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THE CHEAPEST AND MOST NUTRITIOUS FOOD FOR CHARITABLE INSTITUTIONS AND THE POOR.

BEING THE RESULT OF AN INQUIRY, MADE BY DESIRE, ON THE FOOD SUPPLIED TO THE HILL STREET FEMALE REFUGE.

BY

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TO THE SECRETARIES OF THE HILL STREET INFANT NURSERY AND LAUNDRY.

52, Montague Square,
August 7, 1854.

Ladies,

Having been requested by the Ladies' Committee of the Hill Street Refuge, to provide a new Diet List for the inmates of the Institution, I have thought it best in doing so to pre mise by a short and popular treatise on the subject of food generally. There can be no doubt that much of the disease which occurs in public institutions arises as often from the injudicious quality, as from the deficient quantity of the food supplied. This is especially the case in institutions like yours, where the inmates are growing children, already debilitated by previous privations, and necessarily, therefore, requiring better and more nutritious food. I have reason to fear that much of the scrofula which has broken out among the children during the past year, is referrible to some such influence. The period in which we live is, from the high price of provisions, one in which such accidents may be expected. A proper acquaintance therefore with the laws of alimentation becomes doubly necessary. To determine which is the cheapest, and at the same time the most nutritious food, is a question which regards all classes; the poor especially are deeply interested in it.—For these reasons I have thought it best to publish the following report, in the hope that some attention may be given by all to these points, especially in charitable institutions; and that some good may thereby also result to a considerable portion of our working poor.

I have the honour to be,

Ladies,

Your obedient Servant,

C. H. F. ROUTH

THE CHEAPEST AND MOST NUTRITIOUS FOOD
FOR
CHARITABLE INSTITUTIONS, &c.

Part I. Introductory.

Looking to the physical structure of the human frame, we remark that it consists of two portions : first, a more or less solid portion, consisting of the skeleton, flesh, internal organs, brain, &c. ; secondly, a liquid portion, the blood. These also differ in another respect. The first needs not necessarily be in motion, and is not usually so, except when directed by the will. The second must be continually in motion : any arrest of this being inconsistent with health, and, if for a prolonged period, with life. A closer and chemical examination informs us that, however different the physical appearance of these two portions, they differ rather in the relative proportion of their constituents ; since nearly all if not all, the elements of the former are to be found in the latter. And probably, therefore, with these simple premises, the conclusion would be warranted that the solid portion is simply deposited from, or owes its origin to the blood. And such is in general terms the fact.

This may be made more clear, and illustrated by a comparison. Take the example of a large river, which passes through an extended country. The river fertilizes and waters the soil on the banks It deposits some of its contents in one part, and takes up material from another part, under the influence of heat, light, position, &c. It may be thus said both to purify and nourish the adjacent soil. Let us now extend this supposition. On the banks of this river or some of its dependent streams are a number of small manufactories of divers kinds ; all these however, appropriate portions of this water, whether for the movement of the machinery, or the preparation of the articles made, and eject their refuse back again into the stream. 'The river itself receives its waters from one or more tributary streams, and finally much changed, empties its waters by one or more branches into the sea. So it is with man. The blood is the river—the more solid portions of the body, the adjacent country—the manufactories, the secreting and excreting organs, the liver, sweet-bread, &c.—the tributary streams, particular portions of the alimentary canal, and the lungs, the one receiving food, the other atmospheric air—the branches by which the river empties itself are portions of the same alimentary canal and lungs, the perspiratory glands, the kidneys and its appendages, &c. The sea is the external world, into which all indigestible and refuse matters are ejected.

The above example, given to elucidate the general plan of man's physical structure, fails however in some points.

First. The river is exposed everywhere to atmospheric influence. The blood is always enclosed in certain vessels (called arteries and veins), and it is only in the ultimate ramifications of these, still in small tubes, (called capillary vessels from their size) that they are exposed to the air. This is chiefly done in the lungs, perhaps also in the skin.

2. The river moves along its course as its level becomes lower and lower. The blood is propelled onward by a special hollow organ (the heart). By the contraction of the left half of this organ, the blood is propelled into a large tube (the aorta) which gradually divides and subdivides in smaller and smaller tubes and in this way the blood is carried into every part of the body. These tubes are the *arteries*, which terminate in small capillary vessels. In these capillary vessels the blood is chemically changed and converted

from arterial into venous blood. These capillaries by reuniting again, at last terminate in larger vessels, the veins, which uniting and reuniting in their turn, at last terminate in two large trunks, which empty themselves into the right half of the heart. This right half, contracting in its turn, propels the blood into the lungs by another large vessel (the pulmonary artery), which by frequent subdivision, again terminates in capillaries, in which last the blood is exposed to the air, and chemically changed into arterial blood. These capillaries again, by frequent reunion, finally terminate in a large vein (the pulmonary vein) which conveys the arterial blood into the left cavity of the heart, and the same process begins again.

3. The alimentary canal receives the food or aliment taken, which, after having undergone a series of chemical changes in it, is finally converted into a liquid called *chyle*, while the indigestible portion is carried away in the draught. This chyle is taken up in special vessels which empty themselves into a vein, through which vein, conducted into the right side of the heart, and thence into the lungs, it becomes by exposure to the atmosphere converted into blood.

The blood is therefore aptly called the life, as it is essentially the source through which all these processes are carried on. The composition of this fluid is as follows.

Water			779.9
Solid Constituents . . .			220.
Blood Corpuscles	Hæmatin	7.	
	Globulin	123.	
Fibrine . . .		2.1	
Albumen . . .		77.4	
Fatty Matters	Saponified fat Phosphoretted do. Cholesterine Seroline	1.1	
Extractive Matters and Salts		9.3	

The salts are (by another analysis) in the following proportions :—

Common Salt and Chloride of Potassium	4.7
Phosphate of Soda (Sal Mirabile)	1.4
Sulphate of Soda (Glauber Salt)	.4
Carbonate of Soda and Potash	.5
Bone Earth	.7
Peroxide of Iron	1.3
Chalk and Gypsum	.3
Loss	.1
	1000

It is therefore and a priori clear that these elements at least must enter into the composition of food for the support of man.

The food of man may thus be said to consist of three kinds. 1st. Food for the reparation of the body. 2nd. Food for the respiration. 3rd. Mineral agents for the proper action of the two first.

1. The aliment which I have distinguished as *food for the reparation of the body*, and which are here found to occur in the blood, are Fibrine, Albumen, and Globulin. This last is considered by Simon as a peculiar form of *Casein* (or *cheese.*) It must not be confounded with the globuline of Lecanu, which is merely impure coloring matter of blood mixed with Albumen.

These three substances are supposed to be all compounds of a simple substance called *protein*, which is itself a compound of 40 parts of Carbon, 31 of Hydrogen, 5 of Nitrogen and 12 of Oxygen.

These four substances named have the following composition. Thus:

Albumen of blood	10 Proteine,	2 Sulphur,	1 Phosphorus
Fibrine	10 ———	1 ———	1 ———
Casein	10 ———	1 ———	
Globulin	15 ———	1 ———	

All these bodies, however, are readily convertible one into another, and may as aliments, be considered for all practical purposes as identical.

Fibrine is the principal constituent of flesh. From the blood it is easily separated, by stirring the blood up with fine rods. It adheres to these after a time as fine shreds. It exists also in the vegetable kingdom as *gluten*; when flour is enclosed in a bag and washed under water, the gluten is that portion which remains in the bag, the starch having been thereby separated from the flour: or as *vegetable fibrine* the greenish tinged precipitate deposited in the newly expressed juices of vegetables after they have stood a little while, duly freed from colouring matter.

Albumen occurs in the white of eggs, or in the serum of blood. Its analogue in the vegetable kingdom is *vegetable albumen*, which is obtained as a precipitate, when the clarified juices of cauliflower, asparagus, mangel wurzel, turnips, or other nutritious vegetables are boiled in water.

Casein exists in milk, or cheese — or probably as *globulin* in blood. Its analogue in the vegetable world is *legumin* or vegetable *casein*, obtained from the seeds of peas, beans, lentils and other leguminous plants. After the subsidence of the albumen, if the remaining solution is evaporated, a skim forms on its surface, and the addition of an acid causes a coagulum just as in animal milk by rennet. The Chinese prepare in this way a cheese called *tao-foo*. The paste from steeped and ground peas is boiled, which causes the starch to dissolve with the casein. After straining the liquid it is coagulated by means of gypsum. The coagulum is worked up like acid milk, salted, pressed in moulds to form an amylaceous cheese.

There are several other compounds to this group. These are 3 other proteinacous compounds, usually spoken of as aliments. 1. Glutin, obtained by boiling skin in water, constituting the glue of commerce. 2. Chondrine, by treating cartilages, and, 3. Gelatine properly so called, by treating tendons, in the same maner. These are generally spoken of as gelatine collectively. These three substances are also compounds of protein and may be expressed as consisting of 1 part of Protein, 4 parts of Water, and 2 of Oxygen. None of these however exist ready formed as such in the body. They are products of decomposition: and gelatine is generally believed to be not only innutritious but positively injurious. To these reference will be again made.

There are besides, a host of other compounds in this class, all of which however bear a very close analogy to the three former, and are readily mutable into these by digestion. Such are pyine, albuminose, and ptyaline, &c.

This class of substances contains a large quantity of *Nitrogen* or *azote* in their composition. Now Nitrogen is invariably regarded in the present day, as the test of the nutritious nature of an aliment: and, cæteris paribus, when the substance which contains it is digestible and not poisonous, this may be considered strictly true. For instance, hair and horn contain Nitrogen in large quantity, but they are indigestible. Urea is a Nitrogenous body but a poison.

For the foregoing reasons, the terms *plastic*, *proteinaceous*, *nitrogenous* or *azotized*, have been applied to distinguish these bodies.

2. *Food for the respiration.* The blood as before stated contains fatty matters. In addition it contains saccharine matter. As this last however if present in normal quantities, is consumed as fast as it is formed by the liver, in the lungs, and if in excess is very rapidly exhausted by the kidneys, the usual chemical examinations of blood taken from the body, do not

include it,—blood taken however as it comes from the liver and before it enters the lungs, &c. contains it in notable quantities. The sugar exists as *grape sugar* or *glucose* in the body, and all varieties of sugar become converted by the process of digestion into glucose. The same kind of sugar is found in milk and generally called milk sugar.

The fatty matters in animal bodies are various. In addition to those before enumerated they include in their number suet, lard, marrow, blubber, and butter.

But both sugar and oils and fats, exist largely in plants. The former is chiefly found as cane, beet, maple, and grape sugar or glucose. All these varieties however are converted in the process of digestion into glucose. But a chief source from which sugars are obtained for the body is the starch taken as aliment. All varieties of starch are during digestion converted into *glucose*, the admixture of a little saliva being sufficient to insure this change. *Gum* is analagous in its uses to starch, although it is probable that it is not so readily converted into sugar, or so digestible.

The oily matters are various and are usually divided into fixed and volatile. These sometimes exist in large quantities in plants. Thus in the olive and palm trees there is much fixed oil. In the peppermint much volatile oil.

Lastly. Alcoholic liquors of all kinds, from spirits down to the weaker beers and porters, are aliments of this class. These have a tendency to become converted in the chemical laboratory of the body, into fat.

Thus oil of all kinds, sugars, starch, gums and alcoholic liquors, are classed among combustible aliments. In general composition they consist of Carbon and Hydrogen, with or without Oxygen, and in their transmission through the body, it is believed they are burnt or consumed, becoming converted into Water and Carbonic acid, and thus give rise to animal heat. Their power of producing heat. and their relative value as respiratory food, is in direct proportion to the quantity of Carbon and Hydrogen contained.

The animal heat of an animal bears a proportion to its respiration. It is least in cold blooded animals, greatest in birds, and here there is a direct relation to the amount of Carbon and Hydrogen consumed. Again hybernating animals afford a striking proof of this relation: as for instance the bear. The bear becomes very fat towards the fall. As the winter sets in it falls into a semi-torpid state; during which period no food is taken. The respiratory function however imperfectly, goes on: but the body falls in temperature; at the end of the winter season the animal apparently resuscitates, weakened it is true and remarkably thin, the fat having been consumed by the respiration. Disease affords us also a positive lesson on this matter. In fevers in which the animal heat is raised in man from 98° so as to reach 103° and even 110° the respiration is hurried. As life decays the respiration is slower, the animal temperature likewise falls. Conversely in consumption the respiration is much increased in frequency. Hence the hectic fever and perspirations to relieve the excess of heat: and the system is drawn upon to supply for the excessive combustion, there being insufficient fat taken in the food to make up for the increased demand. Hence also one of the reasons why Cod Liver Oil is so effective a remedy in that disease, supplying the ingredient directly required, and allowing the system to rally.

Health affords also its negative as well as positive evidence of the relation of respiration to animal heat. The habitual warmth of the surface of the skin in active persons contrasts with the coldness of that in the sedentary, in whom the respiration is less active.

Hence the warming influence of a good race, an exercise during which the respiration is hurried.

The extraordinary appetite of the natives of cold climates, as compared with those of the more temperate is made hereby susceptible of explanation. Ten pounds of flesh and oil is not an unusual quantity for an Esquimaux to devour in twenty-four hours, besides drinkables. The very coldness of the temperature requires a larger amount of duty to be performed by the lungs. Besides, the capacity of the chest is, on an average, the same in all climates. The atmosphere, however, expands by heat, and contracts by cold; moreover, in very cold air there is an absence of moisture, which abounds in hot. It must needs be, therefore, that a given volume of air inspired in a cold climate must contain absolutely more oxygen than if inspired in a hot climate; more combustible aliment, more *fuel*, so to say, must be therefore consumed, by reason of the greater quantity of oxygen inspired; and secondarily, to keep up animal heat. It is a matter of common experience, that the appetite is keener in cold than in warm weather; indeed, bakers and butchers have practical knowledge of this in the larger stock of provision prepared in winter as compared with summer. The converse proposition is equally illustrated in the familiar proverb, " The south wind always blows after dinner." Providence seems, in like manner, to have pointed out that, in warm climates, less combustible food is required. The fruits in these countries contain only about 12 per cent. of carbon, and 2 to 4 per cent. of hydrogen. On the other hand, the fat, blubber, and oily food, on which the inhabitants of the snowy regions subsist, contain 70 to 80 per cent. of carbon, and 10 to 13 per cent of hydrogen. Thus is again exemplified the supreme wisdom of the Creator, who placed at the disposal of man, according to the climate each inhabited, those articles of food most appropriate and necessary to his existence; and it is chiefly when he transgresses in selecting food not of a kind adapted to the climate in which he resides, that disease results. Hepatic derangements, or diseases arising from excess of carbon in the system, are most common in summer and in tropical climates, because this excess is not consumed in the lungs. Pulmonic disease, on the other hand, is more frequent in winter, from a diminution of hydrocarbon, and an excess of oxygen.

These aliments for the above reasons have been distinguished as *respiratory*, *combustible*, and *hydro-carbonaceous* food. Their more precise composition may be stated as follows: Oil of fat being taken as the type of the fatty matters:

	Carbon	Hydrogen	Oxygen
Oil of fat	11	10	1
Glucose or grape sugar	12	14	14
Gum	12	10	10
Starch	12	11	11
Alcohol	4	6	2

As these substances are well known to most persons, they require here no further description.

3. The *mineral class of aliments*, consists chiefly of common salt, phosphate of soda, Glauber salts, carbonates of soda and Potash, Bone earth, Iron, Chalk, and Gypsum besides Water. These, although themselves innutritious, are yet essential to life, the phenomena of which in their absence could not be carried on. They are in fact those agents by which the nitrogenous and combustible aliments, are preserved either in such solution, consistence, or solidity, as to be useful for the purposes of the economy.

Thus the alkali, may be said to hold in solution the albumen and casein in blood and milk. The bone earth gives solidity to the skeleton, &c. In some animals there is excess of phosphate of soda in the blood, a salt which has an alkaline reaction. This is especially the case with carnivorous animals. In others excess of carbonate of soda, as in herbivorous animals. In both cases the salt serving the purpose of a solufying alkali in the blood.

Vegetable and animal aliments of all kinds contain these salts although in variable quantities. It is a practical distinction to be made between these two great classes that animal food contains more phosphoric acid, more soda and iron; vegetable food more carbonic acid, and potash, with silica.

There is a direct proportion between the quantity of phosphoric acid contained in a plant, and the amount of nitrogenous matter. Those richest in the former are also richest in the latter.

This will suffice to prove the importance of mineral aliments and their uses. They will be incidentally again alluded to in the sequel.

There is one fact in common with all these three classes of aliments which is of great interest. It is that the pure essential aliments of no one class, are capable of supporting life for any lengthened period. After a time, varying from a week to a month or perhaps a little longer, animals die with all the symptoms of starvation. This was proved by a commission of French Academicians who investigated this question, by experiments upon dogs and other animals. A few of these conclusions may be here stated.

1. Dogs were fed on food containing no nitrogen, for instance sugar and distilled water. During the first seven or eight days they continued lively, and with good appetites. The second week emaciation, debility and loss of appetite came on. Ulcers now made their appearance on the cornea of the eye, through which finally, the humours of the eye escaped. These symptoms increasing in intensity, death took place from the 31st

to the 34th day. It should be remembered that dogs kept without food will live as long. Precisely the same phenomena and ulceration of one eye took place in feeding dogs on butter. Dogs fed on olive oil and fat or gum also died in about the same period, only there was no ulceration of the eye.

Tiedemann and Gmelin confirmed further these experiments. Three geese were fed, one on sugar and water, and died on the 22nd day;—another, on gum and water, and died on the 16th day;—another, on starch and water, and died on the 24th day. A goose fed on boiled white of egg (albumen), died on the 46th day, although it maintained its appetite to the last.

The necessity for the variation of diet was also proved by some further experiments of Magendie. A dog fed on white bread died of starvation on the 50th day. Rabbits and guinea pigs fed on any one of the following substances, wheat, oats, barley, cabbage, or carrots, died with all the signs of inanition in 15 days. An ass fed on dry rice and afterwards on boiled rice died in 15 days. Dogs fed on hard eggs or cheese lived a long time but got very weak and lost their hair and flesh.

In speaking of the plastic varieties of food, I spoke of them only as non-combustible aliments. But as they also contain Carbon and Hydrogen, besides the Nitrogen it is clear they may act as combustible aliment occasionally although relatively at a loss. The true combustible aliments cannot act as plastic aliments, because they contain no Nitrogen.

With a view to determine the relative value of aliments various means have been employed. Prout from the first took milk as the best example of food that could be selected. The composition of this fluid may be stated as

Casein	4·48	The salts being	
Butter	3·13	Bone earth, Common salt,	·75
Sugar of Milk	4·77	Phosphate of magnesia, Soda,	
Salt	·75	Phosphate of iron	
Water	86·67	Chloride of Potassium	

Here we have most of the salts found in blood, besides a nitrogenous element, Casein, which may be converted by digestion into albumen and fibrine as before stated—and two combustible elements, butter and sugar. Schlossberger and Kemp took for their standard human milk which has the following composition :—

Water	883.6
Butter	25.3
Casein	34.3
Sugar of milk and extractive matters .	48.2
Fixed Salts	2.3
	In 1000 parts

and thereupon have calculated the following table in which the amount of Nitrogen contained in human milk is reckoned as 100. The numbers opposite each aliment indicate the relative value of other aliments on this scale. Thus if a given quantity of human milk affords 100 parts of plastic food, the same quantity of rice or beef will yield respectively 81 and 880 parts.

Table of Relative Nutritious Value of Aliments.

Vegetable Food.

Rice	81	Oats	138	Peas	239
Potatoes	84	White bread	142	Agaricus russula	264
Turnips	106	Wheat	119-144	Lentils	276
Rye	106	Carrots	150	Harricot beans	283
Maize	100-125	Brown bread	166	Agaricus deliciosus	289
Barley	125	Agaricus cantharellus	201	Beans	320

Animal.

Human milk	100	Salmon raw	776	Flounder raw	898
Cow's milk	237	——— boiled	610	——— boiled	954
Oyster	305	Liver of Pigeon	742	Pigeon raw	756
Yolk of egg	305	Portable soup	764	——— boiled	827
Cheese	331-447	White of egg	845	Lamb raw	833
Eel raw	434	Crab boiled	859	Mutton raw	773
—— boiled	428	Skate raw	859	——— boiled	852
Liver of crab	471	—— boiled	956	Veal raw	873
Mussel raw	528	Herring raw	910	—— boiled	911
——— boiled	660	——— boiled	808	Beef raw	880
Ox liver raw	570	——— milt of	924	—— boiled	942
Pork ham raw	539	Haddock raw	920	Ox lung	931
———— boiled	807	———— boiled	816		

The same value is expressed upon a different scale, reckoning the amount of nitrogen which is 2.61 per cent. in wheat as equal to 100, the following being equivalent quantities.

Rice	225	Peas	59
Onions	221	Cow's milk (dry 212)	68
Turnips	180	Bran	56-59
Buckwheat	167	Lentil	57
White potatoe	167	Dry mushroom	56
Carrots	157	Best white bread made with malt dough	54
Beet root (dry)	153	Yolk of egg, dry	53
Mangel wurzel	145	Oyster dried	49
Rye flour Vienna	123-140	Ox blood albumen chime	65
Wheaten flour	123	Fibrine fresh meat	74
Oats, entire grain with husks	118	Brain	38
White bread	113	Crushed bones	37
Indian corn	113	Cheese varies	36-49
Barley	113	Tea	29
Black bread	108	Flesh dried (212)	17-21
Wheat grain mean	100	Roasted Beef	16
Some kinds of wheat	97	Isinglass	14
Coffee	108	Creatine }	9
Rye	93	Theine }	9
Oats, mean	89	Caffeine }	9
Blood liquid	88		
Wheat flour	87	Theobromine	7.4
White bread made with malt dough	66		

The following table of combustible aliments has been calculated upon the following data, the amount of heat evolved by combustion of hydrogen in the formation of oxygen being considered as well as that of carbon in the formation of carbonic acid. The influence of the former is 4½ times as great as that of the latter; 29831 parts of water being raised 1 degree in temperature by the combustion of one part of hydrogen in the formation of oxygen, and only 6625 parts of water being raised similarly 1 degree of temperature by the combustion of 1 part carbon in the formation of carbonic acid.

Table of Relative Combustible Value of Aliments.

Turnips	1554	Best bran	139
Cow's milk	834	Average wheat ditto	137
Ox blood, potatoes	351	Black bread	124-126
Caseine and Fibrine	343	Rye bread	124
Albumen	336	Rice	119
Fresh lean flesh	325	Lentils	116
Fresh bread made with average wheat, assuming 280 lbs. of wheat flour = 320 of bread, & 115 wheat = 100 dry	128	Wheat flour	115
		Beans dry	112
		Creatine	111
		Honey	166
		Dry albumen and fibrine. Ox blood	82
Turnips dry	106	Roasted flesh	to
Arrow root	106	Albumen	84
Starch	104	Brain	69
Beet root dry	104	Alcohol	68
Sugar	105-101	Walnut oil	56
Yellow Peas		Dry brain, Mutton Suet, Almond oil, Train oil, Oil from maize, Hog's Lard	54 to 56
Dry arrowroot	100	Oil of fat	53
Rye very dry	101	Olive oil	52
Rice	102	Bees' wax	51
Rye flour	97	Butter	49
Indian meal dry	99		
Caffeine, Theine, Gum	98		
Dry Potatoes	96		
Peas dry	95		
Theobromine	93		

As a rule the aliments which are high as nitrogenous are low as combustible aliments.

These results however do not quite correspond with

Liebig's who gives a higher relative value to some of these combustible aliments. Assuming fat as equivalent to 100 he gives the following as equivalent quantities. (A.) My own results are placed side by side (B.) and reduced to the same scale. (C.)

	A.	B.		C.
Fat	100	53	=	100
Starch	240	101	=	190
Cane sugar . . .	249	100	=	188
Milk sugar cryst. Grape sugar dry	263	101	=	190
Spirits 50 per cent. of alcohol	266	136	=	218
Fresh lean flesh . .	770	325	=	613

There can be no doubt that fat taken in a quantity which exceeds the wants of respiration fattens. The same effect appears to be produced by starch, sugar, and alcoholic drinks. Experiments prove this beyond a doubt. The fattening by sugar is analogous to the process which occurs in plants. Fruits become charged with oleaginous matter in proportion as their sugar or starch disappear. All palms elaborate sugar before they produce oil. Bees fed on honey will produce wax, a fatty matter. Nay, sugar has been observed under peculiar conditions to become converted into butyric acid, the oily acid of butter. Yet it must be also admitted that animals fatten most on those substances which naturally contain oil. From a series of experiments undertaken by Messrs. Dumas, Payen, and Boussingault, it appeared that those articles acknowledged the most powerful as fattenners, also contain the largest proportion of fatty principles. Thus in 100 parts,

Oil cake	contains	9·	Wheat flour	contains	2·1
Maize		8·8	Bean meal		2·1
Oats		5·5	Peas and beans		2·
Coarse bran		5·2	Rye		1·8
Fine bran		4·8	Carrots		0·17
Rye flour		3·5	Mangel Wurzel		0·1
Haricots		3·	Potatoes		0·08
Lentils		2·5			

Part II. Quantity and Quality of Food.

Assuming now these several points as preliminary ground on which to tread, the question is, what is the normal quantity and quality of food to be given in a climate like that of England to a healthy adult?

From the foregoing considerations, the following conclusions may be drawn, that, 1. Food to support life must consist of nitrogenous, mineral, and combustible elements. 2. The quantity of the latter must be proportionally large in cold as compared with warm climates.

The quantity and quality of food necessary to support life, and the relative proportion of each class of aliment, must vary with the climate, sex, age, occupation, etc. Take for instance, the amount of bread allowed to a soldier in different parts of Europe.

France . . .	wheat	12·	oz.
Sardinia . . .	ditto	11·7	,,
Spain . . .	ditto	10·7	,,
South Germany, 1-6 wheat, 4-6 rye, 1-6	barley	14·3	,,
North ditto . . .	. rye	16·	,,
England . . .	wheat	12·	,,
Belgium . . .	ditto	12·4	,,

All physiologists seem to have admitted the truth of Prout's proposition, before noted, that milk is the best model we have of food. Thus milk contains both combustible and incombustible aliment, and is capable of supporting life for any length of time. It consists of 4 nitrogenous, and 10 combustible matter per cent. Now few persons, on an average, could consume more than 7 pints of milk daily if restricted to this article alone. The ordinary milk diet of hospitals does not exceed 2 pints of milk daily, and 12 oz. of bread, besides a little rice or gruel, &c. The absolute value of the food or the 7 pints of milk daily would be 5.91 oz. of nitrogenous and 12 oz. non-nitrogenous. Two lbs. of lean flesh, or 2 lbs. of bread, would contain—the former, 6·20 nitrogenous matter,—the latter, 6 nitrogenous to 22 non-nitrogenous matter. Speaking practically however, if we consider that all butcher's meat contains more or less fat, it may be said that 2 lbs. of good wheaten bread, and 2 lbs. of meat or 7 pints of milk are almost equivalent quantities.

The following table gives the amount of food allowed per week in ounces, the age and occupation in several educational establishments, prisons, and hospitals:— [See Table, next page.]
Which reduced to Nitrogenous and non-Nitrogenous as regards the amount gives

Place.	Nitrogenous. oz.	Non-nitrogenous. oz.	1 Nitrogenous to non-nitrogenous oz.
Royal Military Asylum, Chelsea	33·3	104·2	3·1
Royal Navigation School, Greenwich	28·7	110·9	3
Christ's Hospital, London	30·4	113·7	3·7
Dalston Refuge	36·9	124·4	2·1
London Orphan Asylum	31·5	102·1	3·2
Foundling Hospital, No. 1.	26·4	74·6	2·8
——————— No. 2.	27·6	84·3	3·
Merchant Seamen's Orphan Asylum	31·7	108·1	3·4
Hill Street Refuge	24·6	71·3	2·8
Mean (exclusive of latter)	30·8	102·5	3·3
Workhouses.			
No. 1.	16·7	60·2	3·6
No. 2.	17·5	74·7	4·2
No. 3.	21·7	87·3	4·0
No. 4.	17·6	83·5	4·7
No. 5.	18·4	84·2	4·5
No. 6.	16·5	77·1	4·6
Hackney	19·3	98·1	5·

	Sex	Age	Bread.	Meat	Potatoes.	Rice.	Milk.	Flour.	Fat	Cheese.	Peas.	Suet Pudding.	Meat Pud & vegetab	Gruel.	Soup	Broth.	Treacle.	Vegetables	Sugar.	Tea.	Coffee	Cocoa.	Beer.	Remarks.
																								hrs. hrs.
Royal Mily. Asylum, Chelsea	M	5—14	105	44	26	5	105	6	1	—	—	—	—	—	—	-	-	-	4	.	.	3½	—	8½ sleep. 6 sch
Royal Navig. Sch. Greenwich	M	11—18	105	44	42	—	40	6	5½	—	—	—	—	—	—	-	-	6½	8¾	1¼	.	3½	—	9 —— 6 —
Christ's Hospital, London	M	7—15	108	20	40	—	70	12	3½	—	—	—	—	—	—	-	-	.	.	.	.	.	—	10 —— 7 —
Dalston Refuge	F	11—32	112	48	84	—	70	16	8	7	—	—	—	—	—	-	-	.	8	1	2	.	—	8½ ——
London Orphan Asylum	M & F	7—15	105	33	36	—	70	16	4½	—	—	—	—	—	—	-	-	-	1½	.	.	.	—	9-10 — 6½—
Foundling Hospital, No. 1	M & F	above	92	42	40	3	60	—		—	—	—	—	—	—	-	½	-	.	.		.	—	
Foundling Hospital, No. 2	M & F	9	92	42	40	—	60	7½	2	7	—	—	—	—	—	-	-	.	.	.		.	—	
Merchant Seamen's Orphan A.	H	7—15	120	20	30	3	56	23 5		7	1·8	—	—	—	—	-	-	-	.	.		.	—	
Hospital Convalescents.																								
St. Bartholomew's	F	15—70	84	28	56	—	70	7	5½	—	—	—	—	—	—	.	-	-	.	.	.	.	140	various.
St. George's	F	ib	84	42	56	—	70	10½	7	—	—	—	—	—	—	.	-	-	.	.	.	.	140	ditto.
Royal Sea Bathing Infirmary	M & F	4—10	96	38	52	9	80	10	2	—	—	—	—	—	—	..	-	-	.	.	.	2	140	ditto.
Metropolitan Estab. Margate	M & F	10—16	98	30	80	—	35	24	6	—	—	—	—	—	—	-	-	-	7	2	.	.	50	ditto.
Hanwell Asylum	F	15—70	80	21	60	3	20	16	6½	—	—	—	—	—	—	-	-	10	3½	1¾	.	3½	70	ditto.
Prisons.																								
Bridewell, over 2 months	F	16 to	140	18	-	9	14	12		—	—	—	—	—	—	-	.	-	8	.	.	7	—	10 hrs. sleep
Bridewell, under 2 months	F	60	112	12	.	6		20		—	—	—	—	—	—	-	-	-	.	.	.	.	—	Ibid.
Millbank Penitentiary	F	16—70	140	26	62	2	14	14		—	—	—	—	—	—	-	-	-	7	.	.	1½	—	
Workhouses.																								
No. 1.	Females & Children.	Females 15-60. Children above 9	70	15	24	—	—	—		8	—	12	—	10½	4½	4½	..	-	.	.	.	.	—	various.
No. 2.			98	-	-	—	—	—		4	—	20	10	—	—	-	-	.	.	.	.		—	
No. 3.			106	6	24	—	—	—	4	16½	—	—	—	10½	1½	-	-	.	.	.	.	.	—	
No. 4.			92	-	-	—	—	—	5	10½	—	20	10	10½	4½		-	.	.	.	.	.	—	
No. 5.			84	10	48	—	—	—		8½	—	12	—	10½	3	2	-	24	.	.	.	.	—	
No. 6.			88	8	24	—	—	—		3	—	12	—	—	—	-	-	.	3½	.	.	8	—	
Hackney	M & F	7—15	82	15	36	—	—	24	7½	2	—	—	—	—	—	-	.	.	.	.	.	2	—	
Hill Street Refuge	F	7—17	100	13	12	10½	72	—	-	3	—	11	—	—	16	-	9			3½		1	—	

Hospitals and Infirmaries.			
St. Bartholomew's Hospital	24·6	103·9	4·2
St. George's Hospital	27·9	109·3	3·6
Margate Establishment	27·1	132·2	4·9
Royal Sea-Bathing Infirmary	36·1	118·6	3·
Hanwell Asylum	24·9	98·9	3·9
Prisons.			
Bridewell, (over 2 months)	28·9	111·5	3·8
———— (under 2 months)	23·7	87·9	3·7
Millbank Penitentiary	29·3	118·6	4·

The comparison established by the above table is not favourable to the Hill Street Refuge. Among the Institutions named for children above nine, it is the one in which the proportion of both nitrogenous and non-nitrogenous ingredient is smallest, as well as their relative proportions to each other. The disadvantage to which our work-houses appear is truly formidable. The poor inmates appear to be worse fed than our felons in the prison house.

There is another point which appears to have escaped the notice of the Committee; and it is that if hard manual labour is given to any of the girls, (as I have witnessed myself is thecase in the laundry) an additional amount of food is required.

Meat is essential to hard working men. The fact has been amply proved by experiment. In one performed in a foundry at Charenton near Paris, it was observed that the English workmen performed more work than the Frenchmen. The former fed chiefly on meat, good wheaten bread and beer. The latter chiefly on rye bread and vegetables, but with little meat. The French workmen were made to feed as the English, and the amount of work they performed was soon equal to that performed by the English. The same experiment performed at Rione gave rise to a similar result. An increased ration of meat was given, and it proved in the end a measure of economy, more work being performed.

Farmers are perfectly aware of these two facts. Working as well as growing animals require more food. If this be not given, they become weak and emaciated. Thus Boussingault, in his admirable experiments, sums up by the following table. It may be said, he observes, that for every 100 of living weight, neat cattle require

For simple sustenance	0·75	(or $\frac{3}{4}$) lbs. of meadow hay.
When labouring	2·00	lbs.
When growing rapidly	3·08	lbs.

A similar proportion equally applies to the human subject, and to all other animals.

The above remarks go therefore to prove that, in addition to variety of food, there should be, allotted to each growing boy or girl, per week, at least, 1. 1 part of nitrogenous to 3·3 of non-nitrogenous, in the food. 2. The proportion of the former to the latter should not be less than 30·8 oz. of the first, to 102·5 of the non-nitrogenous; and this amount might be safely increased when girls are growing fast; especially when made to labour hard, and when taken in a state already much weakened by long-continued work and scrofulous disease.

Similar results were obtained by Drs. Christison and Maclagan, after due enquiry into the dietary regulations among prisoners in Scottish prisons. They are here subjoined in abstract. The experiments were made on prisoners whose terms varied from 10 days to two months, on 896 males and 724 females.—Each prisoner was weighed on admission, and his state of health, strength and condition noted. Similar experiments were made once a fortnight, and finally before liberation: extending through a period of 3 months from Dec. 2, 1850 to March 2, 1851. The number of observations amounted to 8000.

The diet and the result will be better understood by the following table.

Place.	Amt. of Daily Food, oz. Nitrogenous.	Carbonaceous.	Total.	No. of prisoners	No. per cent whose weight was Increased or maintained.	Diminished.	Average no. of lbs. lost.
Edinburgh	4·05	12·87	16·92	556	82·	18·	1·5
Glasgow	4·06	12·58	16·64	549	67·3	32·6	4·
Aberdeen	3·98	13·03	17·01	143	68·	32·	4·2
Stirling	4.27	13·40	17·67				
Ayr	4·17	13·20	17·37	42	29·	71·	4·2
Dundee	2·73	14·06	16·79	330	50·	50·	5 25
Perth	2·68	14·11	16·79		46·	54·	3·3
Paisley, not fully reported .	..	..	..		56·	43·5	3 2
Carlisle	2·5	11·17	13·67	68	13·04	86·96	6·5
Ditto, with hard labour	2·93	12·17	15·10				

From which table it appears that less than 17 oz. of food daily, of which 4 are nitrogenous is insufficient. The diet of Ayr and Carlisle was defective and the loss of weight resulted in consequence. In Carlisle it was eminently so, as no regard was paid to the fact that hard labour required more food to repair the waste of the body. The diet of Ayr prison though fully equal to that of Edinburgh, Glasgow, Aberdeen, and Stirling, seems to have been insufficient from the class of inmates, who in the former were muscular, bulky, and strong agricultural labourers accustomed to much exercise and a liberal supply of food.

Drs. Christison and Maclagan, also considered the effects of sex, bulk of prisoners, and age. Thus of those who lost weight there were

	Males Pr. cent.	Fem. Pr. cent.	Of those who weighed more than 150 lbs. Pr. cent.	Who weighed at least 150 lbs. Pr cent.	16 to 20	Above 20
Edinburgh	26·3	10·	23·3	36·5	31·2	24·3
Glasgow	41·	21·	38·7	53·	53·4	36·2
Aberdeen	38·2	30·	30·	60·	—	—

The conclusions arrived at were therefore :

1. In the average class of persons and those accustomed to moderate exercise 17 oz. of food daily are required, of which 4 oz. should be nitrogenous. This will suffice to maintain health, strength, and weight.

2. The proportion of Nitrogenous ingredient cannot be sensibly diminished withour risk of injury.

3. The amount stated as sufficient may require to be increased under peculiar circumstances.

4. It is probably inadequate to those accustomed to vigorous occupation in the open air and a liberal dietary even when their employment is changed for one not involving great muscular effort.

5. It is inadequate for a fair proportion of persons exceeding the average bulk in size.

6. *It is inadequate for growing lads between* 16 *and* 20.

7. It is more adequate for females than males. The other conclusions are more special.

8. It is rendered occasionally inadequate by other causes not distinctly indicated by the observations in the Scottish prisons, but certainly independent of increased muscular action.

9. Hence the economical regulation of the diet of bodies of men, must be always a matter of difficulty, and if deviations of the standard dietary be not allowed with a liberal discretion, injury will be apt to ensue.

10. The prison dietary in Scotland will answer the purpose for persons confined for periods of time under two months, but in that dietary fresh water cannot be substituted for milk, without a reduction of flesh, the probable forerunner of ill health, unless due compensation be made by other articles of food.

11. In adjusting dietaries and in all particular inquiries on the subject, reliance ought never to be put on particular observations alone, but scientific analysis should likewise be brought into requisition.

The able authors of the above report have however omitted two or three important considerations which would probably explain away some of the more obscure parts of the subject. The hydrogenous aliment is disregarded, the carbonaceous being alone attended to. The mineral ingredients and the influence of temperature have also been utterly neglected. The report however so far as it goes is invaluable, and elucidates some most important points in the physiology of nutrition.*

From the high price of meat, as compared with that of bread, it is most important for the proper nutrition of the poor, that the latter should be good. It is their staff of life, and its consumption enters more into their habits. Some remarks upon this aliment are therefore necessary.

1. Bread, like meat, contains (vegetable) albumen and fibrine,—the nitrogenous elements of nutrition; starch and sugar, the combustible elements, for respiration; salts, the mineral ingredients, to keep the former in the state of solution or preservation required to serve the purposes of the economy. The composition of white bread, exclusive of salts, is as follows in 100 parts:

Starch ..	68	Veget. albumen,	15
Gluten ...	24	Gummy sugar	5

The salts vary in different varieties of grain, and necessarily in different kinds of bread. In 100 parts of of the ashes of wheat, a mean of thirty-two analyses give 46· of phosphoric acid, and 49·57 of alkali and alkaline salts. In one specimen, however, from Leipsic, analysed by Schmidt, there was as much as 60 per cent. of phosphoric acid; in one from Egypt, by Way and Ogsden, as much as 52 per cent. of alkali and alkaline earths. "The finest American flour is richest in

* London Journal of Medicine.

gluten. Rye contains a substance resembling starch-gum in its properties, *dextrine*, as it is called, which is easily converted into sugar. The starch of barley represents cellulose, and is therefore less digestible. Oats are very rich in plastic matter" (14 to 18 per cent., sometimes as high as 22 per cent.), "especially Scotch oats, which contain in the ashes, after deducting the silica of the husks, very nearly the same ingredients as are found in the ashes of meat."*

It is evident, therefore, that according to the grain with which the bread is made, so must its value as an aliment be estimated.

2. Black bread is capable of supporting life for an indefinite period, and, in this sense, it is more nourishing than white bread. The experiments of the French Academicians proved, that dogs fed exclusively on pure white bread, died in a few weeks, with all the symptoms of starvation; whereas the coarse brown bread proved both nourishing and fattening. Again, the analyses of Thomson, give, for white bread, a nutritive equivalent of 113; and for black bread 100; the equivalent obtained by calculation from Playfair, is 108. In either case, it appears white bread contains less plastic matter than black bread.

Again, according to Playfair's analysis, black bread has a combustible equivalent of 126; white bread has one only of 128. White bread, therefore, is inferior, as a combustible aliment, to black bread, though not to the same degree. These results can, however, only be regarded as approximative, and not in any way justifying the general conclusion that, in all cases, white bread is inferior to black bread. The following table in some measure explains the reason of this disparity:

* Liebig's Letters.

Composition of	Wheat, mean 7 expts.	Average bran. (Johnson)	By Calculation. White bread.	Black Bread, made with a preparation of 21·3 pts bran in the flour.
Starch	39·9	—	44·4	31·6
Starch with husks	—	55·6	—	9 2
Gluten	14·8	—	13 8	9·2
Albumen	—	19·3	—	3·2
Sugar, Gum, Woody fibre	19·1	—	16·7	12 0
Fat of oil	—	4·7	—	0·7
Salts	1·6	7·3	1·4	2·3
Water	12·4	13·1	23·7	31·8

Whence it would appear that whatever change it may have undergone in the process of baking, the best white bread contains, in reality, very little more nitrogenous, *i. e.* about ½ per cent. more than an average black bread, but less combustible matter, and a much smaller quantity of *salts*; to which latter cause is probably specially due the fact, that pure white bread, singly, will not suffice to support life. The above calculations have been made on the supposition that 280 lbs. of good wheaten flour will yield 320 lbs. of bread; whereas flour containing about 21-3 of bran, the average quantity in black bread, will yield 336 lbs. of black bread. To add a larger quantity of bran does not apparently increase the quantity of bread for although, by so doing, more dough (by the larger quantity of water absorbed) is made, still in baking it loses the water more readily.

3. There is another circumstance which renders white bread, as an alimentary substance, inferior to black bread. In many cases by way of facilitating the separation of the husk from corn, the latter is moistened. If this moisture is not, by a subsequent process, removed effectively, the flour becomes musty. To correct this defect, bakers have been in the habit of adopting one of two plans, both of which have the

additional property of rendering the bread peculiarly white,—sulphate of copper, an acrid poison, being added, or alum. The late revelations of the Sanitary Commission of the *Lancet* have shewn to what an extent this practice is carried on in London. The bread is, by this process, deteriorated in its sanguific value; the phosphate of alumina, an insoluble salt, being, as Liebig informs us, formed, and the phosphoric acid, so essential to the system, not assimilated. It is probably chiefly to this cause that the so-called pure white bread is insufficient in itself to support life; and as again suggested by Liebig, this circumstance will probably explain the reason why foreigners find English bread so indigestible. To the soldier or the laboring man, black bread would seem, therefore, to be preferable in every way. To the former, in time of war, it is, besides, most easily procured.

4. The same plan, which is the only efficient means of saving for a large community in times of scarcity, is also the best to adopt, even in more prosperous periods. Liebig informs us that, in many parts of Westphalia, the entire meal, including the bran, is baked in a species of brown bread called the "pumpernickel;" and he adds, that there is no country where the digestive organs in a population are more healthy. The reason of this is the following. Payen found that the gluten or nitrogenous element varied in 4 varieties of wheat from 9 to 22 per cent., and what is of interest with regard to the bran that there was a diminution of the gluten towards the internal part of the seed.

Were it possible to separate perfectly the floury portion from the husk in the bran, we should obtain a flour containing 30 per cent. of gluten and albumen, i. e. ·4 to ·5 times more than is contained in ordinary flour (Knapp). It follows from this that in the present system of grinding the most nutritious portion of the grain is not contained in the flour. The husk in good wheat amounts on the average to 14 or 16 per cent of the entire weight, though the quantity separated at the mill is often not more than 1-9th or 11 per cent. In making the pure white flour for the metropolis and other large towns, about 1-8th of the whole is separated in the form of pollard and bran. For charitable purposes therefore the bread should be made of the entire wheat, bran and all, whereby the bread is rendered fully 7-10ths more nutritious, and the flour used contains from 17 to 21 of gluten instead of 10 which is the usual quantity.

In all Refuges and charitable institutions this variety of bread therefore is to be preferred.

5. Other means have, however, been suggested. In the experiments of the French Academy, gluten alone was found to be capable of supporting life. This was owing to its impurities. Majendie has since shewn that the gluten used in these experiments, was composed of gluten, a little albumen, gum mucilage, starch, and even sugar. As, moreover, it occurs but seldom, if ever, in commerce in a pure state, it must be looked upon as one of the most nutritious of the ordinary vegetable substances prepared. Liebig has directed attention to a source whence it may be procured in large quantities, and at the same time, at a very cheap rate. In England many cwts. of the best and finest flour are employed in the manufacture of cotton goods; the starch being extracted for dressing these, while the gluten, which forms the refuse, is for the most part lost for the food of man. This gluten constitutes from 12 to 20 per cent. of the weight of the dry flour; and, if used in combination with flour of inferior quality, it would form a very excellent and highly nutritious bread.* Gluten bread, which is used for diabetic

* Liebig's Letters.

patients, mixed with but one-sixth part of starch only, is tolerably light, and moderately agreeable to the taste.* No doubt, therefore, an immense quantity of bread might be prepared from this source alone in England, and our manufacturers, with their cry of cheap bread, might produce us this requisite from what they waste.

6. There is yet another source whence a large quantity of bread might be obtained. Schlossberger made a trial of malt-dough (maltzteig), or upper dough (oberteig), of beer breweries, as recommended by Essig of Leomberg, as a substitute for flour. By these terms is understood, as is well known, the dough-like mass which is deposited upon the grains in the process of washing, and which is formed from the mealy portion of the malt. It contains from 4 to 7 per cent. of starch, and from 3·9 to 4·8 per cent. of nitrogen, indicating a much larger quantity of gluten than is contained in flour, and a considerable quantity of phosphates.* This forms, in every respect, an unexceptionable bread.

Rye bread, prepared with an addition of malt-dough, was found to contain from 3 to 4 per cent. of nitrogen, and from 50 to 52 per cent. of water. The bread appeared to keep well, and had not the slightest unpleasant taste.* The breweries of Bavaria alone produce 30,000 cwts. of this malt dough annually; and 7 lbs. of it afford, according to Essig, 4 lbs. of bread.* It is a question whether, in contracts for bread, this should not be taken advantage of, whereby a cheaper kind of bread, and one containing nearly one-third more plastic matter, would be obtained. Its equivalent would probably be somewhere between 70 and 60, instead of 100 to 120; between which limits ordinary bread may be supposed to range.

* Pereira on Food.

The supply of upper dough obtained from our London breweries would appear to be limited. I learn from a gentleman engaged in one of the largest breweries in London, that the appearance of any large quantity of this material is considered rather as evidence of failure in the brewing process, and is owing to the malt not having been perfectly crushed. He had observed it however in some of the country breweries in comparative abundance. On inspection after the process of brewing had been completed, I was enabled to collect and obtain a small quantity of this material. It is readily separated from the adhering husks by repeatedly washing with water, and straining through a coarse sieve—the husks remain on the sieve. If the turbid fluid which has passed through, be now allowed to rest, or be filtered through fine cambric, a powder remains on the filter, which is the *substance* in question Though the supply of this material may be limited, yet I presume in a year it would amount to something considerable, especially in provincial breweries, and might be used for man. Its present use as fodder for cattle in England is evidence of its nutritive properties; and it might form in time a useful article in commerce whence to make bread for the poor.

7. Excellent edible bread might be procured, in many different ways, by the combination of peas, potatoes, and various less rich kinds of grain. The composition of each ingredient should be known, and where there is a deficiency in nitrogenous, combustible, or mineral ingredients, this might be remedied by the artificial addition of the required material.

It may be remarked that this may often be effected by artificial admixture of different kinds of flour, and the following table sets forth this difference approximatively :—

	Nitrogenous reckoned as gluten	Non-nitrogenous reckoned as starch	Water
Potatoes	1	14·9	53·
Rice	1	13·	2·
Buck wheat	1	9·4	1·6
Corve	1	7·	·5
Indian meal	1	6·	1·
Rye flour	1	5·	1·1
Oats	1	4·5	1·
Wheat	1	3·5	1·
Peas	1	2 4	·5
Barley	1	2·1	7·
Coffee	1	1·4	5·
Milk	1	1·3	11·9
Lentils	1	1·3	·25
Tea	1	·5	·15
Meat	1	·4	·3
Cheese	1	·2	1·2
Bran	1	·5	·6

The ingredients might be, perhaps, more easily obtained from the animal kingdom. Thus, in a case where we have a deficiency of salts and nitrogenous matter, as with many of the inferior sorts of grain, it appears rational, to add directly animal albumen or fibrine, it may be the serum of blood. The bread would then be very nourishing, and the material obtained from a comparatively cheap and abundant source; and, to the taste, there is reason to believe the bread so produced would be infinitely more agreeable than that sometimes formed by the admixture of oil-cake, or the raspings of hides. With vegetable admixtures, it is important to notice one fact,—the great advantage derived, in point of nutriment, by drying the vegetable substance before admixture. Take, for instance, the white garden cabbage. In its natural state its nutritive value is very low, its equivalent being 810; when dried at 212°, however, it is 95,—positively higher than wheat. Turnips, in like manner, in their natural state, have an equivalent of 1554; in the dry state, 106; and, in the subsequent admixture, they do not reabsorb as much moisture by a good deal, as they possessed originally.

The bread as prepared at the Hill Street Refuge is good tasted bread, and it appears is made of the following materials :—

Flour	30 lbs.	Rice	2 lbs.
Bran	1 lb.	Salt	9 oz.
Yeast	1 lb.		

making in all, when mixed with water, about 44 to 50 lbs.

This would make it contain about 12 per cent. of gluten or nitrogenous to 53 starch or non-nitrogenous ingredient; a result about the same as that of brown bread, which yields about 12 per cent. gluten to 50 equivalent in starch, whereas bread made of *entire* grain, assuming it to consist on the average of 21·7 gluten to 78-7 starch, would contain 16·4 per cent. of the former to 59.7 of the latter.

If rice be used, which is very rich in starch and comparatively poor in gluten, then, some of the grain richer in gluten should be combined with it, for instance peas or lentils, to compensate in some way for the excess of starch. If wheat however, was so dear as to require the substitution altogether of other grain, then a mixture of equal parts of peas, or lentils, and Indian corn would bring it to an amount of nutriment very nearly equivalent to that of bread made with entire grain : for instance, with

50 Peas = 14 gluten and 33·6 starch, per cent.
50 Indian corn = 6·1 ditto and 40·4 ditto

Peas, beans, lentils &c., however, are open to one objection. They are somewhat deficient in salts, specially the phosphates of lime and magnesia, the component parts of bones. It is necessary therefore with growing children to make amends for this. And this may be readily done. Without this, experience shews that peas, beans, lentils, &c. satisfy the appetite but do not increase the strength. The late eminent Pereira had suggested a remedy to correct this defect, viz. the direct addition of bone earth—by which these leguminous plants would be made more nutritious than cereal grains. Bones are always readily procured, and the raspings of about 7 parts per 1000 would suffice for all purposes, that is about 1oz. in every 100 lbs.

7. But the bread which of all others contains the most nitrogenous nutriment would appear to be prepared from a different source—by admixture with tea, coffee, and cocoa,—or substances extracted from them. The infusion of these substances has been shewn by Liebig to resemble especially juice of flesh. I use this expression, juice of flesh purposely, because animal soups are for the most part innutritious, and indeed, positively injurious. The soups made from bones, are chiefly solutions of gelatine which though a nitrogenous body is in itself innutritious. The composition of the famous soup made by the Compagnie Hollandoise of Paris is a fair example of these. This soup did not contain more than from 2·4 to 2·7 per cent. of solid matter, of which about ·02 to ·30 per cent. were salts. Experiments have now amply proved this. Misled by the representation of the learned, soup made from bones was introduced as an article of diet in the French Hospitals, but the result of a Commission dated Nov. 8, 1831, led to its being finally abandoned, after seven years employment, as tasteless, disgusting, very indigestible, destitute of nutritive value, and positively injurious; and as overloading the blood with nitrogenous products, which rendered it impure and unfit for the purposes for which it was required. The juice of flesh is on the contrary a highly nutritious soup.

The following account abbreviated from Knapp and Liebig will explain its preparation. When flesh is very finely divided and repeatedly extracted with *cold* water, all the soluble matters are removed, and a perfectly tasteless, inodorous residue is left, which is in every case white. This residue is chiefly fibrine. The solution consists of albumen, inosinic and lactic acids, two peculiar animal matters called creatine and creatinine, and a nitrogenous organic acid which forms a pellicle on the surface like casein, though differing from it in some respects. There are several other constituents not clearly made out, besides lactates of Potash, phosphates of alkalies, a little lime and magnesia.

When this solution is boiled the albumen is thrown down. It can be made, however, into an extract, if in preparing it, it be not allowed to boil. If boiled meat be required, the meat should be placed at once in boiling water. By this means the external coating of albumen is coagulated by the heat, and the juice of flesh is retained in it, while the water in which it is boiled makes a very poor soup: and hence the advantage if soup be required of using cold water to extract the juice of flesh. Salt, with especial facility extracts the juice of flesh. This is the reason why, in making corn beef, there is loss of weight, and why salt meat is not so nutritious as fresh meat. The brine is a rich but very salt soup.

Creatine and Creatinine are two bodies which, acaccording to Liebig, closely resemble both in properties and chemical composition, the active principles of tea, coffee, and cocoa, namely, Theine, Caffeine, and Theobromine. Thus the infusions of tea, coffee, and cocoa, come closely to resemble juice of flesh. Take tea for instance.—The equivalent of tea as a nutritive substance is very high, 29, and even of the ordinary infusion, fully half this, i. e. about 59 ;—Coffee has an equivalent of 58. The composition of these several substances not being yet clearly laid down, it is difficult exactly to estimate their combustible value. The following table however from Knapp will, to a certain extent, explain their alimentary composition.

Tea, mean of Java, and hyson milder.		Coffee.		Cocoa, exclusive of husks.	
Ethereal oil	·75	(Fatty oil)	·52	Cocoa butter	53·10
Chlorophyle	2·14		—		
Wax, resin, and gum	15·09	Resin	·41	Gummy matter	7·75
Tannine	15·76	Gum and mucilage	3·64	Starch	10·91
Theine	·53			Brown albuminous matter with aromatic prin.	16 70
Extractive	20 75	Coffee principle	17·58		
Apothein	3·78	Extractive	·62		
Muriatic acid extractive	20·59		—		
			—	Red coloring matter	2·01
Albumen	2·65	Solid residue	66·66		
Fibrine	22·64			Vegetable fibre	·90
Salts	5·23				
Water	—	Water	10·57	Water	8·63

All three substances are therefore evidently from their composition also, particularly rich in combustible matter.

The amount of salts is not stated in two of the preceding analyses, but it is also large, and in this respect these substances resemble animal compounds.

	In 100 parts		
	Infusion of Tea.	Decoction of Coffee.	Cocoa Beans.
Potash	47·45	51·45	37·14
Soda	5·03	—	—
Lime	1·24	3·58	2·88
Magnesia	6·84	8·67	15·97
Oxide of iron	3·29	·25	·10
Phosphoric acid	9·88	10·02	39·65
Sulphuric acid	8·72	4·01	1·53
Silica	2·31	·73	17·
Carbonic acid	10·09	20·50	—
Oxide of manganese	·71	—	—
Chloride of sodium	3·63	Potassium 1 98	Chlorine 1·66
Carbon and sand	1·09	·49	—

Cocoa, from the constitution of these salts would appear to come closest to the juice of flesh, and of the three substances here above mentioned it is the richest in phosphoric acid. The tables now before us moreover explain what is a matter of common observation among the poor. Speaking of London, concerning which I am best acquainted, it is remarkable how many of this class live and apparently thrive, upon tea and cocoa, (which with the coarser kinds of bread are in most instances, the only food they have from one year's end to the other), and manage to live comparatively well without animal food. In regard to tea especially and its nutritive value, it may be stated, that in the ordinary mode of its preparation an immense amount of nutritious matter is lost which might be advantageously employed. The amount of nitrogen contained in tea is about twice as much as that found in rye and wheaten flour, and in the ordinary use made of it, about 2-3rds. of its nutritive matter are actually thrown away. The nitrogenous substances on which this loss depends are, Theine and Casein.

Thus by analysis it has been shewn that 100 parts of the following teas afford

Gunpowder.

Water	10		
Extractive	47 with	volatile oil	·5
		Theine	6·
Exhausted leaves	43 containing	casein	12·

Souchong.

Water	8		
	43 containing	Volatile oil	·5
		Theine	6·
Exhausted leaves	49 containing	casein	14·

The above, and following facts, extracted from Knapp, explain in some measure the reason of this waste. According to Mulder, the portion of soluble matter which hot water extracts from black tea varied in 6 specimens from 29 to 38 per cent. From the same number of green teas, from 34 to 46 per cent. Peligot found that the mean quantity obtained from the dry commercial article was, from black tea 38 per cent., and from green, 43 per cent., and he estimated the amount of nitrogen to be $4\frac{1}{2}$ per cent. in each kind. Thus from 100 parts of tea, supposing it entirely extracted by hot water, 6 per cent. of theine would be contained in the decoction; in domestic economy however, the entire quantity of theine is never extracted, about one third being left in the leaves.

In relation to the other nitrogenous constituent of tea, namely casein. This usually remains in combination with tannic acid in the leaves. The addition of a little alkali will however extract it.

The perfectly exhausted tea leaves contain still $4\frac{1}{2}$ per cent of Nitrogen, or about the half contained in ordinary tea, and this according to Peligot is due to the casein. Hence there must be about 28 per cent. of casein in the perfectly exhausted leaves still remaining, and about 15 per cent. in the commercial (or ordinary infusion of) tea."*

It follows, therefore, that about 28 per cent. of casein, and 2 per cent. of theine, are absolutely lost as food to man, and wasted.

The best way of preparing an infusion of tea is to boil tea with water in closed vessels, and to add a small quantity of soda (say about a drachm) to each large kettle-full. In this way most of the theine and casein is taken up in the solution.

"The Barbarian, Mongol and Burate tribes are more economical in this respect than the more civilized Europeans. They import a particular kind of tea, called brick tea, from their Chinese neighbours, and what they do not consume is sent to Siberia and partly

* See Knapp's Chemistry.

to Astrachan for the Calmucks."* "This Chinese product which is however never consumed in China, consists of the coarser kinds of tea leaves and the refuse and stalks of the better kinds, mixed with the serum of oxen and sheep's blood. It is formed into four-sided cakes, whence its name. It supplies these nomadic races with a very portable food which renders the very worst water drinkable.

Much which has been said in regard to tea, applies equally to coffee and chocolate. Coffee contains also casein, or rather legumin with a trace of albumen. But the larger portion as before remains behind in combination with lime, requiring soda to take it up.

The waste which annually occurs in these three substances is incredible. Take tea for example: the quantity annually imported in this country from January 5, 1836, to January, 5, 1850, was as follows :—

	lbs.			wasted.
1836	36,574,004	= 163,089,749 lbs	Casein	45,665,119 lbs.
1840	35,127,287			
1845	41,363,770		Theine	3,261,794 lbs.
1850	50,024,688			

I have no doubt that a process might be devised, by which the whole of this casein could be separated in a pure state from refuse tea leaves, and a vast amount of food saved to man.

8. There are some more simple methods by which this waste of tea may be made useful and in which it may be employed. The remark previously made that the amount of nitrogen contained in tea was at least double that contained in the best wheaten flour, indicates one of the methods in which this waste may be employed. If the refuse of leaves left in the tea pot be carefully collected, dried, and reduced to an impalpable powder, and mixed with flour, and especially that of the poorer kinds of grain, the mixture makes a highly nutritious bread. I have

* See Knapp's Chemistry.

made the experiment with 1-3rd tea and 2-3rds flour. The result is a very edible bread, but with a black colour, and a very strong taste of tea. A smaller quantity should therefore be mixed, and the result would be a bread having about 20 per cent. of nitrogenous matter in lieu only of 16 which the best white bread contains. And the same holds good with regard to admixture with coffee and cocoa.

The great objection to the tea bread is its colour, and with the prejudices of the lower orders, it is questionable if they would take to it. However, there is one way in which tea, chocolate, or cocoa cakes might be taken, and that is in the substitution for the cup of tea, cocoa, or coffee, of a cup of milk and water, and supplying tea, cocoa, or coffee bread, which dipped in the former would give all the flavour of these infusions, and at a much cheaper rate, besides being more nutritious. In this way the refuse tea leaves and coffee grounds, usually wasted in most households, might be employed for nourishing many a hungry person.

Other substances might in like manner be artificially added, in times of scarcity.

1. The gluten annually wasted in the manufacture of cotton goods might, if purified, be added.

2. a. Fibrine when separated from blood, in its natural state possesses the characteristic softness of flesh and contains about 3-4ths its weight of water. From this it may be separated by drying, and then it becomes a hard and brittle substance, in which state it may be reduced to powder.

b. In its ordinary state fibrine is insoluble in water, when boiled however for a long time under water its nature is altered and it becomes soluble. In this way it could be readily mixed with the dough of bread.

c. Lastly, there is one source in which it might be obtained in very large quantities. In boiling down cattle and sheep in Australia for tallow, the meat, or fibrinous portion remains at the bottom, as a hard, almost leathery substance in strings. This fibrinous substance is usually thrown away, sometimes however pigs are fed upon it, and this is the best proof that it contains much nutritious matter in it. They fatten, I am informed, very quickly upon it. The only disadvantage is that it is found to give their flesh rather a strong flavour. This flavour however is readily removed by feeding them for two or three weeks, when they have become fat, on grain, when experience has proved, the disagreeable taste is entirely removed and they become very delicate eating.

The amount of this waste is very great. From a statement before me, I find that Mr. Fleming, of the Bremor boiling Establishment in Australia, boiled down from January 31, to July 18, 1853, 5551 head of cattle, and 3808 sheep, the yield of tallow being respectively 999,900 and 198,745 lbs. Now assuming the weight of an ox at 400 lbs. and of a sheep at 40 lbs. this would leave for flesh, bones, &c. 1,220,500 from the cattle, and 153,575 lbs. from the sheep, of matters left behind. One half of this would be flesh, i. e. 610,250 from the cattle, and 76,788 from the sheep, i. e. 687000 lbs. in round numbers, which might be employed for the food of man from one establishment only. Now if I am correctly informed, that the whole amount of cattle boiled down annually in Australia is 187,030, and of sheep 96,000, the actual waste of food for man amounts to 26,185,300 from cattle, and 1,680,000 from sheep, equal to 27,865,000 lbs. which might be made useful to man. The above numbers are calculated on the average amount of tallow from cattle being 180 lbs. from sheep, 22½ lbs. and deducting half of the remainder for bone, &c.

The flesh which remains is chiefly fibrine, and may be dried, thus losing 3-4ths of its weight and facilitating its transport. When so dried, it might be reduced to powder, and mixed with food.

3. There is another way in which this desideratum might be obtained. We have seen that while fibrine, casein, and albumen are identical in chemical composition and readily convertible one into another, fibrine is perhaps the least digestible. The substitution of either albumen or casein would in this manner prove beneficial. The serum of blood is at once a source whence albumen might be derived in large quantities, and at a cheap rate.

When blood freshly drawn is allowed to stand it soon separates into 2 portions—a solid clot and a colourless liquid portion. This clot consists chiefly of the blood disks, albumen or globulin, and fibrine. The serum consists of about 77 parts of albumen, 10 of salt and extractive matters, and about 384 of water (assuming that in the clot 3-4ths or 396 of water are retained.) Upon this supposition there is about 20 per cent. of albumen in the serum, so that if in the preparation of bread, serum instead of water were added, we might obtain bread with as much as 22 per cent. of nitrogenous matter (i. e. assuming that the addition of 25 lbs. water to 100 lbs. flour makes 115 lbs. of bread.)

The best animal from whence this serum could be procured would be the *calf*.

It may here be also remarked that the addition of serum to the poor kinds of grain such as rice, buckwheat, &c. would have a double value. As supplying, 1. nitrogenous matter in abundance; 2. the salts which the poorer grains require. Indeed mere serum and starch would suffice to make a richer bread than the ordinary white bread eaten every day.

While upon the subject of the uses of blood as aliment, it may be as well to meet some religious or moral objections, which I know are entertained by some, since by both Levitical and Christian laws, the blood of animals, and the flesh of strangled animals, were forbidden to be eaten. Now no one would maintain the latter law with more reverential obedience than myself; but 1. I do not recommend that blood should be taken in its natural state as food, until after it has been chemically acted upon and changed in most respects. 2. It may be presumed that if we have in *dry blood* a composition identical with that of *dried meat*, while in its natural state blood differs from meat in possessing an excess of *alkali* instead of *acid;* then, blood dried or prepared in any analogous manner may be eaten, because in this process of preparation, the chemical and physical changes brought about are so great, that it can scarcely afterwards be considered as blood at all.

3. Unless this change be considered as doing away with all valid objections to its use, then, although we generally do not bear it in mind, we are all blood eaters. We eat the blood in all the fish and shell-fish tribe, in much of our game, and in beef. For the latter animal is stunned, and it is the presence of the blood which gives beef its rich flavour.

Lastly. I have ventured only to follow nature, and as by a *natural* and chemical process, fibrine, albumen, casein, flesh, &c. which we eat as aliments, are formed from blood in the laboratory of the system; so by an *artificial* and chemical process, I recommend the extraction and manufacture of the same fibrine, albumen, and casein from blood independently of the system.

The only aliment which we are in the habit of preparing from blood in Europe is the ordinary black pudding. This article of food is usually prepared by boiling grits in water, and then straining: hog's blood is then added, and intimately mixed with the grits. The whole being then duly seasoned with spice, fat is added. The liquid is then poured into skins, which, closed at both ends, are perforated with pins and boiled for an hour.

In this process it is clear that the whole nutritious matters of the blood and oats are retained. It is, in fact, a sort of vegeto-animal aliment. In the stirring up the fibrine is separated, it is true, from union with the blood, but remains intimately connected with it. Thus we have the fibrine and albumen and all the salts remaining, while the admixture of fat supplies the combustible element in which blood is not necessarily rich. The addition of the grits supplies a certain excess of phosphoric acid to neutralise the predominance of alkali in the blood, thus rendering it not only more palatable, but more adapted to the formation of muscular fibre. There is certainly an objection in the coagulation of the albumen, which is thereby rendered more indigestible; but as an alimentary substance, the compound is complete in all the requisites. Its equivalent as an article of food is higher than meat as a combustible, and almost as high as an incombustible aliment.

9. I have hitherto spoken of food as equably mixed: i. e. both meat and vegetables. I must now allude to a diet more exclusively vegetable. I have before treated of the change thereby effected on the blood by vegetable as compared with animal food. (p. 11.)

In Ireland the following allowance has been made, and the following are the dietaries in military prisons. This table is authentic, having been kindly supplied to me by Dr. Corrigan of Dublin.

	Per Week.	Oatmeal	Indian Meal	Bread	Milk	Nitrog. Food	Non-nit. Food
No. 1.	Full diet	56	63	56	168	35·2	142·2
No. 2.	Reduced ditto	56	42	56	168	32·7	123·7

We at once perceive by comparing this diet with the diets valued at page 18, that it is very rich. The result of its employment has by experience moreover, been found most successful, all the men being muscular and well conditioned on returning to duty, although from the return of the medical officer it appears from Oct. 1, 1852 tó March 31, 1853, the periods of imprisonment varied from 14 days to 2 years. The aggregate numbers being, 238 men, with an average of 54·5 days imprisonment per man.

The result of this diet is therefore most fortunate.

10. While alluding to the vegetable food required for a Refuge it may be as well to allude to Mr. Masson's process for drying these. We have already alluded to the increased alimentary value of vegetables in a dried state (p. 31). Mr. Masson has applied his process to all vegetables. The following is a short summary, taken from his agent's prospectus in King William Street, City.

			£	s.	d.
Potatoes in packages of 28 lbs. and upwards, free from waste and ready for boiling, 1 cwt. equal to 5 cwt. when boiled			per cwt. 3	5	0
Cabbage in tin boxes of 11 lbs. ditto, equal to 70 lbs. when boiled			per box. 1	0	0
Turnips, ditto	70	,,	1	0	0
Carrots, ditto	66	,,	1	0	0
Parsnip, ditto	55	,,	1	0	0
Beet root, ditto	—	,,	1	2	6
Julienne containing vegetables of all sorts for soup	55	,,	1	2	6
Spinach, ditto	70	,,	1	5	0
Turnip-rooted celery, ditto	—	,,	1	5	0
Apples, ditto	—	,,	1	5	0
Peas, ditto	—	,,	1	5	0

A ration of a $\frac{1}{4}$lb. of the above vegetables when boiled costs about 3 farthings. A ration of a $\frac{1}{4}$ lb. of Potatoes when boiled, costs less than a half-penny.

When vegetables are dear, as in the winter season, they may in this manner bə readily procured at a cheap rate.

Part III.—The Diet Recommended.

Reasoning from the preceding cases, the following is the general diet which I would recommend for the use of the Refuge, and all other Institutions of like character.

In Ounces.

	Bread.	Meat.	Black pudding.	Potatoes.	Milk.	Indian corn.	Fat or butter.	Cheese.	Vegetable greens.	Harricot beans, beans or peas.	Suet pudding.	Soup with sheep's head	Tea.	Coffee.	Cocoa.
Monday	16	—	—	12	8	—	2	—	—	4	—	—	1½	—	1½
Tuesday	14	5	—	—	7	5	—	—	—	—	—	—	—	½	1
Wednesday	14	—	5	—	7	—	2	1	—	4	—	—	½	½	—
Thursday	10	5	—	—	7	5	—	—	—	—	6	—	—	½	1
Friday	18	—	—	—	7	—	2	1	—	4	—	16	½	—	½
Saturday	10	—	5	—	7	5	—	—	8	—	6	—	—	½	1
Sunday	18	5	—	—	7	—	—	1½	—	3	—	—	½	—	½
Total	100	15	10	12	50	15	6	3½	8	15	12	16	2	2	4½

Making a total of 115·4 oz. non-nitrogenous food reckoned as starch, and 31·2 oz. nitrogenous reckoned as gluten, per week. The above table is not intended to be invariably attended to. Occasional changes may be introduced, as we must bear in mind the advantages resulting from a change in diet, before alluded to. (p. 12).

In remarking upon this table, I shall speak first of its animal, secondly, of its vegetable ingredients.

The animal ingredients here recommended are seven in number, viz. meat, black puddings, milk, fat or butter, suet pudding, and the soup with sheep's head.

1. The quantity of meat before given amounted to 13 oz. The increase proposed here is slight, although taken in connection with the other varieties of animal food recommended, the whole amount of this last is much increased, i. e. from about 7 to 11 oz. nitrogenous, and from 10 to 22·6 oz. non-nitrogenous.

2. The black puddings are strongly recommended. Their cheap price is in itself a main reason; but there are others of a more medical character. It is known that the black pudding is very rich in the colouring matters of the blood as well as its salts. The former contain a considerable quantity of iron. Indeed, Dr. Maunthner of the Children's Hospital in Vienna has brought this to bear in practice, giving an extract of blood in lieu of the ordinary preparations of steel, in those diseases in which iron is usually prescribed. I would urge generally a more extended employment of black puddings. I have prescribed these medically in many cases of want of blood and debility. At first they are not liked, but subsequently they come to be relished, and they generally hasten recovery. Their daily use I know is, in many scrofulous cases, of great advantage, and, indeed, in some instances preferable to meat. Some persons, however, are naturally much averse to black puddings, and where they cannot be taken, I would substitute sausages, and especially those of a darker kind, as richer in blood. The amount of nourishment is probably inferior to that of the black pudding, but varieties of these may be obtained at a cheaper rate than meat, and have at least the advantage of cheapness. If a sausage is fresh and well made, my experience also leads me to conclude that it is in many cases as digestible as meat.

The meat best borne for a continuance is mutton;

but all varieties of beef, veal, pork, (the latter especially when cold) should be occasionally given as a change, and when the price admits of it. There is a strong prejudice in this country against horse flesh. This is a pity. It it always a cheap meat, and it is largely consumed on many parts of the continent. The habits of the horse are certainly not more depraved than those of the ox or cow, and, as an animal it is decidedly much cleaner than the pig. It is also a herbivorous animal. The flesh is perhaps a little tougher, but in taste it closely resembles beef, and, if kept for a few days, becomes quite as tender. It may perhaps be difficult to correct a deep-rooted prejudice amongst Englishmen, but it is as well to allude, *en passant*, to its uses elsewhere.

3. I cannot too strongly recommend the soup employed at the Refuge. Ordinary soup, as we take it at dinner parties is certainly very savoury, but very innutritious. The analysis has been made, and it has been found to contain from 2·4 to 2·7 per cent. of nutritive matter only, and a little more of saline matters. Indeed, the purer the soup (a purity due to the straining, whereby all the coagulated albumen, the nourishing ingredient in it, is separated), the less nutritious it is. The French are great soup-eaters, but then they habitually eat after it the "pot au feu," or the meat from which it is made, which consists in great measure of the fibrine. I understand that the soup at the Hill Street Refuge is made by boiling a sheep's head, previously cut up, in water, so that the tongue and brain are dissolved in it; to this two lbs. of rice and a small qnantity of vegetables are added. The ordinary soup of Workhouses consists of about 16·6 oz. meat, 8·3 oz. peas, and 1·3 oz. groats in every 100 oz. I should be inclined to recommend barley to be added to the soup in place of the rice, and it might with advantage be thickened with groats. The addition of brain to the soup I consider a great advan-

tage, especially with growing children. The supply of phosphorus to the system, increases the nervous energy and strengthens the skeleton. I believe that if brains were more generally eaten, and especially by children, it would be of advantage. The brain consists of

Water	78·	Phosphuretted fat	12·4
Albumen	7·3	Extractive matter and salts	1·4

The salts being chiefly phosphate of lime, peroxide of iron, and phosphate of magnesia. The child is under unfavourable circumstances in his education. His brain is heavily taxed, and if it be overworked there is a diminution of its phosphorus ; and experience has shewn that a very small diminution in the quantity of this ingredient brings on general debility and if long continued, insanity. For the same reasons I would recommend the employment of fish, and at times some shell fish, of the cheaper kinds. Occasionally even in our London markets, fish is very cheap and abundant. Oysters if raw are very light and wholesome. Mussels in the season, cockles, and perriwinkles, are much liked by many, and with not a few crabs are considered great luxuries, and do not disagree. All these, if taken in moderation, might I think be given with advantage as an occasional treat.

The milk which has been supplied to the Refuge in Hill Street I understand has been skimmed milk. This milk is cheaper, but certainly much less nutritious. The following analysis shews the reason of this. The column A expresses the composition of skimmed milk after setting aside the milk 7 days and drawing away the cream. B, the composition of the cream. C, the supposed composition by calculation, of the milk originally obtained.

	A		B	C
Casein (with some butter)	2·6	Butter	4·5	4·9
Milk Sugar	3·5	Casein	3·5	6·1
Lactic acid, &c.	·6	Whey	92·	189·
Other salts	·4			
Water	92·9			
	100		100	200

The loss is not so great in 24 hours, yet from this table it would appear very nearly half of its nutritious value is lost, and more than two-thirds of its combustible value as an aliment. If therefore skimmed milk be given, there should at least be an increase in the ration of butter and cheese. Indeed, as casein is a very good substitute either for fibrine or albumen, it might be occasionally substituted altogether for the meat. As meat however contains about 20 per cent. albumen and fibrine, and cheese 28 to 40 per cent. of casein, the ration should be from about one third to one half less of the latter.

5. Another animal substance is butter. I would substitute dripping in many instances, or a double ration of treacle if preferred. I think the former would be preferable as having more taste, and while it is cheaper than butter, if mixed with the peas or haricot beans, it imparts a very agreeable flavour.

6. I have recommended the suet pudding to be given in smaller quantity, and twice instead of once only, in the week. I learn the composition of this pudding as made in the Refuge consists of, flour, 9 lbs., suet, 1½ lbs. salt, 2 oz., water, 3 quarts, and that after the boiling process it makes 18 lbs. altogether. Now suet puddings are very heavy, but at the same time nourishing and very satisfying. The alteration called for here, is a diminution in the quantity taken at one meal, and I would suggest that it might be as well to substitute occasionally some other kinds of flour, such as lentils, peas, Indian corn, &c. as in the preparation of bread.

Before leaving the subject of meats I would recom-
mend a trial to be made of preserved meats, on th
ground of their remarkable cheapness.

7. *Meat* may be considered as the essence of vegetable; its nutritive qualities being more concentrated, if I ma use the expression; in evidence of which, apart fro its chemical analysis, we have the anatomical conforma tion of the intestinal canal in carnivora, which i much shorter than in the herbivora, because the food requires less digestion. Meat has a nutritive equ valent of 48, wheat being 100; in its dried state of 1: so that in its natural state it may be considered as mo than twice, in its dried state nearly seven times a nutritive as wheat. In its purely lean state, as a com bustible equivalent, it is nearly expressed by 32: wheat being 100, and therefore rather more than thre times less valuable in this respect than wheat. In it dry state, however, it is superior to wheat, being 8: while wheat is 100.

The subject of preserved meats has lately been s prominently before the public, that it can scarcely b passed over in this place. Indeed, the revelations c the daily journals, and the government board of inquir have sadly poisoned the public mind against their em ployment. The subject, however, now appears in a differ ent light before us, having recently been lucidly ex plained by the late editor of the *Medical Times and Ga zette*, Dr. Bushnan; to whose leading article I cann forbear alluding. It would appear that the utmost that ca be urged against Mr. Goldner is a little carelessness, even that. In a late return moved by Mr. Miles, it stated, 2,741,988 lbs. have been issued to the nav since the contract with Goldner, up to January 7, 1851 Out of this number, 2, 613, 069, or 95 per cent., hav proved fit for use, only 19 being rejected from contain ing so-called offal (which was, however, only undigest d food); the remainder were so from the putridity of heir contents, *the price at which these were issued being d. per pound, and we are informed by the editor that the ame could now be supplied at 3d. per pound.* There ; nothing repugnant in pieces of heart, roots of tongues, alates, or liver, which some canisters contained. Many steem these as luxuries. The putridity of the meat ı others, is rather to be attributed to the carelessness f those who stored them away in Her Majesty's ships. 'o knock about the canisters, the contents of which nly could have remained good so long as a vacuum urrounded the meat, was precisely the way to admit ıe atmospheric air: and, further, to expose iron canis- ːrs, which in parts might have been inadequately nned, in damp situations, was the best method to ısure the rapid rusting, and subsequent breaking down f the canisters, the consequent admission of atmospheric ir, and the rapid putrefaction of the meat. And yet the rocess is one which is, after all, most simple; and ıe boon thereby conferred on our navy especially, or might be on our poor, by giving it in lieu of salt ıeat, or other less nutritious articles of food, is immense.

It is the peculiar property of all organic substances) putrify when exposed to an atmosphere containing xygen, not too cold in temperature, and not such as) freeze the meat. This process of putrefaction is, fter all, one of fermentation, under the influence of hich the elements of these organic substances undergo ıe chemical changes which were, during the life of the ıimal or vegetable, impeded by *vitality*. This fer- ıentation however, is prevented, indeed annihilated, y heating the substance to the boiling point. Most ːrments have a constitution analagous to albumen, and : a higher temperature pass into a new state. The rocess is thus described by Liebig: "The prepared iments are enclosed in canisters of tinned iron plates, and covers are soldered on tight, and exposed to th temperature of boiling water. When this degree o heat has penetrated to the centre of the contents, whic it requires about three or four hours to accomplish, th aliments have acquired a stability, which we ma almost say is eternal. When the canister is opened after the lapse of several years, the contents appea just as if they had been only recently enclosed. House wives make use of this method in preserving gree vegetables through the winter. This method of pre serving food will become of the greatest importance i provisioning fortresses, since the loss incurred in sellin off old stores, and replacing them by new, is far mo considerable than the value of tin canisters, whicl moreover, may be repeatedly employed, by being care fully cleansed."*

It has been well remarked by the editor of the *Med ical Times*, that although there may be some blam attached in some minor points, to Goldner, still he entitled to our thanks, for having directed attention t this source of procuring a most useful article of con sumption, and one well calculated to do immense goo to thousands of our fellow-creatures. For when w look at the large supply that may be obtained fro Moldavia, and the cheap price at which it may be pur chased, it is no small advantage gained to be able t avail ourselves of it. The editor informs us that the mea of the oxen and cattle which abound on the Danube i Moldavia, costs absolutely nothing on the spot, as th price obtained in Turkey for the hide, horns, hoofs, an tallow, more than pays for the value of the animal.†

1. The first among the vegetable substances in this li is the bread. I learn that the bread in the Institutio is usually made from 30 lbs. of flour, 2 lbs. of ric

* Liebig's Letters. p. 228.

† Medical Times and Gazette, p. 265, No. for Mar. 13, 1852.

; lb. of bran, 9 oz. of salt, with sufficient water, and fter baking it yields about 44 lbs. I would now re- ommend that the flour used should be bolted flour, he wheat finely ground as in a coffee mill so as to pre- ent the bran from being separated in the usual way. 'he bread would not be so white, but cheaper and more utritious, and there would be no waste. If any other lour is added I would recommend Indian corn in lieu f the rice. One third Indian corn and two thirds vheaten flour make very good bread. Its alimentary alue is 14·7 nitrogenous, to 76·6 non-nitrogenous in- redients. About 10 to 12 per cent. of peas, beans, r lentil flour would raise it to the same nature as the est bread. Indeed, I learn that the white haricot bean our is commonly added by London corn factors to the est wheat, which, not having been reduced to flour oon enough, has begun to germinate, and therefore, has ost some of its nutritive properties. Indian corn is apt o make the bread crumble sooner, but this disadvantage s obviated by a small admixture of butter, or sweet oil. ubjoined I have also given a series of tables, in which he quantities of flours given are in the proportions ecessary to make the bread prepared from these of the ame nutritive and combustible value as white bread. page 60.)

2. Potatoes I have given only once in the week. I am duced to do so for two reasons. To be of use they equire to be taken in full quantities. Their high price London is a drawback. Moreover, they are chiefly aluable as combustible food; since they do not con- ain more than 1·41 per cent. of nitrogenous aliment to bout 20 per cent. non-nitrogenous aliment; 20 lbs. of otatoes would scarcely contain the same amount of itrogenous aliment as 1 lb. of meat. Moreover, if we udge from the scrofula which has prevailed, there is n excess of the non-nitrogenous ingredient as com-

pared with the nitrogenous in the Institution. Potatoes therefore do not seem to be called for, but if required at all in winter, certainly Mr. Masson's dried specimens would be preferable.

3. I have ordered 15 oz. of Indian corn to be given as a weekly ration. Indian corn is comparatively the richest of cheap grains ; 12·3 nitrogenous to 88 non-nitrogenous ingredient. It is also rich in salts, and and in that important one, phosphoric acid, equally so with wheat. It is far superior to rice which yields only 6.4 nitrogenous to 80 non-nitrogenous aliment. For the same reason that the potatoes have been omitted, I have thought that rice, for the time at least, should be omitted also. Those who feed on it exclusively are commonly very scrofulous. Singly it cannot support life as before seen. Indeed all food unduly poor in nitrogenous and disproportionately rich in non-nitrogenous element develope scrofula.

4. Peas and beans are of all vegetable aliments the richest in gluten. In price moreover they are generally 1-3rd cheaper. They contain fully 1-3rd more gluten than wheat. There is then an actual gain in their employment of 2-3rds. When soaked over night, and then boiled, with a little butter, they form an excellent dish of vegetables, and by many are considered as far as the taste is concerned an excellent substitute for potatoes; and they certainly are more nutritious. The caution before given in relation to their deficiency in bone earth should however be attended to and remedied in the way suggested.

5. On one day in the week I have recommended greens, and by this term I would be understood to allude generally to the more watery vegetables, such as cabbage, sorrel, spinnage, dandelion, lettuce, &c. There are times when these can be got in London at a very cheap

ate, and being in this way accessible they would form n agreeable change.

The advantage of purchasing these on other occa-ions in the dry state according to Masson's process as already been alluded to and cannot be too strongly ecommended.

6. Of tea, coffee, and cocoa, I have already spoken. 'heir advantages have appeared to me sufficiently reat to recommend their more extended employment. 'he quantity of tea recommended may be considered ırge ; but it has been purposely made so, to admit of ıe re-employment of tea already used once. By the ddition of a very small quantity of carbonate of soda, s before seen, (p. 37) much nutritive matter may yet e extracted from the leaves. A mixture of 10 oz. of ıese leaves when dried with 5 oz. of the ordinary black :a in powder (a shape in which it may be procured ıeaper, and is more readily acted upon by the water,) fords a tea of excellent flavour, and if scented by 1 oz. orange flavoured Pekoe, which restores the lost 'oma, is irreproachable. Indeed, it is far better than uch of the tea drank now by the better classes.

I would still leave the suggestion to be acted upon thought right, of the admixture of tea, but specially ffee and cocoa in some of the bread, whereby a highly ıtritious and therefore a comparatively cheap tea or 'eakfast cake could be prepared.

In the diet before given I have not included oats. his omission has been purposely made. The English e not over fond of porridge or water gruel. There is owever no reason why it should not be employed to icken soups, or in admixture with bread, where more iment is required.

I think it important in conclusion to remark that the tal amount of nitrogenous or non-nitrogenous aliment ken should not be diminished without great caution.

I would on the contrary recommend an increase in winter; and to those girls actively employed in manual labour.

To these last an additional allowance of meat, or black pudding, Indian corn or oats, or bread, should be given. I think 10 per cent. more food would not be too much, i. e. 11 oz. of meat, or 26 of Indian corn, or 24 of oats or bread, &c. per week. If the child is moreover growing fast, I should be inclined to recommend an increase of 20 per cent. in the amount supplied. It is in such cases that cheap and nutritious food become doubly valuable, both as giving the agent additiona strength, and preventing the recurrence of disease.

Alcoholic and malt liquors I do not recommend except in cases of ill health. The tea and coffee, an the other combustible agents given will suffice for a the wants of nature.

It is necessary here however to add one caution The rooms which the girls inhabit, especially those i which they sleep, should be well ventilated. We mus remember each girl consumes at least 350 grains o oxygen, and gives out 360 grains of Carbonic acid, pe hour by the lungs. If the atmosphere they breath contains above 2 per cent. of Carbonic acid it is inju rious to health, and 10 per cent. would be fatal. Th best and most nutritious food cannot compensate fo bad air. Each girl should have 6 feet square of a roo to herself, and at least 7 feet in height of atmospher and if even with this quantity of space, there be not pr vision made for the frequent change of the surroundi air, the exhalations in that apartment must act as a po son, not the less sure because slow; and if contagio disease or cholera should make its appearance among them, the consequences might be most fearful.

In conclusion I would say one word about the Nu sery. What I have said of ventilation and spa applies with equal force to this part of the establishment also. But I wish now to dwell particularly on the food supplied to the infants. For the very young a mixture of 1-3rd to ½ cow's milk, and water, with about 10 per cent. of sugar, taken out of a bottle, is the best substitute for breast milk. If the child be hearty and his digestion easy, a little patent barley added to the milk and water, may be given. This remark applies to most children whose ages extend up to 6 months. Experiments have however shewn that as the period during which a woman nurses is extended, the breast milk changes in chemical properties. In about 6 months time, the quantity of casein is doubled, increasing from about 2 to 4 per cent, the sugar diminishes from 6 to 4 per cent, and the salts increase from ·8 to 2·7 per cent. The butter varies greatly, but does not appear to increase. At this period therefore cow's milk in its pure state may be substituted, or if combined with water, bread crumbs, biscuit powder, tops and bottoms, or other farinaceous paste should be added to it.

The children however who come into the nursery are oftentimes very sickly looking, and in many cases half starved, and ordinary measures would not therefore suffice with these. It has been my lot when visiting amongst the poor, to have to treat many of these little sufferers; and it is in these cases often that a judicious rule of diet has proved far more satisfactory than any other treatment. My sheet anchors in these cases are Cod Liver Oil, and Essence of Beef, and it is simply in the light of aliments that I would now speak of their action. The child's hectic, even though the lungs are not implicated, has brought on great emaciation. The respiration is hurried, the food is rejected, and the child is obliged to drain his own already weakened system, and to feed upon it. Here the oil supplies directly the combustible aliment: the drain ceases, and the child rallies. Given in doses of a tea spoonful twice, or at most thrice a day, this good result has followed.

But the Cod liver oil will not suffice. It will often allay the gastric irritation, check the fever, increase the appetite, &c. but more is required; we must have the nitrogenous aliment also at work. It is here that the juice of flesh in extract, with a little water, works wonders. The best preparation of the kind with which I am acquainted in London, is Hogarth's essence of meat. A tea spoonful three or four times in a day, will often act as magic. I have seen a child so weakened by bad food and hectic, and reduced to such a state of debility, that the power of suction even had ceased, and it was apparently within a very short time of dissolution, and yet it was gradually restored by a tea spoonful of this essence, with a tea spoonful of warm water repeated every 2nd or 3rd hour; and that child has in a few days completely recovered. I do not suppose such an extreme case would be likely to be admitted in the Infant Nursery, but I am satisfied I have seeu many children there with whom such a treatment would if carried out, have been followed with the best results. I should therefore urge strongly upon the Ladies Committee to place these two substances among the usual aliments which are to be supplied to the Nursery.

Such are some general rules which I would respectfully submit to the Ladies Committee for their future guidance in dieting the inmates of their Institution. I have been desirous throughout to ameliorate the physical state of those whose spiritual condition is so much attended to. Our blessed Lord who came to save our souls from death, always went about doing good, and healing the sick. We cannot heal as He did; but it is one of the loftiest attributes of medical science, if followed in humble submission to His divine commandments, to widen the field of usefulness, and enlarge our opportunities of doing good to our fellow creatures. This has been the object of the present pamphlet; and if in the attempt I have even in the most partial manner been successful, the reflection is one full of comfort, and my labour is amply repaid.

FINIS.

APPENDIX.

The Diet List has been calculated on the following values :

Substance. 100 parts of	Nitrogenous aliment reckoned as gluten.	Non-nitrogenous aliment reckoned as starch.
Rice	6 4	80·
Indian Corn	12·3	88·
Peas	28·	67·
Lentils	30·	40·
Potatoe	1·41	19·
Wheat flour	16·	71·
Bran	19·3	8.
Rye flour	11·9	60·9
Buck wheat	6·	68·
Scotch oats	13·7	64·
Barley	15·6	57·5
Bread (Refuge)	11·8	53·1
Bread (ordinary)	13·8	44·
Meat	19·	6·
Cheese	29·	60·
Milk	4·5	11·7
Cocoa	19·	119·
Coffee	20·	29·
Tea	40·	20·
Treacle	—	77 9

Flours for Bread.

Assuming bread at 16 nitrogenous and 71 non-nitrogenous per cent.

			Nitrogenous.	Non-nitrogenous.
No. 1.	50	Lentils	15·2	20·
	50	Rice	3·2	4J·
	11	Starch	—	11·
No. 2.	55·6	Peas	15·	36·3
	45·	Rice	2 8	36·
No. 3.	33	Indian Corn	4·1	32·
	67	Peas	18 7	44·8
No. 4.	33	Barley	5·2	33·
	33	Indian Corn	4·1	29·
	34	Peas	9·3	22·
No. 5.	25	Buck wheat	1·5	17·
	25	Indian Corn	3·	22·
	50	Peas	14·	33·