Miller however in his work entitled "Alcohol its Place and Power" defends the use of those ancient wines by saying that "the ordinary wine of those days was undeniably weak and fruity, little else than the expressed juice of the grapes largely diluting a small quantity of alcohol produced by fermentation in the bottle when opportunity. Such changes. From what source the learned Professor has derived this information I cannot tell, but undeniably he has fallen into an error when he leads us to believe that the primitive wine was incapable of producing a state of intoxication analogous to our modern European vinous beverages, for we read (Gen. Chap. 9) that Noah not only drank and was drunken, but that he was in a state of perfect narcotism. Does this prove that the wine of those days was weak and fruity? We also read (John 2 v. 10) that at first Jesus set forth the good wine first and then that of an inferior quality. Why was this done? Evidently for the following reason: That men might not drink too much good wine and thereby get intoxicated. These two facts obtained from Holy Writ I think sufficiently prove that the passage quoted from the Professor's work is untenable and unfounded.
From what I have said in the foregoing pages, I do not wish it to be understood that I defend the drinking custom of this enlightened country, far from it. I utterly abhor it, and will always support the efforts made by societies for the suppression of drunkenness - the forerunner of horrible diseases, immorality, vice, poverty, and every kind of thought or ignoble deed which fallen man is capable of imagining or performing.

**Acetification**

When a quantity of alcohol is exposed to the atmosphere, no change takes place in its chemical constitution until a body undergoing the putrefactive decomposition is added to it. The atoms of this body being in a state of progressive and communicative to the atoms of alcohol, a tendency to combine with oxygen and to become converted into acetic acid. Thus one equivalent of alcohol (C₂H₅O₂) is acted upon by 8.5 c.c. of oxygen and gives rise to one c.g. of acetic acid (C₂H₄O₂) and three c.g. of water (H₂O). Wine and beer commence this process of oxidation without the addition of any agent as they both contain a quantity of gluten sufficient to effect the change.

Vinegar is a weak solution of acetic acid containing minute quantities of alcohol, acetic ether, tartrates, and colouring matters. There are three varieties of vinegar.
found in the British market: wine vinegar, pyroligneous
or wood vinegar and Malt vinegar.

Wine vinegar is obtained by the acetylation of various
liquors. When it has been manufactured from white wine,
it is a clear liquid, devoid of colour, and is termed white
wine vinegar. When it has been derived from red wine, it
is termed red wine vinegar and is more or less coloured
according to the quantity of colouring matters contained
in it.

Pyroligneous vinegar is got by the destructive distilla-
tion of wood; it is always impregnated with oily-
resinous oils.

Malt vinegar is prepared by allowing an infusion
of Malt to undergo first fermentation during which
process alcohol is generated and secondly acetylation,
during which the alcohol is converted into acetic acid.
It contains sulphuric acid and colouring ingredients; the
former is intentionally added in the proportion of 1 part of
1000 parts of vinegar, for the purpose of preserving it, the
latter depends upon the degree of cooking of the barley
which the Malt has been subjected.

The Adulterations of vinegar are unimportant and do
not require any special notice.

Dietetical uses of Vinegar. Vinegar gives an agreeable
Acid, cooling and refreshing taste to most kinds of food, for which purpose it is much used during the hot months of summer. Judging from its solvent action on vegetable structures when placed under the microscope it would seem to aid the gastric juice in dissolving these substances. Vinegar has also the remarkable property of causing fibrine to swell up and become transparent. This occurring in the stomach would render that alimentary principle more easily digested. Vinegar is sometimes made use of by young females to diminish and prevent the obesity to which they are subject, but as this can only be done at the expense of seriously deranging the digestive organs it is a very dangerous experiment and one that at no time ought to be persevered in. Acetic acid during its transit through the alimentary canal combines with alkaline to form Acetate, their Acetic acid however is decomposed in the blood into Carbonic acid acid and water, so that they appear in the secretions as Alkaline Carbonates. I may here mention that Citric, Tartaric, and Malic Acids undergo similar changes before they are thrown out of the system.

Pectine—a gelatinous alimentary principle—may be conveniently described in this place. It is abundantly distributed throughout the vegetable kingdom, being found more especially in berries and roots. The Chemical cond-
position of pectine has been a subject of much discussion
and at the present time is still sub judice, according to Wulkow
it is C12 Hg O70; when acted on by Caustic potash, it is con-
verted into pectic acid which in composition is isomeric
with pectine. Pectic acid, gelatinized by the addition of
sugar, is contained in all jellies and jams. Little or nothing
is known of its nutritive properties, but it would appear from
its chemical composition (as far as that has been ascertained)
to be a calciuricant.

I now proceed to consider fatty matters as articles of
diet.

Oils are derived from both the vegetable and animal
kingdoms, and are of two kinds: fixed and volatile. The
fixed oils are those which do not readily evaporate at
moderate temperatures, they may be either of vegetable
or animal origin, and in either case fluid or solid, as an
instance of a vegetable fluid oil, imitation linseed
or olive oil, of a vegetable solid oil, palm oil or cocoa, or
animal fluid oil, cod liver oil or whale oil, and of an
animal solid oil, such as butter. Volatile oils are very
readily dissipated by heat even at low temperatures, and
are only of vegetable origin, and are called essential oils
from being the principal ingredients of the plants
from which they are obtained and are only need
medicinally, they therefore require no further notice. The only substances chiefly employed for dietary purposes are all compound bodies. Margarine enters into the composition of some; stearine forms the bulk of others while oleine constitutes the basis of a third group. Each of these substances requires a short notice.

1. Margarine exists mostly abundantly in several fats such as butter, olive oil, and the fats of hams. It is composed of margaric acid \((C_{17}H_{34}O_2)\) and oxide of the hydroxyl radical glycerol. When treated with the alkalies, moss and soda — it is decomposed, the products being a soap of either marge of stearin or stearate according as the one or other has been used, and hydrated oxide of glycerol or oleine \((C_8H_{18}O_2)\).

2. Stearine like margarine consists of two substances — stearic acid and oxide of glycerol. Alkalies combine with the acid and form stearates and at the same time contribute to the formation of glycerine. Stearine occurs chiefly in the oily products of the cow and sheep. Both margarine and stearine are solid at ordinary temperature.

3. Olein. This is oleic acid combined with the unsaponifiable radical glycerole; the alkalies form soaps, reacts with it and set free the hydrated oxide of glycerine.
It is liquid at ordinary temperatures and possesses fluidity on many oleaginous compounds.

Having made these few remarks upon the composition of the oleaginous compounds in general, let us consider one or two individuals fats before I pass their dietetical uses.

Butter is an oily product obtained from the milk of various mammalian animals, but in this country the butter employed for domestic purposes is almost entirely derived from the cow. Its composition is therefore, according to Bromel, as follows:

\[
\begin{array}{c}
\text{Margarine} & 68 \text{ pts} \\
\text{Leine} & 30 \text{ } \text{ } \\
\text{Oxytirine} & \\
\text{Oxyline} & 2 \text{ } \text{ } \\
\text{Capricine} & \text{ } \\
\text{Total} & 100
\end{array}
\]

This however is the composition of butter especially purified for analytical purposes; as it occurs in the shops and dairies it always contains variable quantities of butter-milk, salt and water which are often fraudulent increased so as to make the weight of the butter heavier. Foreign and deleterious ingredients are seldom added to it.
Butter is not difficult of digestion when it has not become rancid—a state depending upon the decomposition of its volatile odoriferous constituents. When butter is exposed to heat as on toasted bread, hot cakes &c. it becomes exceedingly indigestible on account of the development of arid substances the presence of which the stomach, with a considerable degree of justice, deprecates. Butter might I think be more generally employed by sickly patients than it seems to be, for it not only serves all the dietetical purposes for which cod-liver oil is administered, but it does not possess the disgusting taste of that medicine; for this reason it is particularly adapted for children who shudder at everything bearing the name of physic. In large hospitals and workhouses, butter is a thing almost totally unknown (except perhaps to the matrons and nurses); patients and inmates are served with dry bread and coffee or tea at their morning and evening meal. They drink the latter, but very frequently are unable to eat the former, which even to healthy labouring men would be anything but palatable without the addition of butter or some other oily substance. The importance of allowing a moderate quantity of butter to the sick and poor of charitable institutions will
be pointed out immediately.

Animal fats. These consist for the most part of stearine, oleine and a small quantity of margarine; several of them also contain minute quantities of volatile fatty acids. They are all liable to become rancid when long kept and on being heated.

Olive oil is expressed from olives. It contains 28 pts. of margarine, and 72 pts. of oleine per cent. It is only used in this country as an adjunct to salads and is easily digested.

Dietetical uses of fats and oils. They are almost all rather difficult of digestion, although those which contain large quantities of volatile and empyreumatic oils are more so than those which are simple compounds of margarine and oleine or stearine and oleine. They do not suffer any change in the stomach but, when they reach the duodenum they would appear to be emulsified as before said (page 21), after the fatty ingredients of our food are absorbed and carried into the current of the circulation, they rapidly yield to the destructive influence of oxygen, form Carbonic Acid and water and thus serve to maintain the animal heat and prevent an undue oxidation of the tissues. Fatty matters are the most valuable of all heat-producing foods.
or they contain a very large amount of uncombined hydrocarbon.

The mere presence of fat in the stomach according to Lehmann's assists the disintegration and solution of nitrogenised Articles of food. The manner in which this is accomplished does not appear very intelligible, at present our ignorance compels us to place the phenomenon under the mystic veil of what chemists call catalysis. If this view of Lehmann's be correct, it would go far to prove that bread ought not to be eaten without oily compounds.

Histologists have pointed out that whenever fluid albumen and oil are brought together an emulsion is formed by a thin pellicle of albumen enveloping a minute and almost infinitesimal quantity of oil, hence oil seems to be essential for the formation of the alimentary fluids from which the blood is elaborated.

This statement has an important bearing upon the subject which I cursorily mentioned under the head of butter. If bread is eaten alone it is reduced with difficulty according to Lehmann, by the action of the gastric juice, but when it reaches the intestines cancer, its albuminoid principles being deprived of oil and thereby physically incapacitated from forming cells...
and granules are not imperfectly absorbed and the fibre
is consequently poor and destitute of characteristic
and proper cellular elements. Mark the consequence:
the blood—the stamina of the whole frame is support, ed
and formed from malassimilated food; it is hindered
vitality weak and deficient in nutrient materials and
consequently is unable to sustain the vital powers unde
whose control the whole function of nutrition is placed.

As a result of this defective nutrition, pernofulosis
its
numerous train of diseases is developed, perhaps it may
be in an individual hereditarily predisposed to that con
stitutional vice or in one free of any hereditary taint.

It is not mean to assert that a deficient supply of digesti
ous food is the only cause of pernofulosis but it is one which I
think has been greatly overlooked by the medical profession.

A writer in the Westminster Review in alluding to the
social and sanitary condition of the inhabitants of Iceland
days. The combination of what are commonly accounted
the predisposing causes of consumption and pernofula
could be more complete than that which exists among
the mass of the Icelandic peasantry. Whole families
are huddled up with their sheep not only during the
night but during the greater part of the day for half the
year in most miserable hovels destitute of any ven
...ilitation than that afforded by the chimney. Their clothing is not once put on or changed during the whole of that time; their food is scanty, and the external atmosphere is both cold and damp. The unhealthy condition of the population is evidenced by its extraordinary liability to epidemic disorders; and by its want of increase, or even in some districts by its absolute diminution.

And yet amongst this remarkable people, the best educated peasantry in Europe, so far as regards what is commonly accounted education, portfolio and consumption are unknown. "The same writer attributes this immunity to the highly oleaginous nature of their diet, which consists in great part of the oily bodies of piscivorous birds" (Quoted from Dr. Watson's Practice of Physic, etc.). Dr. Watson however takes a different view of the matter and rests satisfied by saying that such immunity is probably due to their exemption from the sanguinolent diathesis. But as facts are always much superior to suppositions. I think neither Dr. Watson nor any one else is justified in theorizing upon the above statements, at all events the subject is worthy of an investigation.

In regard to Dr. Watson's opinion concerning the diathetical origin of consumption, I need only say that it is my belief, that as many individuals suffer...
from Phthisis and other tubercular diseases whatsoever marks whatever of the conspicuous diathesis as those who bear unequivocal signs of that cachectic constitution.

Before leaving this subject I cannot too strongly recommend a moderate allowance of butter or some other oleaginous compound at both morning and evening meals. The inmates of hospitals, workhouses and other charity institutions would relish their food much better than when they are compelled to eat dry stale bread, but the food would not only be more palatable to the consumer but would run every chance of being duly absorbed and formed into healthy molecular chyle.
2. Essential Carnofacients.

The vitrified, firming or plastic elements of nutrition of meats.

Albumen exists in a state of solution in the blood and other fluids of the body, and in the juice of most vegetables. It is rapidly coagulated by heat, strong acids, alkalis, corrosive sublimate, and acetate of lead; it is then rendered insoluble in water, unless it is impregnated with a carbonate of alkali such as Caustic soda. It is not coagulated by lactic acid, which property distinguishes it from casein. Albumen, besides existing in the fluid state, is also found in the solid form in the tissues of animals and in many seeds especially by in mustard and almonds in the form of emulsion, the composition of which appears to be identical with the albumen procured from other sources. Egg albumen contains more sulphur and nitrogen than the other varieties.

Composition of Animal and Vegetable Albumen: C16 N87 H26 82.

Of egg albumen — — C16 N87 H26 82.

I may here state that albumen is easily digested when not rendered tough by boiling, frying, or hard by baking. It is slightly coagulated when received into the stomach in a fluid state but readily redissolved by the gastric secretion.

Fibrin occurs in two conditions in living beings:

Fluid in the blood, chyle, and simple, and solid in the
muscles. It does not exclusively belong to the animal kingdom for it is also abundantly found in vegetables and in them likewise in two distinct forms: solid in seeds and fluid in the juice of plants. Fluid fibrin possesses the remarkable property of spontaneous coagulation. The juice of plants after standing for a short time deposit it as a glistening, pulvulent precipitate; the animal fluids as a sticky, tenacious and elastic substance bearing much resemblance to coagulated albumen. When treated with acetic acid fibrine swells up, becomes transparent and partakes much of the physical properties of gelatine. There are two kinds of fibrin in the animal body each having a different chemical composition; the one flesh fibrine possesses the following composition $C_{216} N_{27} S_{2} H_{69} O_{5}$ and is isomeric with vegetable fibrine; the other, blood fibrine has the composition $C_{296} N_{40} S_{2} H_{228} O_{2}$. By the prolonged action of heat fibrine is rendered tough, solid and very indigestible.

Gluten is abundantly found in most seeds especially cereals associated with starch; when the latter is washed out as in the manufacture of starch a tough substance is left behind which is the nitrogenous principle under notice. This residue however when it is
Closely examined is not gluten in its perfectly pure state, but contains a considerable proportion of fibrine; when acted upon by heat at a part is dissolved out, this when separated from that reagent is soft when moist, but hard and translucent when dry. This is called by chemists gluten; but as it is merely pure gluten separated from the fibrine with which it was mechanically incorporated, I cannot see why a different name has been bestowed upon it or why a mixture of fibrine and gluten should be termed gluten, such nomenclature is not only unnecessary but puzzling to those who are studying the subject. Gluten is the principal ingredient of bread and is easily digested. Its composition is 40% N 50% C 10% O 20%

Casein is another nitrogenous substance, it is found in a state of solution in milk and vegetable juices, but solidified in seeds more especially in those of the leguminous order. Hence it is sometimes called legumine or vegetable caseine. It is not coagulated by heat, but readily converted by the action of acetic acid into a firm mass which can be redissolved by alkalis. It is the substance which enters into the composition of cheese and is easily digested except rendered indigestible by the art of the dairymaid or the officious services of the cook. Its ultimate com-
position is C288 N36 W228. 890 S2.

Cheese. The major part of this much esteemed article of diet is composed of Caseine; butter however is always present, and the more so if the cheese has been manufactured from unskimmed milk. Cheese is very prone (by reason of its complex constitution) to undergo spontaneous decomposition during which Acetic Acid, Salt of Ammonia, and Potash and Acrid, tunger, volatile fatty acids are developed. It is also frequently attacked by parasites and fungi, both of which create such vast depredations, that they sometimes devour the whole mass.

Adulterations. Red oxide of lead is sometimes to be found in cheese and is a very dangerous adulteration. It is not directly added to the cheese, but Staines entrain into it by being mixed with the Annatto, with which cheese is artificially coloured. It may be readily detected by digesting a small portion of the suspected article in a little water acidulated with Nitric Acid and filtering the liquid. The Nitric Acid decomposes the red oxide of lead into the Binoxide which is insoluble, and the Protoxide which unites with the Nitric acid to form a soluble nitrate of lead. After having divided the filtered solution into 4 parts, proceed as directed for the detection of lead at page 87.
Cheese is a very undigestible substance and ought never to be taken in large quantities as is frequently the case. By dyspeptics, who it is remarkable to relate sometimes have a morbid appetite for it, it should be scrupulously avoided. It has been said that old cheese has the property of accelerating and aiding digestion; in pursuance to ascertain if it possessed this desirable virtue, I instituted a series of experiments upon the artificial digestion of cheese 1st. Very itself and 2nd. in conjunction with the substances whose relative digestibility I previously noted. I invariably found that the presence of the cheese rather interfered with the solution of these substances than quickened that process.

Gelatine is found in hoofs, tendons, skin, parenchymatous tissues and the swimming bladders of fish. That obtained from the latter source is almost perfectly pure and is called bone-gelatine of which there are innumerable varieties, while that obtained from the foramed is very impure and goes under the commoner name of fish gelatine. Gelatine is very soluble in hot water and forms a thick jelly on standing for some time, but by long continued boiling it loses the latter property. The tannic acid of vegetable astringents forms insoluble compounds with gelatine.
Chondrine very much resembles gelatine both in its chemical and physical properties, except that it differs a little from the latter substance in its behaviour with different reagents.

Osazone may be conveniently mentioned here although it is strictly speaking a compound of many very different substances. It is the flavouring ingredient of soups and beef tea and contains besides lactic acid, lactates and phosphates, nitrogenous matter, namely, creatine, creatinine and inosinic acid. The former (creatinine) has I think been erroneously looked upon by Liebig as an important element of food for it seems to be a product of disintegration as it is readily convertible into urea and is even to be found in the urine without having undergone any change whatever. Creatinine and inosinic acid are also products of the secondary digestion. Osazone however must contain some very subtle nutrient for it cannot be denied that beef tea and extracts of meat are very nourishing articles of food and particularly useful for those recovering from acute and long protracted diseases.

Dietetical uses of the nitrogenised elements of food. It has been already stated that they are all
mutually convertible into each other when brought within the range of the vital chemistry of the human stomach: so theoretically it would appear that if any one of them be received into the system as food it would be changed into the others as occasion might require, and practically this is found to be the case. Take for example the young of any of the mammalian animals, they rapidly grow and attain strength, yet all their diet consists of milk containing besides butter, sugar (calorificient elements) and a small quantity of salts, only caseine; now if caseine did not contribute to the formation and maintenance of the composition of the blood, how would it be possible for the newly born animals to live? And further the caseine must be changed into albumen before it reaches the vascular system for at no time has caseine been found in the blood. Dr. Proust believes that the nitrogenous compounds are, during their solution in the stomach, lowered in their composition so as to become albuminised or peptone, that in this state they are absorbed and again raised in their chemical composition to act as forming true albumen which enters the blood as such. But it may be asked from what source does the fibrine of the blood come as it does not enter the blood as fibrine precipitated.
it has been taken into the stomach, but as Allman, I answer, that the fibrine of the blood is not a
formative but a retrograde substance, and that having fulfilled its purpose in the economy, is on its way to
the great excreta to be excreted from the system in the form of urea, sulphuric acid, water and carbon
acid, either directly or after it has split up into simpler animal compounds. I have authenticated items that the
fibrine of the blood is a hydrolytic element, and among the rest Prof. Henderson of this University, I will con-
sider the subject briefly and endeavor to refute his arguments with as much candour as possible, being
extenuated by no feeling of hostility towards that gentleman.

The first argument adduced by the learned Prof.
in support of the hydrolytic power of blood fibrine is
that it cannot be effete flesh fibrine, for that compound
has not the same chemical composition as blood fibrine.
No one so far as I am aware has ever asserted that
blood fibrine has the same chemical composition as flesh fibrine, so that this argument proves nothing
except a fact, that has never been denied.

His second argument is that if flesh fibrine was
decomposed into blood fibrine, the other two elements
(creatinic acid and gelatine) of that decomposition
would be found in the blood. This would at first sight seem to be a very unsmountable obstacle to those advocating opposite views as it did to me when I heard it first profounded in the class room, but it occurred to me that those substances if they are not found in the blood might be rapidly oxidized when in the nascent state into excretory products and upon consulting Gregorv's Manual of Chemistry I found that both gelatine and choletic acid might be thus oxidized as the following tables copied from that work will show:

**Oxidation of Gelatine**

3 gals of creatine,
+ 2 " of sulphuric acid,
+ 1/2 " of water, excreted by kidneys and lungs,
+ 1/2 " of carbonic acid, excreted by the lungs.

**Oxidation of Taurocholic Acid (Choleic acid of Gregory)**

1 eq. of ammonia,
+ 2 eq. of sulphuric acid,
+ 52 eqs. of carbonic acid,
+ 42 eqs. of water.

This effectual oxidation therefore prohibits all possibility of detecting either gelatine or choletic acid in the blood. But Dr. Henderson waving or rather completely overlooking this theory goes on to say that if to one eq. of blood fibrine, 8 eqs. of water be added,
1 eq. of flesh fibrine and 1 eq. of gelatine may be derived from it, thus:

1 eq. of flesh fibrine: C298 N40 S2 H228 O92
+8 eq. of water: 298.40.2.236.100

1 eq. of flesh fibrine: 216.27.2.169.68
1 eq. of gelatine: 82.13.0.67.32

The Doctor is right in his calculations as well as Gregory, the only difference being that the one shows how two tissues of the animal body may be derived from blood fibrine while the other shows how one elementary texture and one very important constituent of the bile may be derived from blood fibrine. But as neither the one nor the other theories tend to settle the question, I need not make any further remarks upon them except that facts are wanting not vague and conflicting calculations.

Prof. Henderson goes on to relate some experiments of the following description: — Majendie, by withdrawing the blood from the vascular system of animals, was enabled to defibrinate it by whipping it with rods; he then returned the serum and blood coagulates into the vessels from which they had been taken, but the consequence of the animals ulcerated and struggled. Reasoning...
Upon the data furnished by those experiments, Dr. Henderson comes to the conclusion that the blood fibrine is an essential element of nutrition for when it is removed from the blood lesions of nutrition occur. How any person can draw conclusions from such imperfect experiments as these I cannot conceive, for doubtless the blood corpuscles, which are looked upon as the most highly elaborated ingredients of the blood, would be seriously damaged by such a process as that to which they were subjected; and moreover the mere exposure of such cells to atmospheric influences would endanger their future vitality. Might not the albumen also undergo some modification and change so as to render it unfit for the support of the textures.

As an appendix to the above argument he (Dr. H) adds that in Bright's disease, although the albumen is totally diminished there is no ulceration of the cornea. It is perfectly true that the cornea remains entire during the persistence of an attack of albuminuria, but the same cannot be said of the body in general. For an individual labouring under that fatal disease rapidly becomes emaciated and feeble - a fact which appears to me to go far in proving that the albumen serves a most important purpose in the blood and that it is from it that
the fibrine of flesh is derived. I am of opinion that the reason why the cornea does not ulcerate in albuminuria is from the gradual withdrawal of its nutritive fluids compared with the rapid loss of that formative fluid in Majendie's experiments. Another reason why the cornea does not ulcerate in albuminuria whilst it under went that process in Majendie's experiments is that in the former the blood corneoles are not exposed to injurious agents likely to cause their degeneration whilst in the latter they were so exposed.

Another argument brought forward by the Opposers against those who regard fibrine as an element of destruction is that the blood fibrine is excluded in inflammation and forms either permanent or temporary tissues which it could not do if it was a retrograde element. In answer to this allow me to say that in my humble opinion that the blood fibrine never forms either permanent or temporary tissues. I believe that the fibrinous exudation which is poured forth during inflammatory action is derived from the albumen of the blood and not from the fibrine of that fluid, because the essential part of inflammation is neither more nor less than an exaltation by means of which the textures form more fibrine than they require. Probably a portion of the
fibrine of the blood is drawn out of the capillaries, but
may ask that portion degenerate into pus cells or be re-
absorbed, while the other (that which has had its origin
from Albumen) forms new tissue?

It may with justice be asked how can I prove that
Albumen gives rise to fibrine, in normal nutrition and in
that form of exalted nutrition known as inflammation.
During normal nutrition the proportion of blood
fibrine is very small (2 or 3 parts 1000 parts of blood)
and from this fact I think it may be safely conjectured
that the amount is far too small to afford nourishment
for fibrinous textures - textures which are very much ex-
posed to disintegrating forces and therefore require more
nutrient materials than they would do if they were for
the most part in a state of quiescence. Dr. Kindness
says or rather hints that there is enough fibrine in the
blood to yield a nutrient blastema to all the fibrinous
textures, for says he, the blood corpuscles abound in fibrine
they certainly contain fibrine but I am not aware that
the quantity is so great as the Professor would lead one
to believe; if there were 10 parts of fibrine in 1000 parts of
blood it would not warrant us in attributing a forma-
tive function to it. Again the quantity of Albumen is
very large, much larger than is requisite for those pro
of the Albuminous tissues properly so called, why should it less, if it was not to yield flesh fibrine, which by this by it does by an isomeric transmutation.

There is no fibrine in the egg, and yet the muscles and other fibrous textures are all well developed before the chick leaves its calcareous shell, so that it must have formed its fibrine from the contained Albumen. It is said, although I doubt it, that the blood of the fetus contains less fibrine than the blood of the adult, if it is so, the reason is obvious, for the fetus not having to exercise itself has scarcely any waste tissue circulating in its vascular system.

During the continuance of inflammation the parts possess a morbid tendency to attract from the blood an excessive quantity of their proper nutrient elements and among the rest Albumen, a portion of which is to rapidly drawn out of the capillaries as to escape the transforming or moulding action of the surrounding tissues, but the remainder is rapidly transformed into the most highly organized compound in the body—flesh fibrine, which becoming disintegrated, very shortly appears in the blood constituting that abnormal amount of blood fibrine found during and after an attack of inflammation. But this is not the only change perceived in the blood during inflammation for
the albumen is diminished and that in proportion the increase of fibrine, a fact which amounts almost to proof positive that the excess of fibrine has been formed from that portion of albumen of which the blood has been robbed. The quantity of fibrine last ought to be increased during starvation for the tissues being rendered vitally weak may readily give way to disintegrating influences and would load the blood with retrograde fibrine. Such has actually been found to be the case, while others deny it, consequently no reliance can be placed upon their observations. Blood letting by rendering the tissues vitally weak and unable to withstand destructive agents, augments the amount of fibrine in the blood.

Another and the last argument I purpose to now in defence of the histolytic doctrine of the blood fibrine is that fibrine is abundantly found in the lymph (a fluid containing the debris of worn out textures) while mere traces if it are present in the lacteals before they join the thoracic duct. Albumen however is in much greater quantities in the latter.

From these arguments I come to the conclusion that blood fibrine is a product of the secondary digestion of albumen; that it is a retrograde not a formative, a histolytic not a histogenetic element.
As I have discussed the question which I have just finished at so great a length, I am prevented by reason of limited space from considering the metamorphoses which the nitrogenised foods undergo in the body, as I would have liked to have done. Sufice it to say that they are all directly or after having contributed to the formation of various secretions, resolved into some two or more of the following compounds: Uric Acid, Urea, Carbonic Acid, water, Creatine, Ammonia, Hippuric Acid, and Sulphuric Acid.

Moulder, by digesting the albuminous compounds in caustic alkalis until they were dissolved, obtained a precipitate on adding acetic acid to the solution, that he called proteine and gave to its composition C₆0H₈O₂₇. He considered that that substance by entering into combination with sulphur yielded materials for the formation of blood, the great majority of chemists however, deny even the existence of proteine, while some believing that it is such a compound, maintain that it is not free from sulphur.

Gelatine differs from the other allied constituents of food inasmuch as it has been proved by direct experiments not to afford any nourishment to the tissues of the body, for when an animal is fed exclusively
upon gelatine, it soon becomes languid and emaciated and finally dies exhibiting all the signs of starvation. Mulder explains this phenomenon by saying that as gelatine yields no protein when treated with caustic alkalis and acetic acid, it cannot form blood. Those who are opposed to this view hold that gelatine cannot contribute to the formation of the sanguinogenous fluid because it contains no albumin and that it is not susceptible of undergoing the isometric transformations of the albuminous compounds (fibrin, albumen, and casein). The purpose served by gelatine food appears to be the renovation of the tissues, partly composed of gelatine and chondrine. The excessive use of calf's foot jelly, ineglass and other gelatinous substances does not prove to be of that nourishing quality which is generally believed. Hence the larger quantities of such foods consumed by invalids and others of weak habits do not in reality contribute to their support.

Inorganic Alimentary Principles.

Water. This useful aliment has been divided into various divisions by authors, some of these divisions being based upon the source from whence the liquid is derived, others upon the quantity of mineral ingredients.
held in solution in it, but as all of these divisions are more or less arbitrary, I prefer speaking of it as water without taking into consideration whether it is got from rivers or springs, lakes or wells.

Water is a compound of hydrogen and oxygen. It always contains atmospheric air, except it has been distilled when it acquires an insipid and non-refreshing taste. Various other inorganic substances such as alkalies and earthy salts are also present in it and not only confer an agreeable taste upon it but serve useful purposes connected with nutrition. The water of London contains about 19 gos. of inorganic matter, while that of Edinburgh contains only 15 gos. in a gallon. The quantity of organic matters in water is subject to much variation and depends much upon the vicinity of running streams, wells or to places where decomposing animal and vegetable products abound. There are 18 gos. of organic matters in a gallon of London water, while there are only 5 gos. in that of Edinburgh. The presence of such substances deteriorates the quality of the water for when they undergo decomposition they load it with deleterious and offensive gases. Such putrefying matters were a fruitful exciting cause of disease, chiefly dysentery, on board our ships, until the authorities
caused the water to be kept in air tight, or charred, vessels. There are many other impurities with which water is impregnated to which I would have directed attention, but as I have not space to spare for such an inquiry nothing of the greatest importance in a sanitary point of view, I will refrain from entering upon the subject. There is however one impurity - lead - which I cannot pass over in silence; it occurs in waters which have been in contact with leaden pipes, cisterns, spouts &c. and it is curious to remark that it only occurs in water comparatively free from sulphates and chlorides. The manner in which water is rendered poisonous by lead is the following: - It contains Carbonic acid and oxygen both of which chemically act upon the lead and form Carbonate and oxide of lead, which though sparingly soluble in water are sufficiently so to bestow upon it dangerous and poisonous properties. But when sulphates and chlorides are present in the water they act upon the lead and coat it over with an excessively insoluble though extremely thin lining of sulphates and chlorides - lead. Water impregnated with lead may be detected by following the tests given for the detection of that metal at page 87.

Dietetical uses of water. These have been before
Shortly noticed at page 26, and do not require repetition. It is impossible to lay down any rules regarding the quantity of water that should be used daily by a healthy individual, as that is governed by a host of circumstances over which we have no control, but I consider about 2½ to 3½ pints a fair average allowance. For much water or liquids of any kind should not be taken along with the meals, as they, by diluting the gastric juice, frequently prevent the digestion of the food and lay the foundation, it may be, of incurable dyspepsia. Snow water has been accused of causing goitre, but this is certainly not the case for not only is goitre to be found where there is no snow water to be had, but goitre is an unknown disease in climates where such water is abundant and where it constitutes the sole drink of the inhabitants. Great draughts of water increase the flow of bile, both its fluid and solid constituents. Water and watery liquids ought never to be taken excessively, for they induce a degree of hyperaemia, if not actual inflammation, of the mucous membranes over which they pass, producing in the former case permanent thickening, in the latter dangerous and painful ulceration.

Chloride of Sodium is a very necessary ingredient of our food as it is abundantly distributed throughout two
bodies as has been already shown. It is obtained for domestic use from three sources, 1st by the evaporation of brine springs, 2nd by the evaporation of sea water, 3rd it is dug out in the bowels of the earth, having been formed there by the crystallization of primaeval seas. It is composed of chlorine and sodium.

Dietetical use of Salt. As animals by a natural instinct assiduously search for salt and fearless, by encounter all obstacles and dangers until they have discovered it, we are justified in concluding that it is of the greatest use in the animal economy. When taken in moderation it gently stimulates the digestive organs and causes an increased flow of gastro-intestinal secretions, but if taken in too large quantity it deranges the stomach by its irritant action upon the mucous membrane. Salt causes thirst on account of the strong affinity which it possesses for water. It appears that the hydrochloric acid of the gastric juice and the soda of the bile are both obtained by the action of water on chloride of sodium, by a kind of double decomposition, thus:

\[
\text{Cl}\text{.Na} + \text{HCl} (\text{Hydrochloric acid}) \rightarrow \text{NaOH} (\text{Soda}) + \text{HCl}
\]
Salt has been used to cure or prevent paroxysms of ague. Liebig says that it prevents the deposition of fat, but whether this is the case or not I am unable to say.

The other inorganic constituents of the body are always naturally present in sufficient abundance in the multifarious varieties of food used by man, so that none of them require any notices except lime, which, believe might be advantageously given to children during their infancy. It would not only prevent that irritable condition of the digestive organs to which infants and young children are liable, but would also prove useful as a nutrient to the long framework of the body generally.
Compound Aliments.

Having gone over the simple alimentary principles, I now come to consider aliments composed of two or more of those elementary principles, that is to say Compound Aliments. They have been variously classified by authors, some dividing them according to a natural history and botanical arrangement, others follow a kind of popular classification, while a third class adhere to no special rules in regard to their classification. All these different ways of treating the subject seem to one faculty in the extreme; however scientific they may appear they are utterly useless in a practical point of view and I think should be laid aside in antiquarian museums among the curiosities of bygone ages. Such classifications leave us totally in the dark concerning the dietary value of the many compound aliments which form the staple food. Man has such information I consider to be of paramount importance and as a basis of classification not to be superseded by any that has yet made its way into the literature of medicine. We have before seen (page 50) that the quantity of Carbon excreted by the body and the quantity of nitrogenised tissue daily destroyed during exercise be in a healthy man stand to each other in the ratio.
of about 1 of the latter to 2½ or 3 of the former. The carnosfacient and calorificacient ingredients of man's
food must be combined in about the same proportion

to sustain healthy nutrition; there must be neither
an excess of the one nor a deficiency of the other.

Now as such is the case it appears to me that we
may have a division of compound Aliments into which
the carnosfacient and calorificacient elements enter in
their proper proportions, i.e., Aliments whose carno-
sfacient ingredients stand to the calorificacient as 1 is
to 3. We may have as a second division, Aliments
containing an excess of carnosfacient elements and as
a third class Aliments containing an excess of Calori-
sicacient elements. As these three divisions will not
however include all varieties of compound Aliments
it will be necessary to have a class of nutrient
drinks, including tea and coffee. The above are the
classes under which I propose to treat of the different
kinds of Compound Aliments.
Class I. Aliments containing a proper quantity of Carbohydrates and Calorificc Aliments, that is to say, Aliments containing 1 part of the former to 2 ½ or 3 parts of the latter.

There are no compound Aliments ready formed by nature which come under this head, not even Milk, although it approaches very near to the required standard, its proportion of heat forming materials are however too small.

All the Aliments coming under this class are artificially compounded and go under the general designation of mixed diets; they embrace the numerous and complex dietaries with which several books upon diet abound. As I have not time to consider the important subject of dietaries I will only make the following remarks: The Carbohydrates and nutrigenous substances should be as nearly as possible in their proper proportions. The age of the individuals for whom we are preparing a dietary should be taken into account; their occupation as well as the season of the year should also receive consideration. The dietary should not contain many substances of different degrees of digestibility as such a complexity would seriously interfere with proper digestion. Dietaries should be framed in such a manner, that the quantity allowed to each
individual should neither be too concentrated nor too bulky as either extremes would derange the digestive process. Economy and variety should also receive attention, the former especially in charitable institutions. Judging from what has been before said with regard to oleaginous substances, they should also form a part of almost every meal. Dietaries for children ought to be drawn up with a liberal hand for the reasons before stated (page 52). There is another point to which I wish to direct attention before I have done with the subject of dietaries and that is the idiosyncrasies of the appetite to which some people are liable. Dr. Prout relates the case of a man who could not eat mutton without being seized with violent vomiting and diarrhea. Others cannot eat fish, stomachs without unpleasant symptoms arising from their use. Such circumstances ought always to be borne in mind as peculiarities of this sort are very often attributed to petulance and caprice rather than to their true cause.

In drawing up dietaries the following table of constituents contained in 100 parts of the undermentioned articles will be of great use:

<table>
<thead>
<tr>
<th>Article</th>
<th>Carboniferous</th>
<th>Nitrogenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat Flour</td>
<td>71.25</td>
<td>16.25</td>
</tr>
<tr>
<td>Bread</td>
<td>51.5</td>
<td>10.5</td>
</tr>
<tr>
<td>Article</td>
<td>Carboniferous</td>
<td>Nitrogenous</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------</td>
<td>-------------</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>65.75</td>
<td>16.25</td>
</tr>
<tr>
<td>Barley (Pearl)</td>
<td>67.0</td>
<td>15.0</td>
</tr>
<tr>
<td>Pease</td>
<td>55.5</td>
<td>24.5</td>
</tr>
<tr>
<td>Potatoes</td>
<td>74.0</td>
<td>2.5</td>
</tr>
<tr>
<td>Carrots</td>
<td>8.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Turnips</td>
<td>5.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Cabbage</td>
<td>6.7</td>
<td>0.3</td>
</tr>
<tr>
<td>Lean Beef and Mutton</td>
<td>0.0</td>
<td>27.0</td>
</tr>
<tr>
<td>Fat of Meat</td>
<td>100.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Average Beef and Mutton</td>
<td>15.0</td>
<td>20.25</td>
</tr>
<tr>
<td>Bacon</td>
<td>62.5</td>
<td>8.36</td>
</tr>
<tr>
<td>Skimmed Milk Cheese</td>
<td>0.4</td>
<td>64.6</td>
</tr>
<tr>
<td>White Fish</td>
<td>0.0</td>
<td>2.10</td>
</tr>
<tr>
<td>Raw Milk</td>
<td>8.0</td>
<td>4.5</td>
</tr>
<tr>
<td>Skimmed Milk</td>
<td>5.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Buttermilk</td>
<td>1.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Beef tea (strong)</td>
<td>0.0</td>
<td>1.44</td>
</tr>
<tr>
<td>Beef tea and meat decocted with</td>
<td>0.0</td>
<td>0.72</td>
</tr>
</tbody>
</table>

The following table shows the number of grains of nitrogenous combination and of carbon in an ounce of some of the more important articles of diet.
<table>
<thead>
<tr>
<th>Article</th>
<th>Nutritional Contents</th>
<th>Carbon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meat (without bone)</td>
<td>84.30</td>
<td>48.12</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>50.30</td>
<td>179.37</td>
</tr>
<tr>
<td>Bread</td>
<td>30.18</td>
<td>122.50</td>
</tr>
<tr>
<td>Rice</td>
<td>30.62</td>
<td>188.10</td>
</tr>
<tr>
<td>Barley</td>
<td>43.26</td>
<td>139.00</td>
</tr>
<tr>
<td>Potatoes</td>
<td>6.82</td>
<td>43.75</td>
</tr>
<tr>
<td>Pease</td>
<td>99.30</td>
<td>179.30</td>
</tr>
<tr>
<td>Beans</td>
<td>117.90</td>
<td>175.00</td>
</tr>
<tr>
<td>Carrots</td>
<td>8.79</td>
<td>24.06</td>
</tr>
<tr>
<td>Milk</td>
<td>18.58</td>
<td>30.60</td>
</tr>
<tr>
<td>Sugar</td>
<td>18.02</td>
<td>363.12</td>
</tr>
</tbody>
</table>

Composition of food in 100 parts (by weight):

<table>
<thead>
<tr>
<th>Article</th>
<th>Nutritional Contents</th>
<th>Nutritional Contents</th>
<th>Nutritional Contents</th>
<th>Nutritional Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bacon</td>
<td>8.36</td>
<td>62.5</td>
<td>0.5</td>
<td>53.92</td>
</tr>
<tr>
<td>Wheat flour</td>
<td>17.00</td>
<td>66.0</td>
<td>0.7</td>
<td>45.5</td>
</tr>
<tr>
<td>Barley meal</td>
<td>14.00</td>
<td>68.3</td>
<td>2.0</td>
<td>40.5</td>
</tr>
<tr>
<td>Oatmeal</td>
<td>13.5</td>
<td>70.3</td>
<td>3.3</td>
<td>44.1</td>
</tr>
<tr>
<td>Pease</td>
<td>23.4</td>
<td>60.0</td>
<td>2.5</td>
<td>35.7</td>
</tr>
<tr>
<td>Rice</td>
<td>5.43</td>
<td>84.65</td>
<td>0.5</td>
<td>36.0</td>
</tr>
<tr>
<td>Meat (without bone)</td>
<td>22.33</td>
<td>14.3</td>
<td>0.5</td>
<td>24.5</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1.41</td>
<td>22.1</td>
<td>1.0</td>
<td>12.1</td>
</tr>
<tr>
<td>Article</td>
<td>Alginated</td>
<td>Unalginated</td>
<td>Mineral</td>
<td>Carbon</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------</td>
<td>-------------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Sugar</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>42.58</td>
</tr>
<tr>
<td>Rock Salt or Brine</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
<td>79.00</td>
</tr>
<tr>
<td>Bread</td>
<td>6.83</td>
<td>48.63</td>
<td>1.51</td>
<td>25.19</td>
</tr>
<tr>
<td>Beer</td>
<td>0.5</td>
<td>9.17</td>
<td>1.20</td>
<td>4.33</td>
</tr>
<tr>
<td>Cheese</td>
<td>31.02</td>
<td>25.30</td>
<td>4.90</td>
<td>33.80</td>
</tr>
<tr>
<td>Cocoa</td>
<td>9.56</td>
<td>85.76</td>
<td>2.70</td>
<td>88.50</td>
</tr>
<tr>
<td>Milk</td>
<td>4.50</td>
<td>7.90</td>
<td>0.6</td>
<td>6.94</td>
</tr>
<tr>
<td>Carrots</td>
<td>1.48</td>
<td>11.61</td>
<td>0.81</td>
<td>5.40</td>
</tr>
<tr>
<td>Turnips</td>
<td>1.64</td>
<td>10.50</td>
<td>0.60</td>
<td>6.20</td>
</tr>
<tr>
<td>Parsnips</td>
<td>2.10</td>
<td>17.70</td>
<td>0.80</td>
<td>8.63</td>
</tr>
<tr>
<td>Cauliflowers</td>
<td>1.75</td>
<td>4.05</td>
<td>2.20</td>
<td>2.65</td>
</tr>
<tr>
<td>Fish</td>
<td>14.00</td>
<td>7.00</td>
<td>1.08</td>
<td>9.15</td>
</tr>
<tr>
<td>Maize</td>
<td>10.71</td>
<td>75.25</td>
<td>1.84</td>
<td>36.41</td>
</tr>
<tr>
<td>Margold Viregel</td>
<td>1.68</td>
<td>12.26</td>
<td>1.94</td>
<td>5.50</td>
</tr>
</tbody>
</table>

Class II. Aliments containing an excess of carnosilient ingredients, i.e. Aliments containing more than 1 part of carnosilient to 3 parts of calorisilient elements.

Eggs. These form an article of food to the inhabitants of almost every nation, civilized and uncivilized. The eggs of various birds are used for culinary purposes, but those which occur most commonly in this country are the produce of the common fowl (the domestic gallus)
An egg consists of a shell composed of carbonate and phosphate of lime, a membrane or outermem, albumen and yolk. The shell is porous for the respiration of the young chick (if its development ever takes place), through these minute orifices air passes in and acts upon chemical changes in the interior by which the contents of the egg are decomposed. Numerous means have been taken to prevent this decomposition, such as putting the eggs in lime water or besmearing them over with grease. One which I have found very successful is coating the shell over with glue or gum arabic after the egg has been dipped for a few seconds in boiling water. The white of the egg consists almost entirely of albumen held in solution by means of water. Its composition is as follows:

\[
\begin{align*}
\text{Albumen} & \quad 12 \text{ to } 15 \text{ pts.} \\
\text{Gums} & \quad 2 \quad 2 \frac{1}{4} \quad 2 \frac{1}{4} \\
\text{Salts} & \quad 8 \frac{1}{2} \quad 10 \frac{1}{2} \quad 10 \frac{1}{2} \\
\text{Water} & \quad 90 \quad 90 \quad 90 \\
\end{align*}
\]

The yolk is an emulsion of oil and albumen and yields the following ingredients upon analysis:

\[
\begin{align*}
\text{Albumen} & \quad 16 \text{ to } 17 \text{ pts.} \\
\text{Oil and Cholesterol} & \quad 28 \quad 24 \quad 24 \\
\text{Salts (soda, potash, magnesia)} & \quad 1 \quad 2 \quad 2 \\
\text{Water} & \quad 55 \quad 51 \quad 51 \\
\end{align*}
\]

100 100 100 Branched.

Eggs are easily digested when not hardened by the act of
cooking, they are also very nutritious as the above analyses show them to contain on an average about 15 parts of nitrogenous constituents and 28.5 of Carbonaceous, together with a small quantity of salts per cent. They form a very eligible diet for the sick, being when mixed with wine or brandy.

Milk is a whitish fluid secreted by the mammae of animals. It is an emulsion being made up of oil globules suspended in a fluid. When recently drawn it has an alkaline reaction but after standing for a time exposed to the atmosphere, particularly if the weather is hot, its sugar very speedily passes into Lactic Acid by a process analogous to fermentation. The development of Acid however is limited for when a certain quantity is formed it puts an end to the fermentation, the excess of Acid be neutralized. The Milk globules are minute droplets of oil (Butter) enclosed in an envelope of Caseine which when acted upon by Acetic Acid dissolves and thus exposes its contents to the dissolving influence of Ether and Alcohol. The globules are large, round, distinct and never adhering to each other. The suspending fluid which is a solution of Caseine, sugar of milk and salts in water is called Liqueur Lactis. The Milk drawn immediately after delivery differs from ordinary milk in the following particulars; it is viscid and of a yellow colour, it is seen to contain when examined by the microscope large cells (plasmodin corpuscles).
filled with fat, these cells have a great tendency to accumulate and to form masses of variable size, the nutritive material being albumen of which colostrum contains a large quantity (from 15 to 25 per cent, Gregory). The following are some analyses of the milk of different domesticated animals.

<table>
<thead>
<tr>
<th></th>
<th>Cow's Milk</th>
<th>Cows Milk</th>
<th>Woman's</th>
<th>Goat's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Casein</td>
<td>4.48</td>
<td>1.82</td>
<td>1.52</td>
<td>4.02</td>
</tr>
<tr>
<td>Butter</td>
<td>3.13</td>
<td>0.11</td>
<td>3.55</td>
<td>3.32</td>
</tr>
<tr>
<td>Sugar of Milk</td>
<td>4.17</td>
<td>0.18</td>
<td>5.07</td>
<td>5.28</td>
</tr>
<tr>
<td>Various Salts</td>
<td>3.66</td>
<td>0.34</td>
<td>5.40</td>
<td>5.38</td>
</tr>
<tr>
<td>Water</td>
<td>187.02</td>
<td>91.65</td>
<td>87.98</td>
<td>68.80</td>
</tr>
<tr>
<td></td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Cow's Milk</th>
<th>Cows Milk</th>
<th>Woman's</th>
<th>Goat's</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter</td>
<td>4.10</td>
<td>3.00</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td>Sugar of Milk and salts</td>
<td>5.00 (sugar)</td>
<td>4.6</td>
<td>3.7</td>
<td></td>
</tr>
<tr>
<td>Soluble in Alcohol</td>
<td>0.68 (salts)</td>
<td>3.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Casein and insoluble</td>
<td>4.50 Casein</td>
<td>5.1</td>
<td>2.9</td>
<td></td>
</tr>
<tr>
<td>Salts</td>
<td>55.32</td>
<td>87.3</td>
<td>91.0</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

Milk by rest or chemical agents is divisible into 3 separate portions - Cream, Casein, and whey. Cream being lighter than the liquor, casein rises to the surface after the milk has stood for some time. It is neither more nor less than the milk coagulated mechanically suspended in a large quantity of water. It has the following composition according to Bergelius:

Butter 4.5 Casein 3.5 Whey 92.0 = 100. When the

The first 3 are by O. Henri and Chavalier, the last two by Steidler.
stratum of cream is removed from the surface of milk, the remainder goes under the name of Skimmed Milk. Its composition is, Butter traces, Caseine 2.86, Sugar of Milk 35.0, Salts 10.85, Water 928.75 = 1000.0. When Milk is deprived of its caseine as in cheese making it constitutes whey, a greenish yellow fluid containing traces of Caseine and a considerable quantity of saccharine ingredients, originally contained in the milk. Buttermilk owes its acid properties to Lactic Acid, a product derived from the fermentation of the sugar of Milk; it also contains a little caseine and sugar.

Adulterations. There is perhaps no article of diet which is so extensively and constantly adulterated as Milk, and yet the British Public have borne the imposture with a tameness which almost grants permission to fraudulent dealers to continue the practice. The substances ordinarily employed to adulterate milk are water, Chalk, Starch and the brains of animals.

Water might be easily detected if the specific gravity of Milk remained always the same, but like other substances of the body it is subject to much variation so that the Sp. Gr. of any sample of Milk cannot afford any exact criterion of its purity and goodness. The Sp. Gr. of genuine Milk ranges from about 1.024 to 1.030, but there are specimens of pure milk to be met with whose densities are above and below these standards. M. Lassaigne gives 1.031 as the Sp. Gr.
of milk and states that if 73 parts of milk have been mixed
with 25 parts of water the sp. gr. will fall to 1.021 and that
if 66 parts of milk have been mixed with 33 parts of water
the sp. gr. will fall a degree lower. The best method that I
know of for detecting milk which has been diluted with a
large quantity of water is by the colour, pure milk being
of a rich white colour, while that which contains water has
a bluish pearly lustre. The globules of milk mixed with
water do not crowd so closely upon each other as in milk
which has not been so adulterated, indeed the further the globules
are separate the more water has been added as a general rule.

If this substance has been added to milk the following experiment will suffice for its detection: Take a
quantity of the suspected article and dilute it with its own
weight of water, by this means the chalk quickly gravitates
to the bottom, decant the supernatant liquor and dissolve
the deposit (if any) in a small quantity of diluted muriatic
acid; if chalk or any other carbonate has been present,
effervescence will occur, after which the dissolved lime
may be detected by xalate of ammonia. Another method
of detecting chalk is by evaporating a quantity of milk, in-
seminating the residue and treating it will hydrochloric acid
as just mentioned.

Iodine may be detected in milk by adding a few drops of iodine.
to the liquid; or if the microscope is called into requisition, starch granules may be observed floating about among the oil globules.

The brains of animals have frequently been used for the purpose of rendering the milk "creamy". This adulteration can only be detected by the microscope, by the aid of which instrument the anatomical structures peculiar to and characteristic of nervous matter may be identified.

Very frequently milk is deprived of its cream in whole or in part, before, it is sold as "unskimmed milk". Such a fraud might possibly be detected by the hydrometer, but the only way of arriving at proof, upon which reliance can be placed is by ascertaining the percentage of butter in the sample by chemical analysis.

Dietetical uses of milk. Milk forms an agreeable and nutritious article of food and as such is used by the young of mammalian animals during several months of their life. The milk of different animals possesses different nutriment qualities, as the subjoined table indicates:

<table>
<thead>
<tr>
<th>Proximate percentage of nutriment</th>
<th>Carbonaceous</th>
<th>Nitrogenous</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow's milk, raw</td>
<td>6</td>
<td>4.5</td>
</tr>
<tr>
<td>Skimmed milk</td>
<td>5.5</td>
<td>4.5</td>
</tr>
<tr>
<td>Butter milk</td>
<td>11.0</td>
<td>6.0</td>
</tr>
<tr>
<td>Horses' milk</td>
<td>nearly 8.20</td>
<td>1.82</td>
</tr>
<tr>
<td>Woman's milk</td>
<td>10.00</td>
<td>1.52</td>
</tr>
<tr>
<td>Goat's milk</td>
<td>8.60</td>
<td>4.02</td>
</tr>
<tr>
<td>Sheep's milk</td>
<td>9.20</td>
<td>4.50</td>
</tr>
</tbody>
</table>
Seeing that the milk of the ass and of woman contain an excess of calorific elements their presence under this class of compound aliment might seem unadmissible, but when we take into consideration the infrequency of the times we are called upon to attend to their dietary value and the imconstancy of their composition, I think it will appear advisable not to separate the different kinds of milk into two classes notwithstanding their interference with the rules before laid down with regard to classification. Milk is generally easily digested but on account of the butter and caseine contained in it, it frequently proves heavy and indigestible; the latter (Caseine) may be readily removed by boiling the milk and skimming up the coagulated caseine as it rises to the surface in flakes. Whey is very digestible and agreeable on account of which properties it constitutes a very useful drink during sickness and convalescence. The same may be said of butter milk.

Asses Milk is very nearly allied to human milk and forms an excellent substitute for it in cases where the secretion of the latter is temporarily or permanently suppressed or rendered unfit for use on account of some dangerous disease in the female.

Milk is objectionable in some instances where typhsy and inertia of the stomach the food is long retained in
viscus for the sugars of the milk is very prone to commence fermentation and thus derange the digestive organs.

Leguminous seeds such as beans, peas and lentils, by containing an excess of carnivorous elements naturally, come under the class of alimentary compounds to which our attention is at present directed.

Beans the produce of faba vesea contain according to the most recent analyses of Beysen about 51.50 pts. of Carbonaceous to 24.40 of nitrogenous constituents per cent.

Peas the seeds of Pisum Sativum, contain according to Dr. Christie 55.5 pts. of Carbonaceous to 24.5 of nitrogenous compounds per cent. Lentils, the seeds of Evron Lens, have about the same composition.

Dietetical uses of Leguminous seeds. These, beans and lentils are very nutritive and form as will be shown valuable adjuncts to other articles of food. They are easily digested when well boiled especially when they have just arrived at maturity and are yet green. Instead of being unsuited for dyspeptics as some authors say, I think they prove agreeable and beneficial to those unfortunate individuals by combining easy digestibility with strengthening and tonic properties. Much controversy has taken place relative to the nutritive value of the leguminous seeds; the majority of writers deny that they aid in the nutrition of the body and Liebig ac-
inquiring in this view, attempts to explain it by supposing
they do not contain a sufficient quantity of phosphates.
Cereals, whilst offering no opinion as to the validity of
Libris's assertion, suggests the employment of bone ashes
( phosphate of lime) along with beans, peas &c. It appears
to me that a more likely reason for their limited nourishing
properties is their freedom from oleaginous substances
which have been before mentioned as playing a most
important part in the digestive and assimilating process.
Mass by a natural instinct uses beans and bacon together
the one entirely free from the other loaded with oil. I
may here take the liberty to remark that I cannot
too strongly recommend the more general use of legum-
ous seeds, as valuable and economical articles in diet,
in workhouses, prisons, hospitals and other institutions.

Flesh is procured from many domesticated and wild
animals. After their death the whole muscular textures be-
come strongly contract, hard, and inflexible; but after a
time this contraction or rigor mortis as it is called passes
off and leaves the entire muscular system soft and pliant.
Immediately this latter results happens the inherent
vital properties of the individual muscular fibres de-
part and give way to putrefactive changes which render the
meat tender and more digestible, but whether its long exposure
to such changes impart to it desirable qualities. Sand was not prepared today. Although I would rather be inclined to believe that all meats ought to be prepared and eaten when they are on the very verge of putrefaction and that they are unfit for human food after they have become putrescent to any great extent. Different parts of animals are used as food, the most important of which will shortly notice.

Muscular fibre. By this I mean the muscular tissue properly so called together with its tendons, nerves, vessels, fibrous sheaths etc. Schlosberger has analysed the muscular flesh of various animals and has given the following results:

<table>
<thead>
<tr>
<th></th>
<th>Ox.</th>
<th>Calf</th>
<th>Pig</th>
<th>Roe</th>
<th>Chicken</th>
<th>Carp.</th>
<th>Trout</th>
</tr>
</thead>
<tbody>
<tr>
<td>Muscle, vessels, nerves</td>
<td>17.5</td>
<td>15-16.2</td>
<td>16-8</td>
<td>18.0</td>
<td>16.5</td>
<td>12.0</td>
<td>11.1</td>
</tr>
<tr>
<td>Inelastic tissue</td>
<td>2.2</td>
<td>3.2-2.6</td>
<td>2.4</td>
<td>2.3</td>
<td>3.0</td>
<td>5.2</td>
<td>4.4</td>
</tr>
<tr>
<td>Inelastic albumen</td>
<td>1.5</td>
<td>11.1-1.4</td>
<td>11.7</td>
<td></td>
<td>1.4</td>
<td>1.0</td>
<td>1.6</td>
</tr>
<tr>
<td>Muscular extract with salts</td>
<td>1.3</td>
<td>10.1-1.6</td>
<td>0.8</td>
<td>2.4</td>
<td>1.2</td>
<td>1.7</td>
<td>0.2</td>
</tr>
<tr>
<td>Water, extract with salts</td>
<td>-</td>
<td>3.1-1.1</td>
<td>traces</td>
<td>0.1-0.0</td>
<td>traces</td>
<td>0.14</td>
<td>0.6</td>
</tr>
<tr>
<td>Muscle, fat, containing albumen</td>
<td>77.5</td>
<td>77.5-82.78.3</td>
<td>76.9</td>
<td>77.3</td>
<td>80.1</td>
<td>80.5</td>
<td></td>
</tr>
<tr>
<td>Water + ash, 100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Analysis of Lean Meat (Lebey)

<table>
<thead>
<tr>
<th></th>
<th>100.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumen</td>
<td>-</td>
</tr>
<tr>
<td>Gelatine</td>
<td>0.2</td>
</tr>
<tr>
<td>Tannin</td>
<td>0.3</td>
</tr>
<tr>
<td>Moisture</td>
<td>77.7</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>

Analysis of Fleshy System (Rosique)

<table>
<thead>
<tr>
<th></th>
<th>100.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumen</td>
<td>-</td>
</tr>
<tr>
<td>Gelatine</td>
<td>-</td>
</tr>
<tr>
<td>Tannin</td>
<td>12.6</td>
</tr>
<tr>
<td>Moisture</td>
<td>-</td>
</tr>
<tr>
<td>Water</td>
<td>87.4</td>
</tr>
<tr>
<td></td>
<td>100.0</td>
</tr>
</tbody>
</table>
The osmazone increases in meat with the age of the animal and is most abundant in those which have not been reared under the care of man.

The bone, cartilaginous, cutaneous and ligamentous tissues of animals all contain gelatine, the two latter being almost wholly composed of that proteinate principle.

The liver, which contains about 20 per cent of albumen, and kidneys are extensively used as articles of food. Both are very indigestible and altogether unfit for dyspeptics and those who have weak digestive organs.

The sweetbread (thyroid gland) of animals which contains about 19 per cent of albumen, is nutritive and easily digested.

The intestinal canal of animals is made into trite, it is also easily digested as appears from Beaumont's experiments.

Dietctical use of flesh. If thou have little to eat, Beef and mutton are the most digestible of all animal meats and from Beaumont's experiments it appears that the latter is more digestible than the former, consequently mutton ought to be selected by the invalid and dyspeptic in preference to beef or any other animal food. Both beef and mutton are highly nutritious; Dr. Christianson states that the lean of each contains 27.0 per cent of nitrogenous elements whilst the average portions of beef and mutton i.e. those
postions mixed fat and lean contain 15.0 parts of carbonaceous ingredients to 10.75 of nitrogenous. Reared lamb are neither so nutritious nor so digestible as beef and mutton. Pork on account of the large quantity of fat which it contains is very indigestible. Duck meat and also that of the state that bacon, which like all other salted meats is apt to derange the digestive functions, contains 8.36 per cent of nitrogenous, to 62.5 per cent of carbonaceous elements. The flesh of birds is in general easily digested and well suited for dyspeptics and invalids, but some of the domesticated tribes by becoming loaded with fatty matters are rendered objectionable even to powerful stomachs. White fleshed fish as the haddock, whiting, turbot and cod are more readily dissolved in the stomach than those of a reddish colour as the salmon, eel and herring, which contain large quantities of oil. Crabs and lobsters are excessively indigestible and liable to produce urticaria. Oysters are usually considered of easy digestibility, but I doubt whether this is altogether true, at least they are very indigestible when cooked and made into oyster sauce; they are also apt to give rise to skin eruptions and therefore would seem to irritate the mucous membrane of the intestines, for the integumental inflammatory affection appears to be nothing more than the outward manifestation of an irritation existing.
in a homologous texture. Some shell fish, especially mussels, have before now produced fatal consequences on account of some insectitious poisonous principle in them, which has hitherto escaped detection by all the refined and delicate modes of modern analysis. Ordinary butcher's meat, as in the famous German sausages, has also occasionally proved poisonous, seemingly from some putrefactive decomposition.

Class III. Aliments containing an excess of Calorificant ingredients, i.e. aliments containing more than 2½ or 3 pts. of calorificant to 1 pt. of Carno-

caceous elements.

Wheat. There are various species of this grammea

plant cultivated in this country; amongst the most com-

mon may be mentioned Triticum vulgare, T. Turcicum,

T. Omega, and T. monococccum, the seeds of all of which

cemente when ground wheaten flour—an article which

transformed part of the food of man from the remotest period

of antiquity and still deservedly occupies a prominent

place in the Materia Alimentaria of almost every

civilized nation. A general idea of the composition of

wheat may be obtained from the following analyses

of Dumas.
The proportions of the various constituents are however greatly influenced by the state of the weather, locality, fertility of the soil etc.

Wheat flour is of two kinds, coarse and fine. The former contains all the bran or outer husk of the seed, a part rich in glutinous matters and consequently has the same chemical composition as the grain itself; the latter has nearly all the outer covering removed and has the following composition according to Mitchell:

<table>
<thead>
<tr>
<th>Constituents</th>
<th>French Wheat</th>
<th>Odessa Hard Wheat</th>
<th>Odessa Soft Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>Starch</td>
<td>71.49</td>
<td>56.30</td>
<td>62.00</td>
</tr>
<tr>
<td>Glutin</td>
<td>10.96</td>
<td>14.55</td>
<td>12.00</td>
</tr>
<tr>
<td>Sugar</td>
<td>4.72</td>
<td>8.48</td>
<td>7.86</td>
</tr>
<tr>
<td>Decrime</td>
<td>3.32</td>
<td>4.90</td>
<td>5.81</td>
</tr>
<tr>
<td>Water</td>
<td>10.00</td>
<td>12.70</td>
<td>10.00</td>
</tr>
<tr>
<td>Bran</td>
<td>100.00</td>
<td>98.73</td>
<td>98.46</td>
</tr>
</tbody>
</table>

Fine flour

<table>
<thead>
<tr>
<th>Water</th>
<th>No. 1</th>
<th>No. 2</th>
<th>No. 3</th>
<th>No. 1</th>
<th>No. 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>16.5</td>
<td>14.1</td>
<td>15.0</td>
<td>16.5</td>
<td>17.4</td>
</tr>
<tr>
<td>Gluten</td>
<td>8.5</td>
<td>9.5</td>
<td>9.5</td>
<td>8.5</td>
<td>7.7</td>
</tr>
<tr>
<td>Sugar</td>
<td>5.0</td>
<td>4.8</td>
<td>5.5</td>
<td>4.5</td>
<td>5.8</td>
</tr>
</tbody>
</table>

Bread may be either made from coarse or fine flour and in either case may be fermented or unfermented.

Fine fermented bread (Baker's Bread) is made by mixing flour into a paste with a certain quantity of water and adding to the mixture a little yeast. To see the import of the addition of the yeast, we must con-
Consider the action of malt upon starch and yeast upon sugar described at pages 73-4-5-61. There it will be seen that the nutritious gluten of the malt or yeast converts starch into dextrin, 2nd into grape sugar and 3rd grape sugar into alcohol and carbonic acid. The same series of actions take place in baker's dough and have been unnecessarily included under the term 'panary fermentation,' for it differs in no respect from the alcoholic fermentation before alluded to. Both the alcohol and carbonic acid are rapidly dissipated, the former on account of its volatility, the latter by reason of its gaseous properties; but as the carbonic acid is disengaged it distends the tough and pasty mass so that it renders it porous, spongy, and light. If the process of fermentation is not stopped at a certain period the alcohol generated in the third stage undergoes acetification i.e. it is converted by oxidation into acetic acid (page 104) and gives to the bread a sour taste. If on the contrary the fermentation does not proceed far enough, the bread, instead of being spongy and light, is flat and heavy.

Unfermented bread may be made in one of two ways, either by simply baking a mixture of flour, water or milk in which case it is heavy and totally devoid of that lightness and sponginess which belongs to that
bread whose dough has been permeated with gases, or by adding substances, which by their chemical union set free gaseous products which expand the tough elastic mass. The chemicals generally employed for this purpose are Bicarbonate of Soda and Mutaric Acid or Carbonate of Soda and Tartaric Acid, the former serve two purposes for they not only by their decomposition raise the bread, but also salt it by means of the chloride of sodium formed during their decomposition.

Coarse underfermented and underfermented bread are made in the same way as the same varieties of fine bread.

Adulterations of flour and bread. These are pretty numerous, but none possess deleterious properties with the exception of flour. Barley and pea flour are sometimes added to whole flour; they may be detected by the peculiar sickening smell which they evolve when the adulterated flour is moistened with boiling water. Barley carbonate of lime and bone earth (Phosphate of lime) have both enjoyed a reputation as articles with which flour and consequent bread have been contaminated. Their presence may be recognised by treating an emulsion of the flour with diluted hydrochloric acid (if Carb. Plime is contained in it effervescence will be produced), filtering and testing with oxalate of ammonia; after the filtered liquid...
Potato meal is almost universally added in large quantities to flour, especially the coarser kinds. It may be detected by the microscope.

Alum is extensively used by Bakers for two purposes: for rendering coarse and discoloured flour white and for making the bread take up an additional quantity of water. It may be detected in the following manner, "First heat 1000 gms. of the flour or bread, then boil in a flask with 4 drs. of Nitric Acid, 4 drs. of Hydrochloric Acid, and 4 drs. of water, evaporate to dryness; while boiling when cold add 1 oz. of distilled water and boil for a few minutes, while boiling dilute with 2 oz. of liquor potasse and boil again for a few minutes; then filter, neutralize with Hydrochloric Acid and precipitate with Ammonia" (Dr. Haswell).

Dietetical uses of bread. Having taken a cursory glance at the different kinds of bread, it will be necessary for us to consider as briefly as possible their different recommendations in a dietetical point of view. The proportion of nutritive elements contained in flour and bread, as before stated, is subject to much variation; the following table will however convey some idea as to the quantity of the nutrients contained in 100 parts of each.
Although wheat, of all the cereals, contains the best proportion of carnosaceous and calorific cereals ingredients, yet the former are not in sufficient abundance to support the nutrition of the agitated tissues. As to the difference between fermented and unfermented bread in regard to digestibility, little or nothing need be said, except that the latter agrees better with those labouring under or subject to dyspepsia, probably because it is not so susceptible of inducing fermentation in the stomach as bread which has undergone that process preparatory to baking.

Unfermented bread is more economical than fermented bread, and the reason of this is very evident when we consider the changes which take place during. Mr. Jorgenson, in his handbook of organic chemistry states that the quantity of flour which will yield 1500 leaves by fermentation furnishes 1600 by the new method. Dr. Douglas Maclagan, in a paper in the Medical and Surgical Journal for 1855, page 104, denies this statement, and details a few analyses of his own to bear \* exclusive of sugar, gum, etc.
his assertion, which is to the following effect: that it is the increase in the quantity of water in the unfermented bread which produces a greater number of loaves from a given quantity of flour. Have not the least doubt that the difference arises from a saving in the alcohol producing constituents although it may not be to the extent which Dr. Gregory would lead one to believe.

We may now ask ourselves a very important question for the solution of which we are often called upon, not only in public but in private practice. Is there any difference in the nutritive properties of coarse and fine bread? Certainly there is, for chemical analysis has pointed out that the bran contains a larger proportion of nitrogenous principles than any other part of the grain and consequently that wheaten is more nutritious than the finer varieties of bread, while at the same time it is not as expensive. But there is another advantage which appertains to wheaten bread and that is that it is not so liable to produce constipation for it mechanically acts as a moderate but at the same time very effective irritant to the mucous membrane of the intestines. For this reason it ought not to be given to children and persons in whom the digestive organs are very irritable.

Oats are the produce of Avena sativa. They deprived of their outer covering they are called groats from which
gruel—a very valuable liquid aliment for invalids—is prepared. When groats are ground oatmeal is obtained, from which a very large proportion of the inhabitants depend for food. Oatmeal contains a large quantity of Carbohydrate food and thus forms a very cheap and valuable caloric agent. It also contains much nitrogenised ingredients. But the quantity of these is too small for to support the rapid and great destruction of the fibrous tissue of the working man whose diet chiefly consists of oatmeal. Not nature has sufficiently guarded against this diabolical error by instinctively causing man to have a taste of large quantities of milk with those preparations into which oatmeal enters as the fundamental part.

Dr. Christison states that oatmeal contains 65.75 parts of Carbohydrate, and 16.25 of nitrogenised ingredients per cent. Oats contain a larger quantity of oil than any of the other cereal grains, this oil not infrequently becomes rancid and acid, to much so as not only to give the meal a disagreeable taste, but even sometimes to peril the existence of the consumer. The coarse grains of oatmeal and the remains of the inner part of the floral envelope are very liable to excite diarrhoea in some people, while in others they cause intestinal concretions; these are formed by the beards and fragments of the inner nearly covering
of the seeds agglutinating together to form a nucleus around which various salts and the undigested remains of various substances stick until a ball of considerable size is formed. These concretions are now very rare owing to the very perfect manner in which Machinery prepares every description of food. Formerly and indeed at a distant date the separation of the chaff from the grain was effected by exposing both to a favourable breeze, an operation of great difficulty and very often imperfectly performed, and the next process that of bruising the grain which was done by manual labour was still more tedious and at the best but a feeble attempt to assist the grinding action of the stomach. Oatmeal does not make strongy bread and is very little used for this purpose.

Barley is the produce of several varieties of Hordeum. Large quantities of it are used by the distillers for the making of malt. When deprived of its husk it is called O. V. barley and when pounded pearl barley, both of which are used for the preparation of broth. A decoction of pearl barley is used in the sick rooms under the name of barley water as a very useful demulcent drink. Barley is sometimes made into bread which is close in texture, agreeable to the taste but not very easily digested and liable to excite heartburn. Barley-meal contains a
large amount of Calorificent Constituents, and a consider-
able quantity of Carbohydrate. The former according to
Dr. Christian (in pearl barley) 67 0/50; according to Dr. Johnston
(in Barley meal) 68 parts per cent; of the latter according
to Christian 15 0/50; according to Johnston 14 0/50, per cent.

When barley meal is mixed with peas or beans a highly
nutritious bread is formed combining the Carbonaceous
food of the barley with the nitrogenous of the beans or peas.
By taking the analyses of Christians for the proportion
of these constituents in barley and peas we see that the
barley and pea bread contains about the required
proportion of Calorificent and Carbohydrate ingredients.

<table>
<thead>
<tr>
<th>Barley meal from pearl barley</th>
<th>Carbonaceous</th>
<th>Nitrogenised</th>
</tr>
</thead>
<tbody>
<tr>
<td>67 0/50</td>
<td>55 0/50</td>
<td>24 0/50</td>
</tr>
<tr>
<td>52 0/50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12 0/50</td>
<td></td>
<td>39 0/50</td>
</tr>
</tbody>
</table>

This is a very economical bread, highly nutritious and not
difficult of digestion especially in those who are habituated
its use, viz. the Agricultural population among whom
it is the staple article in the way of bread. I am much
surprised that such bread is not used in charitable
institutions, prisons, and workhouses, especially at a
time when there is a general cry for economy throughout
all the public departments.

Maize is largely imported into this country for
the purpose of making Indian corn meal which contains about 67 per cent of Calorificant elements and 1 1/2 of Carnifacient. It is very valuable as a diet for children and invalids when prepared with milk.

Rice contains about 85 per cent of Calorificant and 0 of Carnifacient food. It is very digestible and like Indian corn valuable for children and those of weak digestive powers when made with milk.

Potatoes. The potatoe is a very valuable article of diet, valuable not only for its nutritious qualities but for its antiscorbutic properties which it possesses on account of the minute quantity of Citric Acid which it contains. The following is the composition of real potatoes according to Michaelis,

<table>
<thead>
<tr>
<th>Component</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>66.825</td>
</tr>
<tr>
<td>Starch and amylaceous fibre</td>
<td>30.469</td>
</tr>
<tr>
<td>Alburnose</td>
<td>0.503</td>
</tr>
<tr>
<td>Gluten</td>
<td>0.056</td>
</tr>
<tr>
<td>Fat</td>
<td>1.995</td>
</tr>
<tr>
<td>Gum, Asparagine, extractive &amp; salts</td>
<td>0.047</td>
</tr>
<tr>
<td>Free citric acid</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>100.000</td>
</tr>
</tbody>
</table>

Potatoes are very indigestible when young owing to the large quantity of fibrous tissue which they contain, but after they have attained maturity they become mealy from the deposition of a large quantity of starch in their fibrous matrix. Dr. Christian states that they con-
tain 24.5 Jts. of Calorifician and 2.5 of Carnofacient ingredients per cent.

Chocolate and Cocoa are both got from the cacao tree (Theobroma Cacao). The former is prepared by grinding the kernels of the seeds alone, the latter by grinding both kernels and pods. Before however, the seeds are reduced to powder they are subjected to pressure to act to free them from a large quantity of oil which they contain. This oleaginous substance is of a semi-fluid consistency and called butter of cacao, it constitutes about 53 per cent of the seeds but a small quantity is also contained in the husks. Lampard gives the following as the composition of cocoa seeds:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Fat, matter</td>
<td>53.10</td>
</tr>
<tr>
<td>Albuminous</td>
<td>16.70</td>
</tr>
<tr>
<td>Fiber</td>
<td>10.91</td>
</tr>
<tr>
<td>Gum</td>
<td>7.75</td>
</tr>
<tr>
<td>Theobromine</td>
<td>6.90</td>
</tr>
<tr>
<td>Ash</td>
<td>2.61</td>
</tr>
<tr>
<td>Water</td>
<td>3.43</td>
</tr>
<tr>
<td>Does</td>
<td>100.00</td>
</tr>
</tbody>
</table>

They also contain a crystallizable alkaloid called theobromine which bears much resemblance to theine. Its composition is C_{10}H_{15}N_{3}O_{2}.

Adulterations of chocolate and cocoa. Animal fats are frequently added to such preparations. They may be detected as pointed out by Mitchell, by spreading
a thin layer of the chocolate and cocoa upon a sheet of paper and exposing it to the atmosphere, by this means the foreign fatty matters will be oxidized and become so rancid that they can at once be detected by their taste. Oil of cocoa undergoes no change by exposure to the atmosphere.

Starch is frequently, if not always, constantly added to cocoa and chocolate. As they naturally contain a quantity of starchy matter the iodine test, as was formerly recommended, is worthless. The microscope can only detect the presence of starch granules artificially added.

Sugar can be recognised by the taste, if the quantity added has been large.

Chalk when it has been fraudulently mixed with either cocoa or chocolate causes effervescence when sulphuric acid is dropped upon an adulterated specimen.

Dietetical use: Both chocolate and cocoa form very agreeable drinks and besides they are highly nutritious containing according to Dr. Playfair, 65.76 per cent of mineralised and 9.58 per cent of organic elements in 100 parts. They are also easily digested even by dyspeptics and merit more extensive use than has hitherto been given to them.
Class IV. Nutrient drinks.

Definition. Milk, consisting of water holding in solution minute quantities of organic substances.

Tea and Coffee. Much doubt exists as to the distinctive botanical differences between the shrubs which yield green tea and those which yield the black varieties; some botanists hold that they are both the product of one species (Thea sinensis), while on the contrary assert that each kind of tea is prepared from different species: green tea from Thea sinensis and black tea from S. Bohea. Be this as it may, their essential chemical composition and physiological actions are similar in every respect.

Mulder has carefully analysed black and green tea and has given assigned to each the following composition:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Tea</th>
<th>Green Tea</th>
</tr>
</thead>
<tbody>
<tr>
<td>volatile oil</td>
<td>0.79</td>
<td>0.60</td>
</tr>
<tr>
<td>chlorophyllide</td>
<td>2.22</td>
<td>1.84</td>
</tr>
<tr>
<td>wax</td>
<td>0.28</td>
<td>0.10</td>
</tr>
<tr>
<td>resin</td>
<td>8.32</td>
<td>3.84</td>
</tr>
<tr>
<td>gum</td>
<td>17.89</td>
<td>12.88</td>
</tr>
<tr>
<td>tannin</td>
<td>0.43</td>
<td>0.46</td>
</tr>
<tr>
<td>theine</td>
<td>22.85</td>
<td>19.88</td>
</tr>
<tr>
<td>extractive</td>
<td>1.48</td>
<td></td>
</tr>
<tr>
<td>ash from theine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>extractive (fermented)</td>
<td>23.60</td>
<td>19.12</td>
</tr>
<tr>
<td>hydrochloric acid</td>
<td>3.00</td>
<td>2.80</td>
</tr>
<tr>
<td>allumine</td>
<td>17.08</td>
<td>28.32</td>
</tr>
<tr>
<td>fibrous matter</td>
<td>5.75</td>
<td>95.30</td>
</tr>
</tbody>
</table>

Salt included in the above:

95.24
Coffee is obtained from Coffea Arabica, a native plant of Arabia. The seeds after being taken out of the husks are roasted and then ground. The ground root of Chicory—an indigenous plant of the British Isles—is almost invariably present in ground coffee; it can only be satisfactorily detected by the microscope, the long spiral vessels of the powdered Chicory bearing a strong contrast to the opaque, angular cells of which genuine coffee only consists. Starch may be detected in coffee either by the microscope or by the iodine test.

Payen has chemically examined coffee and has given the following as the result of his analysis:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cellulose</td>
<td>31.000</td>
</tr>
<tr>
<td>Water</td>
<td>12.000</td>
</tr>
<tr>
<td>Fatty substances</td>
<td>10 to 13.000</td>
</tr>
<tr>
<td>Glucose dextrose</td>
<td>15.500</td>
</tr>
<tr>
<td>Leguminous matters</td>
<td>10.000</td>
</tr>
<tr>
<td>Caffeine</td>
<td>3.5 to 5.000</td>
</tr>
<tr>
<td>Tannin substances</td>
<td>3.000</td>
</tr>
<tr>
<td>Free Caffeine</td>
<td>1.800</td>
</tr>
<tr>
<td>Concrete essential oil</td>
<td>0.001</td>
</tr>
<tr>
<td>Ash</td>
<td>0.002</td>
</tr>
<tr>
<td>Mineral substances</td>
<td>6.697</td>
</tr>
<tr>
<td>Total</td>
<td>100.000</td>
</tr>
</tbody>
</table>

Dietetic use of tea and coffee. Both tea and coffee yield their active principles to boiling water and therefore require no other mode of preparation than simple infusion. They ought not to be made too strong as they are then very apt to derange the nervous system and digestive organs.
Sea and coffee act as direct stimulants to the nervous centres and as such are very useful in exhaustion and fatigue following severe corporeal and mental labour. Both tea and coffee are occasionally employed for the relief of neuralgic cephalalgia.

Whether theine and caffeine possess any nutritive properties remains a question which can neither be positively affirmed nor absolutely denied. Liebig has theoretically attempted to show how taurine (a constituent of bile) can be derived from theine, but his explanation appears to be very unsatisfactory inasmuch as taurine contains a large quantity of sulphur while theine contains but a trace of that elementary body. It cannot, however, be doubted that the minute quantities of alimentary principles, which tea contains and which we have before seen to be highly nutritious, support either the animal heat or repair the waste of the worn-out textures; even theine has been looked upon by some as an agent which has the remarkable property of diminishing the wear and tear of the tissues.

I intend to have given a chapter upon the employment of diet therapeutically, but as I have (as this time) no space at my disposal I must refrain.
from doing so. Christopher James Allen.