hygiene that no cases of even mild scurvy were detected; the pallor and languor and depression of spirits of some among the sailors were attributed to the want of sunlight for 142 days, and it was expected that a few days sledge travelling in the open air would reinvigorate them. There was plenty of lime-juice aboard; but it seems that it is not the custom to add to the weight of provisions, which Polar sledging parties have to propel, by including the preservative amongst them. Sir George Nares, the commander of the expedition, cites the names of 10 admirals, 10 doctors, and 15 captains who have conducted land explorations in this fashion without it; and they returned unscathed to any serious extent. But on this recent occasion the crews seem to have been peculiarly predisposed to illnesses of scorbutic nature by the more than ordinary scarcity of fresh meat in their dietary, arising out of the deficiency of game in the extremely high latitude where they wintered. With few exceptions the whole of the crews of the "Alert" and the "Discovery" were employed in sledging, and the consequence was, that of the 122 officers and men, 59 were more or less incapacitated by scurvy, and 4 died.

The real reason for not carrying lime-juice in such expeditions is its cumbersomeness. Including bottles, though in truth they are not wanted in a hard frost, it may be said that 1 lb a week for each man would have to be added to the baggage,[1]—a serious item, no doubt. And with a view of remedying the inconvenience, medical men have long sought to discover to what constituent of the complicated mixture afforded by nature it is that it owes its efficacy. In a contribution to the *Medico-Chirurgical Review* for 1848, Dr Parkes examined exhaustively the evidence concerning the various deficiencies in ship food as compared with fresh food which might be filled up by one or other of the components of lime-juice; and by exclusion he is led to the conclusion that the cause of scurvy is to be found in deficiency of salts whose acids form carbonates in the system, viz., citric, tartaric, acetic, lactic, and malic acids.

Though not so good as when in their natural form, because less digestible and pleasant, yet a supply of citrates, tartrates, lactates, and malates of potash might be packed in small bulk, and, under circumstances where weight is of importance, might take the place of lime-juice. Or bolo-lozenges might be made of lime-juice freed from its aqueous portion and preserved with sugar. Three or four of these a day might be easily swallowed without stopping work.

Before leaving the subject of maritime scurvy, it may be suggested how useful it would be if those who sail in desolate regions were to carry seeds of antiscorbutic vegetables, which, strewn broadcast in uninhabited places, would form a flora capable of saving the lives of many a wrecked or weather-bound crew.

Scurvy, as landsmen see it in time of peace, amounts to little more than anæmia with a softening and bleeding condition of the gums. But it indicates the use of exactly the same preventives and remedies as the more severe complaint.

Starvation is a disease which it is a platitude to say may be prevented by diet; nevertheless there are connected with it a few peculiarities of scientific and practical interest which may not be unworthy of notice. "Inedia," as it is called in the nomenclature of diseases by the London College of Physicians, is of two kinds, arising from *want of food* and from *want of water*.

When entirely deprived of nutriment the human body is capable of supporting life under ordinary circumstances for little more than a week. In the spring of 1869 this was tried on the person of a "fasting girl" in South Wales. The parents made a show of their child, decking her out like a bride on a bed, and asserting that she had eaten no food for two years. Some reckless enthusiasts for truth set four trustworthy hospital nurses to watch her; the Celtic obstinacy of the parents was roused, and in defence of their imposture they allowed death to take place in eight days. Their trial and conviction for manslaughter may be found in the daily periodicals of the date; but, strange to say, the experimental physiologists and nurses escaped scot-free. There is no doubt that in this instance the unnatural quietude, the grave-like silence, and the dim religious light in which the victim was kept contributed to defer death.

One thing which remarkably prolongs life is a supply of water. Dogs furnished with as much as they wished to drink were found by M. Chossat (*Sur l'Inanition*, Paris, 1843) to live three times as long as those who were deprived of solids and liquids at the same time. Even wetting the skin with sea-water has been found useful by shipwrecked sailors. Four men and a boy of fourteen who got shut in the Tynewydd mine near Porth, in South Wales, in the winter of 1876–7 for ten days without food, were not only alive when released, but several of them were able to walk, and all subsequently recovered. The thorough saturation of the narrow space with aqueous vapour, and the presence of drain water in the cutting, were probably their chief preservatives,—assisted by the high even temperature always found in the deeper headings of coal mines, and by the enormous compression of the confined air. This doubtless prevented evaporation, and retarded vital processes dependent upon oxidation. The accumulation of carbonic acid in the breathed air would also have a similar arrestive power over destructive assimilation. These prisoners do not seem to have felt any of the severer pangs of hunger, for they were not tempted to eat their candles. With the instinctive feeling that darkness adds a horror to death, they preferred to use them for light.

It is a paradoxical fact, that the supply of the stomach even from the substance of the starving individual's body should tend to prolong life. In April 1874, a case was recorded of exposure in an open boat for 32 days of three men and two boys, with only ten days provisions, exclusive of old boots and jelly-fish. They had a fight in their delirium, and one was severely wounded. As the blood gushed out he lapped it up; and instead of suffering the fatal weakness which might have been expected from the hemorrhage, he seems to have done well. Experiments have been performed by a French physiologist, M. Anselmier (*Archives Gén. de Médecine*, 1860, vol. i. p. 169), with the object of trying to preserve the lives of dogs by what he calls "artificial autophagy." He fed them on the blood taken from their own veins daily, depriving them of all other food, and he found that the fatal cooling incident to starvation was thus postponed, and existence prolonged. Life lasted till the emaciation had proceeded to six-tenths of the animal's weight, as in Chossat's experiments, extending to the fourteenth day, instead of ending on the tenth day, as was the case with other dogs which were not bled.

These instances of the application of the art of dietetics to the treatment of disease are sufficient to show the principles which should be kept in sight. The pathology of the ailment should be considered first, then its bearing upon the digestive organs, and lastly the bearing of the digestive organs upon it.

And before quitting the subject of health as affected by diet, the common-sense hint may be given to those who are in good sanitary condition, that they cannot do better than let well alone. The most trustworthy security for future health is present health, and there is some risk of overthrowing nature's work by overcaring.

[1] In merchant ships lime-juice is used during Polar service in a ration of an ounce daily. See "Report" above cited. But the opinions of the officers examined seems to agree that the quantity is not sufficient, and advise half as much again or more.

Pleasure as an object of Dietetics.

The social importance of gratifying the palate has certainly never been denied in practice by any of the human race. Feasting has been adopted from the earliest times as the most natural expression of joy, and the readiest means of creating joy. If ascetics have seemed to put the pleasure away from them, they have done so in the hope of purchasing by their sacrifice something greater and nobler, and have thus tacitly conceded, if not exaggerated, its real value. Experience shows that its indulgence, unregulated by the natural laws which govern our progress in civilization, leads to unutterable degradation and meanness, brutalizes the mind, and deadens its perception of the repulsiveness of vice and crime. But that is no cause why this powerful motive power, governed by right reason, should not be made subservient to the highest purposes.

The times of meals must be regulated with a regard to the disposal of the remainder of the day, whether that depends on choice or on necessity. Violent exertion of either mind or body retards digestion; and therefore, when this is practised, food is not called for so soon as on a day of rest. The heaviest meal should be postponed till the day's work is done; it is then that social home joys give the requisite repose to the body and mind. Light eaters may dine as late as they please, but those of larger appetite should lengthen the interval between their repast and bed-time. After the night's sleep and the long fast which has emptied the digestive canal of its nutritive contents, a breakfast should be taken before any of the real business of life be begun. It is no proof of health or vigour to forego it without inconvenience; but it is proof of health and vigour to be able to lay in then a solid foundation for the day's labour. Not less than four and not more than six hours should elapse before the store is again replenished. A light farinaceous lunch with vegetables and fruit may be made most appetizing, and is followed by a cheerful afternoon, whereas a ponderous meat and wine meal entails heaviness of spirit.

Diet in relation to Economy.

Due Proportion of Animal and Vegetable Food.—It has been taken for granted thus far, that the mixed fare, which has met the approval of so many generations of men, is that which is most in accordance with reason. But there are physiologists who argue that our teeth resemble those of the vegetable-feeding apes more than those of any other class of animal, and that therefore our most appropriate food must be of the fruits of the earth.[1] And if we were devoid of the intelligence which enables us to fit food for digestion by cookery, it is probable no diet would suit us better. But our reason must not be left out of account, and it is surely quite as natural for a man to cook and eat every thing that contains in a convenient form starch, fat, albumen, fibre, and phosphorus, as it is for a monkey to eat nuts or an ox grass. The human race is naturally omnivorous.

Moreover, man is able not only to develop his highest faculties and perform all his duties on any form of digestible aliment, but he is able also very much to diminish the requisite quantities by a due admixture. The diet which supplies the demand most accurately will be the most economical in the highest sense. And that this diet is a mixed one can be shown by the following method of calculation. We can measure by experiment the ultimate elements of all that is thrown off from the body as the result of vital decomposition, the ashes, the smoke, and the gases which the fire of life produces; and thus we can lay down a rule for the minimum quantity of those elements which the daily food must contain to keep up the standard weight. If the diet be such as to make it necessary to eat too much of one element in order to secure a sufficient amount of another, there is a waste, and the digestive viscera are burdened with a useless load. But there is no single article procurable for the food of the adult population which presents the exact proportion of elements required by an adult, and therefore no single article alone can supply human wants without waste.

As an example, apply this reckoning to the elements carbon and nitrogen, which constitute the main bulk of the solids in our food and in our bodies. Suppose a gang of 100 healthy prisoners to excrete, in the shape of breathed air and evacuations, $71\frac{1}{2}$ lb of carbon and $4\frac{1}{4}$ lb of nitrogen (which is pretty nearly the actual amount of those elements in the dried solids of the secreta, as estimated by current physiological works). Both nitrogen and carbon to that extent must of course be supplied in the food. Now, if you fed them on bread only, there would be wanted daily at least 380 lb of it to sustain them alive long, for it takes that weight to yield the $4\frac{1}{4}$ lb of nitrogen daily excreted; while, in the 380 lb of bread there are $128\frac{1}{2}$ lb of carbon, which is 57 lb above the needful quantity of that substance.[2]

If, on the other hand, the bread were replaced by a purely animal diet, there would have to be found 354 lb of lean meat in order to give the $71\frac{1}{2}$ lb of carbon; and thus there would be wasted 105 lb of nitrogen contained in the meat, over and above the $4\frac{1}{2}$ lb really required to prevent emaciation.[3]

In the first case each man would be eating about 4 lb of bread, in the second $3\frac{1}{2}$ lb of meat *per diem*. If he ate less, he would lose his strength. The first would carry about with him a quantity of starch, and the last a quantity of albuminous matter not wanted for nutrition, and would burden the system with an useless mass very liable to decompose and become noxious.

When work is undertaken, much more is actually wanted. According to Mr Vizetelly, the labourer in a Spanish vineyard consumes daily between 8 and 9 lb of vegetable food, consisting of bread, onion-porridge, and grapes.[4] And when animal food alone is taken, as in the case of the Esquimaux, 20 lb of it a day is the usual allowance.

Now, if a mixed dietary be adopted for the gang of 100 prisoners before mentioned, 200 lb of farinaceous food, with 56 lb of animal muscle, would fulfil the requirements of the case; 2 lb of bread and a little more than $\frac{1}{2}$ lb of meat a head would be enough, under ordinary circumstances, for each man's daily food.

200 lbs. of bread contains.........	60 of carbon,	2 of nitrogen.
60 lbs. of meat (including $12\frac{1}{2}$ lbs. of fat on it), contains	12 ,,	$2\frac{1}{4}$,,
	72	$4\frac{1}{4}$

Balance of Food and Work.—The most important modification to be made in the above estimate arises from the differences of work demanded. Men may exist in inaction on a scale of food-supply which is followed by death from starvation when they are put to hard labour. It is of importance, therefore, to have some measure of the effects of physical exertion. And here mechanical science has con-

[1] Milne-Edwards, *Cours de Physiologie*, vol. vi. p. 198.

[2] Dr Letheby's analysis gives 8·1 per cent. of nitrogenous matter to bread (*Lectures on Food*, p. 6). Of this $\frac{1}{6}$th is nitrogen, Boussingault's analysis of gluten giving 14·60 per cent. (*Annales de Chim. et Phys.*, lxiii. 229). M. Payen makes the proportion of nitrogen to carbon in bread as 1 to 30.

[3] The proportion of nitrogen to carbon in albumen is as 1 to $3\frac{1}{2}$ (15·5 to 53·5 by Mulder's analysis, quoted in Lehmann, *Phys. Chemie*, i. 343). In red meat there is 74 per cent. of water (ditto iii. 96).

[4] *Facts about Sherry*, chap. i. 1876; and Sir John Ross's *Second Voyage for the Discovery of the North-West Passage*, p. 413.

tributed to physiology a precision rarely attainable in our dealings with social economy. Mr Joule of Manchester analyzed, about thirty years ago, the relation which the heat, used as a source of power in machinery, bore to the force of motion thus made active. He showed that raising the temperature of 1 ℔ of water 1° Fahr. was equivalent to raising 772 ℔ to the height of 1 foot; and conversely, that the fall of 772 ℔ might be so applied as to heat 1 ℔ of water 1° Fahr. Thus, the mechanical work represented in lifting 772 ℔ 1 foot, or 1 ℔ 772 feet, forms the "dynamic equivalent," the measure of the possible strength of 1° of temperature as marked by the thermometer in 1 ℔ of water. Physiologists seized eagerly on the opportunity which Joule's demonstration seemed to afford them of estimating in actual numerals the relation of living bodies to the work they have to do. So much earth raised on an embankment represents so much heat developed in the machinery, be it living or dead. The fully digested food, converted through several stages into gaseous, liquid, and solid excretory matters, produces by its chemical changes a definite amount of heat, of which a definite amount escapes and a definite amount is employed in working the involuntary machinery of the body, and the rest is available for conversion at will into voluntary muscular actions.

It may be reckoned that the daily expenditure of force in working the machinery of the body—in raising the diaphragm about 15 times and contracting the heart about 60 times a minute, in continuously rolling the wave of the intestinal canal, and in various other involuntary movements, without anything to be fairly called work,—it may be reckoned that the expenditure of force in doing this is equal to that which would raise a man of 10 stone 10,000 feet.

There are several reasons for believing that in assigning their physiological functions to the several sorts of food, nearly all the business of begetting force should be ascribed to the solid hydrocarbons, starch and oil, by their conversion into carbonic acid and water, just as there are good grounds for thinking that it is the conversion of the solid hydrocarbon of coal into the same substances which drives a locomotive. To the nitrogenous aliments seems allotted primarily the task of continuously replacing the wear and tear of the nitrogenous tissues, while any excess of them assists the starch and oil in keeping up the animal heat.

One of the most cogent of the reasons for this view is that the chief nitrogenous excretion, the urea, is not increased in amount in proportion to the work done, as shown by the experiments of Messrs Fink and Wiscelenus; whereas the excretion of carbonic acid in a decided manner follows the amount of muscular exertion. Now, it is very clear that if the supply of power to do work depended on the decomposition and renewal of the muscles by flesh food, the urea must be exactly proportioned to the exertion, which is not the case.

To give an example of the mode of working out a problem by this theory. Professor Frankland, in a series of experiments made in 1866 at the Royal Institution, and published in the *London Philosophical Magazine*, vol. xxxii. p. 182, ascertains with the "calorimeter" (which reckons the *amount* of heat evolved as a thermometer does its *degree*) the quantity of energy or force evolved under the form of heat during the oxidation of a given weight of alimentary substance. It has been explained that heat and mechanical work, being convertible into one another, bear a constant proportion to one another; so that a definite production of so much heat invariably represents the potentiality of so much motion, used or wasted according to circumstances. From the reading of the calorimeter therefore may be calculated how many extra pounds ought to be raised a foot high by a man who has eaten an extra pound of the food in question; how many steps a foot high he ought to raise a weight of ten stone (say himself) before he has worked out the value of his victuals. Professor Frankland has thus estimated the comparative value of foods as bases of muscular exertion, and he has made out a table of the weight and cost of various articles that would require to be consumed daily to enable a man to support life, the equivalent of which has been already reckoned as the muscular force in action which would raise a man of 10 stone 10,000 feet.

Name of Food.	Weight in pounds required.	Price per Lb.		Cost.	
		s.	d.	s.	d.
Cheshire cheese	1·156	0	10	0	11½
Potatoes	5·068	0	1	0	5¼
Apples	7·815	0	1½	0	11¾
Oatmeal	1·281	0	2¾	0	3½
Flour	1·311	0	2¾	0	3¾
Peameal	1·335	0	3¼	0	4½
Ground rice	1·341	0	4	0	5½
Arrowroot	1·287	1	0	1	3½
Bread	2·345	0	2	0	4¾
Lean beef	3·532	1	0	3	6½
Lean veal	4·300	1	0	4	3½
Lean ham (boiled)	3·001	1	6	4	6
Mackerel	3·124	0	8	2	1
Whiting	6·369	1	4	9	4
White of egg	8·745	0	6	4	4½
Hard-boiled egg	2·209	0	6½	1	2½
Isinglass	1·377	16	0	22	0½
Milk	8·021	0	2½	1	8
Carrots	9·685	0	1½	1	2½
Cabbage	12·020	0	1	1	0¼
Cocoa-nibs	0·735	1	6	1	1¼
Butter	0·693	1	6	1	0½
Beef fat	0·555	0	10	0	5½
Cod-liver oil	0·553	3	6	1	11¼
Lump sugar	1·505	0	6	0	9
Commercial grape sugar	1·537	0	3½	0	5½
Bass's pale ale (bottled)	9 bottles.	0	10	7	6
Guinness's stout	6¾ bottles.	0	10	5	7½

After the supply of sufficient albuminoid matters in the food to provide for the necessary renewal of the tissues, the best materials for the production of internal and external work are non-nitrogenous matters, such as oil, fat, sugar, starch, gum, &c. When the work is increased, not so much extra meat as vegetable food, or its dietetic equivalent, fat, is demanded.

In comparing the cost of a daily sufficiency of the various foods to produce the required force, we must not forget the inconveniences which many of them entail. These inconveniences must be added to the cost. For example, suppose a man to have been living upon potatoes only, just supporting life with 5 ℔ a day, and then to get work which enabled him and required him to take a double supply of non-nitrogenous food, he would act unwisely if he were to swallow it in the form of 12 ℔ of cabbage. He would be knocked up by the shear labour of carrying 12 ℔ extra in a vessel so ill-adapted to sustain heavy loads as the stomach. A similar objection would lie against milk, or veal, or apples, however cheap accident might make them; and a more serious objection still would hold against nine bottles of ale, or seven of stout. On the other hand, the over-concentration of cheese, beef dripping, and lump sugar, makes them nauseous when in large quantity or monotonously persisted in, though when introduced as a variety they are appetizing and digestible. There is no saving in using that against which the stomach is set, or which the absorbents refuse to assimilate.

Reverting to the illustration of the gang of a hundred prisoners, and supposing it were requisite to put them on hard labour equivalent to half "Frankland's unit" of 10 stone raised 10,000 feet—such, for instance, as carrying up ladders, altogether 1½ mile high, three tons of stone daily—calculation would show that to add this amount of labour to the outgoings caused by the functioning of physiological life, would involve the addition to their spare diet of at least 117 ℔ of bread, or of 58 ℔ of bread with 44 ℔ of lean meat and 63 ℔ of potatoes. The slightest imperfection or indigestion of any of this would cause a loss of bodily weight, and cases of illness would be culpably frequent. Were a draught of milk, or a cup of cocoa and sugar, or some oatmeal porridge and treacle, or even a little dripping or butter or bacon given, the danger would probably be averted.

The most conspicuous fault in the dietary of the working classes is want of variety. Many of the articles which combine ample nutritiousness with small cost are habitually neglected, because when used exclusively they are disagreeable and unwholesome. From never being eaten they become absolutely unknown. There are many sorts of cheap beans, vetches, and pease, unheard of except at gentlemen's tables, of which a complete meal may be made, or which may support the dish of meat; while beet-root, cresses, kail, carrots, and other plants easily grown are left unused.

Quantity of Food required.—The calculations of Dr Playfair "on the food of man in relation to his useful work[1]" enable us by another route to arrive at an estimate of what amount of solid victuals is required by an adult living by bodily labour to preserve his health under various circumstances. The circumstances which chiefly affect the question can be classified thus:—(1) bare existence; (2) moderate exercise; (3) active work; and (4) hard work.

1. The first is calculated from the mean of sundry prison dietaries, of the convalescents' diet at hospitals, that of London needlewomen, and of that supplied during the Lancashire cotton-famine, as reported by Mr Simon. The result is that, in a condition of low health, without activity, 2½ ounces of nitrogenous food, 1 ounce of fat, 12 ounces of starch, and ½ of an ounce of mineral matters a day are necessary. The amount of carbon in this is equal to 7·44 ounces. In other words, a man's life will be shortened or burdened by disease in the future, or he will die of gradual starvation, unless his provision for a week is equivalent to 3 ℔ of meat with 1 ℔ of fat on it, or with the same quantity of butter or lard, two quartern loaves of bread, and about an ounce of salt and other condiments. If he cannot get meat, he must supply its place with at least two extra quartern loaves, or about a stone and a half of potatoes, or between 5 and 6 ℔ of oatmeal,—unless he is, indeed, so fortunate as to be able to get skim milk, of which 5 pints a week will replace the meat.

A person reduced to bare existence diet can undertake no habitual toil, mental or bodily, under the penalty of breaking down.

"Bare existence" diet is that which requires to be estimated for administration to certain classes of the community who have a claim on their fellow-countrymen that their lives and health shall be preserved *in statu quo*, but nothing further. Such are prisoners, paupers, or the members of a temporarily famine-stricken community.

It would be obviously unjust to apply the same scale of quantity and quality to all persons under varying circumstances of constitution and outward surroundings; and to attempt to feed in the same way all these people for short or long periods, idle or employed, with light work or hard work, in hot or in cold weather, excited by hope or depressed by failure, involves an error of either excess or defect, or both at once. The dietaries recommended by the Home Office for prisoners very properly take all these circumstances into consideration. They allot "bare existence" diet only to those sentenced for short terms without labour. And they recognize the fact that a man's health is not injured (perhaps sometimes it is improved) by a few days of such abstinence as would in the long run be deleterious to him. Under a sentence of seven days a prisoner gets daily 1 ℔ of bread, and a quart of gruel containing 4 oz. of oatmeal. For more than seven and under twenty-one days he has an extra ½ ℔ of bread. For longer terms it is advised to add potatoes and meat.

The nutritive value of the first named diet is thus calculated by Dr Pavy (*Treatise on Food*, p. 415):—

Nitrogenous matter	1·800 oz.
Fat	·486 ,,
Carbohydrates	10·712 ,,

of the second—

Nitrogenous matter	2·448 oz.
Fat	·608 ,,
Carbohydrates	14·792 ,,

In the convict establishments prisoners are all under long sentence, and are classified for dietetic purposes according to their occupation.

The sparest of all is called "punishment diet," and is administered for offences against the internal discipline of the prison. It is equivalent to corporeal chastisement, being designed to make the stomach a source of direct pain. It is limited to a period of three days, and fully answers its proposed end as a deterrent by causing the sol r plexus to experience the greatest amount of distress it is capable of; for after the expiration of that period sensation becomes blunted. It consists of 1 ℔ of bread and as much water as the prisoner chooses to drink. This last-named concession is not an unimportant one; for it has been already remarked that a supply of fluid enables starvation, and by implication abstinence, to be longer borne. At the same time it probably postpones the anæsthesia, and therefore makes the intended suffering more real. "Punishment diet" contains, in Dr Pavy's estimate,—

Nitrogenous matter	1.296 oz.
Carbohydrates	8·160 ,,
Fat	0·256 ,,
Mineral matter	0·368 ,,
Total of dry solids	10·080 ,,

This is about half of what an average man requires to sustain himself without work, and under its discipline he would probably lose 3 or 4 ounces of his weight daily till his bodily substance was reduced by six-tenths, at which period, according to Chossat's experiments, he would die.

"Penal diet" is that which is apportioned for more protracted punishment. It may be continued for three months. It consists of 20 oz. of bread, 8 oz. of oatmeal, 20 oz. of milk, and 16 oz. of potatoes daily. Its chemical constituents are as follows:—

Nitrogenous matter	3·784 oz.
Carbohydrates	19 864 ,,
Fat	1·580 ,,
Mineral matter	0·972 ,,
Total of dry solids	26·200 ,,

Upon this diet a fair amount of work may be done. The combustion of the carbohydrates evolves sufficient force to raise a ton 4193 feet; and thus the effete muscular substance may be worn off by destructive assimilation, making place for new muscle derived from the nitrogenous matter of which a bare sufficiency, but yet probably a sufficiency, is supplied. A man of strong constitution is usually found at the end of it to be in good health and of normal weight;

[1] *Lecture delivered at the Royal Institution, London*, April 28, 1865.

yet he has never probably experienced the content which arises from a *luxus*-consumption of food. It is intended to deny him the normal pleasure of the accumulation of reserve-force in the gastric region. This pleasurable sensation under ordinary circumstances much promotes digestion, so that the whole of the ingesta are made the best use of; and therefore in "penal diet," as above quoted, it has been found expedient to introduce the slight excess to be noticed above what is needful to accomplish the required work in "foot-tons" (see before). The penalty of the regimen involves a certain degree of waste.

A close imitation of "penal diet" is that which the duty of a responsible Government demands should be served out during a temporary famine, that is, one calculated not to last above three months. It is more economical to introduce the elements of variety in the diet than to be too monotonous,—that is, to save in the daily issue and to be occasionally liberal, to feast from time to time as a break in the regular fast. The expense of the excess is more than replaced by the diminished habitual ration, and that powerful preservative of life, anticipation of pleasure, is brought into play. A reduction of the allowance below what experience has indicated as "bare existence diet," made during the famine in Madras in the beginning of 1877, was attended with disastrous results.

By dint of mixing and varying his diet and making it consist of very nutritious articles, such as bread, meat, yolk of eggs, and soup, Signor Cornaro (see CORNARO) succeeded in reducing the quantity he daily consumed to as little as 12 oz. (Venetian). But then he made the solids go much further by taking 14 oz. of good wine. And the probability is that this gentlemen had a peculiar constitution, for, in spite of his many readers, he has had no imitators of the experiment on their own persons.

2. The appropriate food of the second class may be fairly represented by the dietaries of European soldiers in time of peace. The English soldier on home service, according to Dr Parkes, receives from Government $5\frac{1}{4}$ ℔ of meat and 7 ℔ of bread weekly, and buys additional bread, vegetables, milk, and groceries out of his pay. Such a diet is sufficient for anybody under ordinary circumstances of regular light occupation; but should extra demands be made upon mind or body, weight is lost, and if the demands continue to be made the health will suffer. Mr F. Buckland, surgeon in the Guards, remarks (*Soc. of Arts Journal*, 1863, quoted by Dr Playfair) that though the sergeants in the Guards fatten upon their rations, the quantity is not enough for recruits during their drill.

The Prussian soldier during peace gets weekly from his canteen 11 ℔ 1 oz. of rye bread, and not quite $2\frac{1}{2}$ ℔ of meat. This is obviously insufficient, but under the conscription system it is reckoned that he will be able to make up the deficiency out of his own private means, or obtain charitable contributions from his friends. Dr Hildesheim (*Die Normal-Diät*, Berlin, 1856, p. 60) states that asthenic diseases are very common in the army, which leads to the inference that the chance assistance on which the authorities lean is not trustworthy. As the legal ration in these two services does not profess to be a man's full food, it is needless to analyze it. In the French infantry of the line each man during peace gets weekly 15 ℔ of bread, $3\frac{3}{10}$ ℔ of meat, $2\frac{1}{2}$ ℔ of haricot beans or other vegetables, with salt and pepper, and $1\frac{3}{4}$ oz. of brandy. This seems to be enough to support a man under light employment. Its analysis gives—

Water	179·83 oz.
Nitrogenous matter (or albuminates)	30·17 ,,
Fat	9·29 ,,
Carbohydrates (or starch)	126·84 ,,
Total of dry solids	166·30 ,,

An Austrian under the same circumstances receives 13·9 ℔ of bread, $\frac{1}{2}$ ℔ of flour, and 3·3 ℔ of meat. The alimentary contents are—

Water	129·50 oz.
Nitrogenous matter	27·40 ,,
Fat	8·23 ,,
Carbohydrates	119·45 ,,
Total of dry solids	155·08 ,,

The Russian conscript is allowed weekly[1]—

Black bread	7℔.
Meat	7℔.
Kawass (beer)	7·7 quarts.
Sour cabbage	$24\frac{1}{2}$ gills, – $122\frac{1}{2}$ oz.
Barley	$24\frac{1}{2}$ gills, – $122\frac{1}{2}$ oz.
Salts	$10\frac{1}{2}$ oz.
Horse radish	28 grains.
Pepper	28 grains.
Vinegar	$5\frac{1}{4}$ gills, – $26\frac{1}{2}$ oz.

The "moderate exercise" of brain and muscle combined in the above classes is fairly represented in the convict scale by "light labour" (such as oakum-picking), and by "industrial employment" (such as tailoring, cobbling, Roman mosaic and mat making, basket weaving, &c). The dietary for prisoners thus engaged is nearly identical, except that the artisans using their brains are supplied with about an ounce extra daily.

The "industrial employment diet" for a week is thus analyzed by Dr Pavy:—

Weekly Allowance.		Nitrogenous matter.	Carbohydrates.	Fat.	Mineral Matter.	Total water-free matter.
	oz.	oz.	oz.	oz.	oz.	oz.
Cocoa	3·500	0·560	1·540	1·295	0·105	3·500
Oatmeal	14·000	1·764	8·932	0·784	0·420	11·900
Milk	28·000	1·148	1·456	1·092	0·224	3·920
Molasses	7·000	...	5·390	...	...	5·390
Salt	3·500	...	...	...	3·500	3·500
Barley	1·000	0·063	0·743	0·024	0·020	0·850
Bread	148·000	11·988	75·480	2·368	3·404	93·240
Cheese	4·000	1·340	...	0·972	0·216	2·528
Flour	8·625	0·931	6·081	0·172	0·147	7·331
Meat (cooked, without bone or gravy)	16·000	4·416	...	2·472	0·472	7·360
Shins (made into soup	8·000	1·688	...	0·320	2·072	4·080
Suet	1·500	...	...	1·244	0·030	1·274
Carrots	1·000	0·013	0·145	0·002	0·010	0·170
Onions	3·000	0·036	0·216	...	0·018	0·270
Turnips	1·000	0·012	0·072	...	0·006	0·090
Potatoes	96·000	2·016	21·120	0·192	0·672	24·000
Total water-free matter		25·975	121·175	10·937	11·316	169·403

This is probably a fair model for the most economical dietary on which an artisan or labourer on light work can thrive. It may be observed that the principle of variety is very conspicuous, and in private life it is possible to introduce still more variety by cookery (see COOKERY.) In the English and Prussian armies the introduction of variety is left to be attained by forcing the soldier to purchase some portion of his food out of his own pocket; in the French scale it is managed by issuing spices and various vegetables, and trusting to the innate genius of the Gaulish warrior for cooking. The issue of an occasional glass of brandy on holidays makes an agreeable change and benefits digestion; but if wine could be obtained it would be better, and not extravagant. The Austrian bill of fare is sadly monotonous. The Russian ration may be noticed as particularly liberal of accessory and antiscorbutic food, from which civil as well as military dieticians might take an useful hint.

[1] Report of Sanitary Commission, 1858, p. 425, quoted by Dr Parkes.

Vinegar and other vegetable acids are too much neglected by our handicraftsmen and soldiers. The Carthaginians are stated by Aristotle to have used vinegar as a substitute for wine during their campaigns; and the recipes given by Cato for flavouring vinegar with fruits show that it was in use among the labouring population in Italy.

3. "Active" labourers are those who get througn such an amount of work daily, exclusive of Sundays, as may be represented by a walk of 20 miles. In this class are soldiers during a campaign, letter carriers, and engineers employed on field work or as artisans. These habitually consume on the average about a fifth more nitrogenous food and twice as much fat as the last class, while the quantity of vegetable hydrocarbons is not augmented, except in the Royal Engineers.

The "hard labour diet" of convict prisons fairly represents what the authorities consider the minimum. It is the same as that already described as "industrial employment diet," with the following additions:—barley, 1 oz.; bread, 20 oz.; shins for soup, 8 oz.; carrots, 1 oz.; onions, $\frac{1}{2}$ oz.; turnips, 1 oz. It contains, however, 14 oz. less milk, and 1 oz. less "meat."

The nutritive value of the additions may be seen by Dr Pavy's alimentary analysis, which is as follows:—

Weekly Additions.		Nitrogenous matter.	Carbohydrates.	Fat.	Mineral matter.	Total water-free matter.
	oz.					
Barley	1·000	0·063	0·743	0·024	0·020	0·850
Bread	20·000	1·620	10·280	0·320	0·460	12·680
Shins	8·000	1·688	...	0·320	2·072	4·080
Carrots	1·000	0·013	0·145	0·002	0·010	0·170
Onions	0·500	0·006	0·036	...	0·003	0·045
Turnips	1·000	0·012	0·072	...	0·006	0·090
Total water-free matter		3·402	11·276	0·666	0·571	17·915

From these totals must be deducted the articles cut off:—

Weekly Diminutions.		Nitrogenous matter.	Carbohydrates.	Fat.	Mineral matter.	Total water-free matter.
Milk	14·000	0·574	0·728	0·546	0·112	1·960
Meat	1·000	0·276	...	0·154	0·030	0·460
Total water-free matter		0·850	0·728	0·700	·142	2·420

The same food is given summer and winter, though the demand must be greater to provide for the extra quantity of heat required to be produced in cold weather. But then the amount of work is diminished at the latter season by $1\frac{3}{4}$ hours, which is equivalent to an augmentation of the diet. The additions are more judicious than those made by the classes above mentioned who partly furnish their own food; for bread and vegetables constitute a large portion of the convict ration, and the extra quantity of soup replaces the lost milk, without risk of the waste in cooking common when the uneducated deal with solid meat.

4. "Hard work" is that got through by English navvies, hard-worked weavers, and blacksmiths, &c. which is more earnest and intense than the enforced "hard labour" of the convict. It is difficult to obtain accurate information, but it would appear from Dr Playfair's estimates that the customary addition to the diet is entirely in nitrogenous constituents. The higher their wages the more meat the men eat.

The neglect of vegetables by the last two classes is in a physiological point of view imprudent, and possibly may be a contributing cause of an inordinate thirst for alcohol which impoverishes and degrades many among them. To satisfy their instinctive craving for a hydrocarbon, they take one convenient indeed in some respects, but of which any excess is unwholesome. The discovery already mentioned of the production of force from the assimilation of starch leads to a knowledge, opposed to old prejudices but supported by experience, that the raising of the energies to their full height of usefulness may be effected by vegetable food quite as well as by the more stimulating and more expensive animal nutriment, or by the more rapidly absorbed alcohol.

With regard to the tables quoted above in which ultimate analyses are used as data for dietetic rules, it must be noticed that their authors deprecate arguments being founded on any but the very broadest characters of the articles analyzed. Specimens, even when of the highest quality, differ strangely from one another. Season, soil, modes of culture, the variations of species, and many other little known influences come into play and prevent our taking the market names of eatables as representatives of a definite chemical constitution. And it may be added that ample scope should be allowed for the peculiarities of the individual and of his life-history. In the application of general rules some one must be trusted to relax or strain them when circumstances require, or failures of a fatal character may occasionally result. and more often a galling perversion of justice.

Estimates for the thrifty management of food-supply have usually reference to the feeding of others rather than to the calculation of a man's own dietary. Enough has been said on that point under the head of the influence of diet upon health, and if a person really wants to bring down the expense of feeding himself to the lowest point, he can readily rate himself under one of the classes enumerated above, and act accordingly. It may, however, be doubted whether it is wise to reduce the diet to the minimum which the work requires. The certain evils of an accidental deficiency or of a miscalculation are so serious that the danger outweighs the possible inconvenience of a slight excess. It were an unthrifty thrift indeed which imperilled vigour of mind and body to effect a pecuniary saving; for there is no investment so remunerative as high health. A man need not consider that he is wasteful when he spends money upon making his bill of fare palatable and provocative of indulgence to the extent of moderate superfluity. Pleasure and prudence here walk hand in hand.

(T. K. CH.)

DIETRICH, CHRISTIAN WILHELM ERNST (1712–1774), was born at Weimar, where he was brought up early to the profession of art by his father Johann George, then painter of miniatures to the court of the grand duke. Being sent to Dresden to perfect himself under the care of Alexander Thiele, he had the good fortune to finish in two hours, at the age of eighteen, a picture which attracted the attention of the king of Saxony. Augustus II. was so pleased with Dietrich's readiness of hand that he gave him means to study abroad, and visit in succession the chief cities of Italy and the Netherlands. There he learnt to copy and to imitate masters of the previous century with a versatility truly surprising. Winckelmann, to whom he had been recommended, did not hesitate to call him the Raphael of landscape. Yet in this branch of his practice he merely imitated Salvator Rosa, Roos, and Everdingen. He was more successful in aping the style of Rembrandt, and numerous examples of this habit may be found in the galleries of St Petersburg, Vienna, and Dresden. At Dresden, indeed, there are pictures acknowledged to be his, bearing the fictitious dates of 1636 and 1638, and the name of Rembrandt. Among Dietrich's cleverest reproductions we may account that of Ostade's manner in the Itinerant Singers at the National Gallery. His skill in catching the character of the later masters of Holland is shown in candle-light scenes, such as the Squirrel and the