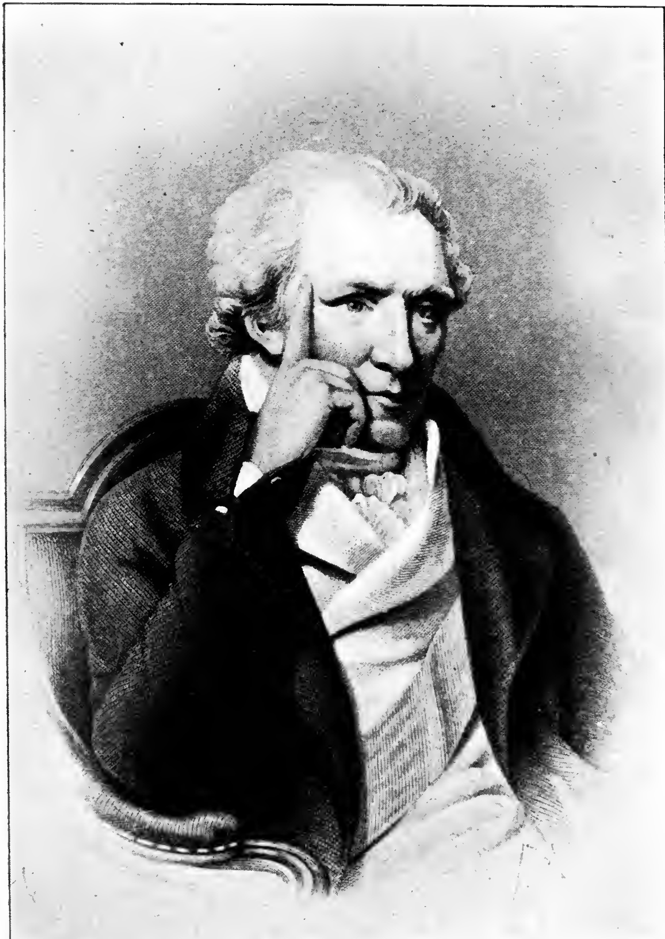
PLAIN WORDS ABOUT FOOD

The Rumford Kitchen Leaflets



COUNT RUMFORD.

PLAIN WORDS ABOUT FOOD

THE

RUMFORD KITCHEN LEAFLETS

1899

BOSTON
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1899

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(Numbers 1 and 6 are reprinted from the American Kitchen Magazine. Numbers 2, 12, 16, 18, 19, 20 are printed here for the first time.)

LIST OF ILLUSTRATIONS.

"He who works with all his strength on the development of our knowledge of food and nutrition, and who also persistently strives to apply the results of investigation, is working on a broad basis for the development of mankind." — DONDERS.

A GOOD COOK.

"To be a good cook means the knowledge of all fruits, herbs, balms, and spices, and of all that is healing and sweet in fields and groves, savory in meats; it means carefulness, inventiveness, watchfulness, willingness, and readiness of appliance; it means the economy of great grandmothers, and the science of modern chemists; it means much tasting and no wasting; it means English thoroughness, French art, and Arabian hospitality; it means, in fine, that you are to be perfectly and always ladies (loaf givers), and you are to see that everybody has something nice to eat." — RUSKIN.

INTRODUCTION.

THE constant demand for copies of the leaflets distributed from that part of the Massachusetts Exhibit called the Rumford Kitchen at the World's Columbian Exposition in Chicago, in 1893, has led to this collection of the literature, with illustrations of the exhibit.

It should be remembered that the leaflets are published as they were written five years ago, so that the distinguished scientific men, who then gave generously of their time and thought to further the plan, have not had an opportunity to qualify their statements in view of later discoveries.

During the World's Fair, visitors at the Rumford Kitchen were often seen copying the mottoes which hung upon the walls. Since that time many calls for these quotations have come from all parts of the country. To supply this demand they were printed in the American Kitchen Magazine, Vol. IV., No. 5, and Vol. V., No. 2. They are now given this permanent form.

Four luncheons have been selected as typical of the ten which made up the original Bill of Fare. Numbers one and two show a higher food value than the standard, while numbers three and four fall below, although the cost of number two is the least and of number four the greatest.

THE RUMFORD KITCHEN, COLUMBIAN EXPOSITION, 1893.

GUIDE TO THE RUMFORD KITCHEN.

An Exhibit made by the State of Massachusetts in connection with the Bureau of Hygiene and Sanitation.

WORLD'S COLUMBIAN EXPOSITION, CHICAGO, 1893.

STATEMENT BY GENERAL FRANCIS A. WALKER.

THE exhibit known as the Rumford Kitchen is the outgrowth of the work, in the application of the principles of chemistry to the science of cooking, which has for three years been carried on as an educational agency by Mrs. Robert H. Richards and Mrs. Dr. John J. Abel, with pecuniary assistance from certain public-spirited citizens of Boston.

The Massachusetts Board of World's Fair Managers, recognizing the high scientific character of those who have initiated and conducted this enterprise, and believing that such practical demonstration of the usefulness of domestic science could not fail to be of advantage to multitudes of visitors to the Columbian Exposition, have invited the ladies named to open the Rumford Kitchen as a part of the exhibit of Massachusetts in connection with the Bureau of Hygiene and Sanitation.

In order to reduce, in some degree, the expenses of this exhibit, the food cooked in the Rumford Kitchen will be sold under a concession from the administration of the Exposition; but it should be understood that this is not a money-making exhibit; that nothing is cooked for the sake of being sold; and that the enterprise is to be regarded as absolutely a scientific and educational one.

The exhibit consists of ten parts:

1st. A selection from the apparatus used in the New England Kitchen, Boston, for the preparation of certain kinds of food.

2d. Samples of the food served at the tables to illustrate the effects of cooking by the methods used.

3d. Samples of food prepared for the very sick.

4th. Menus giving the composition and food value of the dishes thus cooked and served.

5th. Charts and diagrams illustrating methods of teaching important facts in connection with food.

6th. Models of some of Count Rumford's inventions.

7th. A library containing Count Rumford's complete works and various other publications of interest.

8th. A series of leaflets written expressly for this exhibit by eminent authorities, or selected from the literature of the New England Kitchen.

9th. A kitchen laboratory table with indispensable apparatus.

10th. Some forms of apparatus and some utensils especially desirable for home use.

THE RUMFORD KITCHEN.

The purpose of the exhibit in the Rumford Kitchen is two-fold: first, to commemorate the services to the cause of domestic science rendered by Count Rumford one hundred years ago, services which to-day stand unrivalled in spite of the progress of other departments during this century; second, to serve as an incentive to further work in the same direction, as he expressed it, "to provoke men to investigation," "to cause doubt, that first step toward knowledge."

The Rumford Kitchen, then, stands for the *application of science to the preparation of food.* A careful study of all the published essays of Count Rumford will show that in so far as the question is that of method of preparation and application of heat we have advanced very little in this one hundred years; but that the science which was so carefully worked out at that time has been lost sight of to a great extent, and that the common practice is now quite as bad as when Count Rumford so strongly deprecated it. We can to-day only echo his statements — "The common kitchen range seems to have been calculated for the express purpose of devouring fuel." "It is a common habit to boil a dish of tea with fuel sufficient to cook a dinner for fifty men."

We cannot do better than follow the example of this remarkable man and patient experimenter in the study of those problems which affect the daily life of all people alike; and certainly if a man held in so much honor and respect by the whole civilized world, who had a high position at court, and who busied himself with the most abstruse theories of the science of the time, yet found his greatest joy in planning kitchen utensils, surely it is not beneath the dignity of any modern investigator to follow in his footsteps. "A real improvement in the art of cookery, which unites the advantage of economy with wholesomeness and an increased enjoyment in eating, appears to me very interesting."

The century which has passed has indeed added some things to our knowledge of food. The increase in facility of transportation, and in means of preservation, has increased many times the number of food materials available. Chemical analysis has given us the ultimate composition of most of these food materials, and the agricultural experiment stations have, as a side issue, determined in a few cases the amount of these food materials which are daily required by the human animal, so that we have already a basis upon which to build; but there still remains the most important branch of the subject, the one to which Count Rumford gave his attention, namely, the relation of the proportion of food materials and their combination to the best and most economical nutrition of men. In fact we must carry on the study of the "science of nutrition" which Count Rumford so well began.

It is, then, not as an exponent of any theory, not as the advocate of any one process, not as illustrating a universal panacea for all of the ills of mankind, not as offering a completed plan to be exactly followed, that the Rumford Kitchen has been fitted up, but rather to show that certain knowledge is within our reach, and that certain improvements are possible in the line of our daily life. It is hoped to arouse the intelligent, thinking citizen to the need and to the possibility of improvement in these directions.

FOODS PREPARED AND SOLD AT THE RUMFORD KITCHEN, WITH THEIR FOOD VALUES.

FOUR STANDARD LUNCHEONS.

			Food Value in Grams. Proteid.	Fat.	Carbohydrates.	Calories.
Voit's Standard. One-quarter of One Day's Ration			24.5	14.	125.	742.
Atwater's Standard. One-quarter of One Day's Ration			31.2	31.2	114.	882.
	Ounces.	Grams.				
No. 1. Baked Beans	8.4	238.1	26.3	35.6	131.4	979.3
Brown Bread	4.2	119.1				
1 Roll	2.0	56.7				
Butter	0.7	19.8				
Apple Sauce	5.3	150.2				
No. 2. Pea Soup	9.8	277.8	23.6	35.4	126.1	935.3
Rolls or Bread	4.0	113.4				
Butter	0.7	19.8				
Apple Cake	4.0	113.4				
No. 3. Beef Broth	9.4	266.5	26.3	20.4	128.4	817.5
Rolls or Bread	4.0	113.4				
Butter	0.7	19.8				
Gingerbread	4.0	113.4				
No. 4. Escalloped Fish	4.0	113.4	26.8	24.0	109.8	777.2
Rolls or Bread	4.0	113.4				
Butter	0.7	19.8				
Baked Apples	8.0	226.8				

Cost of Raw Materials of Each of Four Standard Luncheons, at Average Market Prices.

No. 1	4.39 cents.	No. 3	4.32 cents.
No. 2	3.49 "	No. 4	5.34 "

RUMFORD KITCHEN MOTTOES.

Wherefore do ye spend money for that which is not bread, and your labor for that which satisfieth not? — *Isaiah, lv. 2.*

Preserve and treat food as you would your body, remembering that in time food will be your body. — *B. W. Richardson.*

The palate is the janitor, and unless he be conciliated, the most nutritious food will find no welcome.

There are three companions with whom you should keep on good terms — your wife, your stomach, and your conscience.

Myriads of our fellow-creatures have perished because those around them did not know how to feed them. — *Fothergill.*

Prayer and provender delays no man's journey. — *Old Proverb.*

The fate of nations depends on how they are fed.

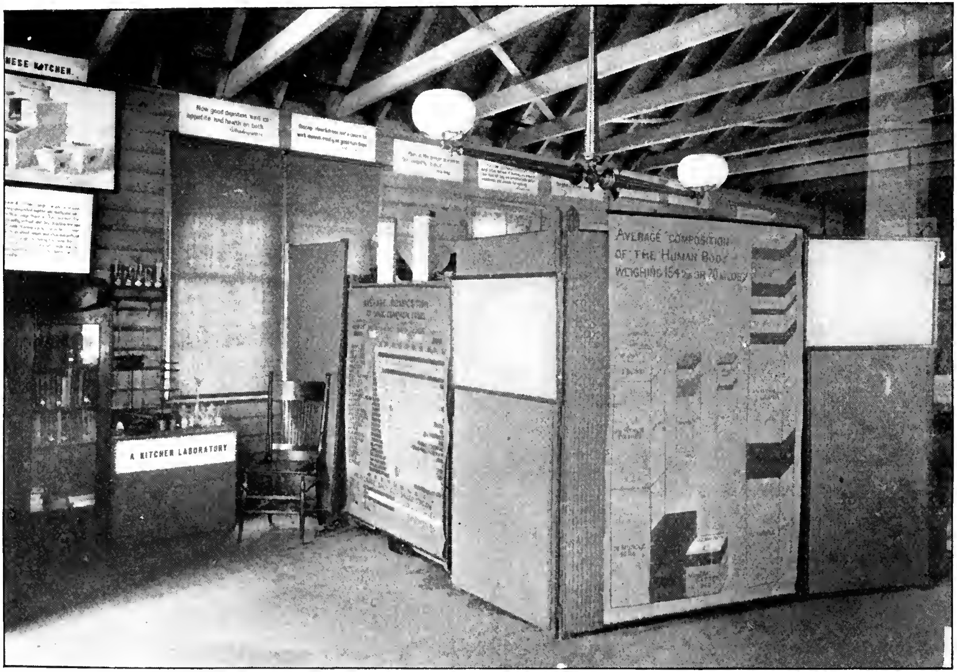
Plain food is quite good enough for me. — *Oliver Wendell Holmes.*

A man is what he eats.

It is an irritating, nay more, a deeply saddening problem for a wise dyspeptic to ponder, the superabundance in this little world of ours of things cookable, and the extreme rarity of cooks. — *Maarten Maartens.*

There is no pain like the pain of a new idea. — *Bagehot.*

The time indeed is at hand when systematic lectures on food will be part of medical education, when the value of feeding in disease is admitted to be as important as the administration of medicines. — *Fothergill.*



INTERIOR RUMFORD KITCHEN, COLUMBIAN EXPOSITION, 1893.

The scientific aspect of food must be united in the bonds of holy matrimony with a practical knowledge of the cook's art, before a man can discourse learnedly of food. — *Fothergill.*

It is in vain to suppose that the poor should adopt better methods of choosing and preparing their food till they are furnished with better implements and utensils for cooking. — *Rumford.*

Pain is the prayer of a nerve for healthy blood. — *Romberg.*

Courage, cheerfulness, and a desire to work depends mostly on good nutrition. — *Moleschott.*

The stomach is a good servant; let his hours of repose be unbroken.

Keep as near as ever you can to the first sources of supply — fruits and vegetables. — *B. W. Richardson.*

Nothing surely is so disgraceful to society and individuals as unmeaning wastefulness. — *Rumford.*

An hour of exercise to a pound of food. — *Felix Oswald.*

The seat of courage is the stomach. — *German Proverb.*

A good heart will have a care of his meat and drink. — *Ecclesiasticus.*

What pleases the palate, nourishes.

Eat when I have stomach, and wait for no man's leisure. — *Shakespeare, Much Ado, i. 3.*

A man too busy to take care of his health is like a mechanic too busy to take care of his tools.

Better is a dinner of herbs where love is, than a stalled ox and hatred therewith. — *Proverbs.*

Hunger is the best sauce.

The proof of the pudding is in the eating. — *Old Proverb.*

> The spirit of each dish, and zest of all,
> Is what ingenious cooks the relish call.

There is nothing better for a man than that he should eat and drink. — *Ecclesiastes, ii. 24.*

Many sick persons pass into a critical stage from which they never rally, because they are insufficiently fed. — *King Chambers.*

Haste in the preparation is the ruin of stews. Curiosity, too, is a drawback. The lid of the stewpan should never be lifted until it has to be taken off.

Ost oder West daheim schmeckts am best. — *German Proverb.*

Every man has lain on his own trencher. — *Old English Proverb.*

Now good digestion wait on appetite, and health on both. — *Shakespeare, Macbeth, iii. 4.*

After breakfast walk a mile,
After dinner sleep awhile.

As hungry as the sea, and can digest as much. — *Shakespeare, Twelfth Night, ii. 4.*

If I bring thee not something to eat, I will give thee leave to die. — *Shakespeare, As You Like It, ii. 6.*

Then to breakfast, with what appetite you have. — *Shakespeare, Henry VIII., iii. 2.*

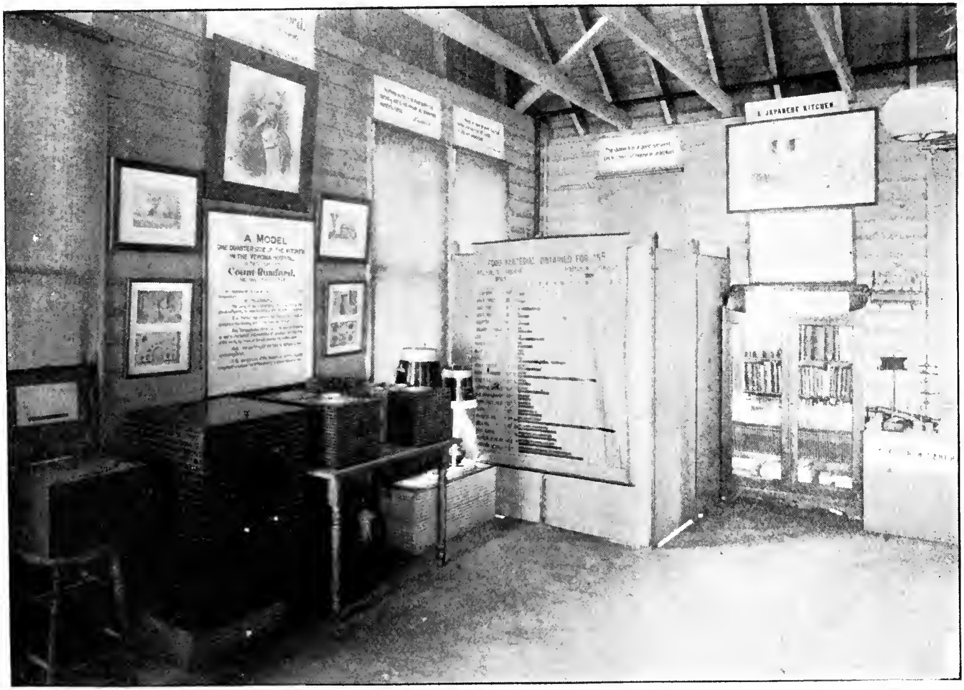
The six o'clock dinner marks the progress of civilization around the world. So do dyspepsia and gout.

Where the dinner is ill got there is poverty, or there is indolence, or there is ignorance. — *Dr. Samuel Johnson.*

Joy and temperance and repose
Slam the door on the doctor's nose.

Our stomachs will make what's homely, savory. — *Shakespeare, Cymbeline, iii. 6.*

In building up an army, begin at the stomach. — *Bismarck.*



INTERIOR RUMFORD KITCHEN, COLUMBIAN EXPOSITION, 1893.

THE RUMFORD KITCHEN LEAFLETS.

No. 1.

COUNT RUMFORD, AND HIS WORK FOR HUMANITY.

BY ELLEN H. RICHARDS.

Benjamin Thompson, "the benefactor of humanity," was born March 26, 1753, in what is now the town of Woburn, Mass., within twelve miles of the birthplace of Benjamin Franklin, "the patriotic statesman." As a youth he was dependent upon his own exertions, like so many New Englanders of that century. At an early age he delighted in experiment and investigation, and in the use of mechanical tools. He was also skilful with the pencil. When, in 1781, he began the study of medicine with Dr. Hay, of Woburn, he was busy in inventing an electrical machine.

Owing to certain political complications he was banished from the country on charge of being a Tory, a charge which he stoutly denied. Nevertheless he accepted a military position with the British forces, and held himself always to be a British subject.

In 1784, with the permission of the King of England, he entered the service of the Elector of Bavaria. In 1802 he took up his residence in France, where he died in 1814.

The complete works of Count Rumford were published in four volumes, with his life in a fifth volume in 1875, by the American Academy of Arts and Sciences, Boston.

"HUNGER and cold are the two great foes of our race, and to meet them all our skill and art are most resolutely directed in palaces and in hovels."

This sentence gives the keynote of Cuvier's eulogy pronounced upon Count Rumford before the French Institute less than five months after his death. He reminds his audience that the sciences had reached a point where the immense advantages which their applied uses daily insured to society had just begun to excite the amazement of all thoughtful persons.

"Le Moniteur" of Aug. 25, 1814, says: "This celebrated man has consecrated his life to the study of the sciences and always in the service of humanity."

Delessert, in the address over his grave, says: "In England, in France, in Germany, in all parts of the Continent, the people are enjoying the blessings of his discoveries; and from the humble dwellings of the poor even to the palaces of sovereigns all will remember that his sole aim was to be always useful to his fellow-men."

The work of Count Rumford was carried on in three nearly distinct periods of his life and was directly influenced by the circumstances in which he found himself placed; indeed, he was in a great measure the puppet of fate, and "so susceptible to impressions that he could not fix his attention upon any uniform line of conduct," although "he had a genius which never suffered him to stop short of the object of his pursuit." "His ambition was to rise in the estimation of mankind by his usefulness, and to call forth that applause which springs from public love;" hence, if his friend Colonel Baldwin was right in the foregoing estimate of his character, it was very natural that he should throw himself into the task of securing the power of the Elector of Bavaria, then hanging in the balance, by binding his people to him as a ruler, under whom they had become well fed and busily employed, and therefore so contented that they did not perceive that they were under the most despotic control. The world has never seen a better example of the improvement of the condition of a people without any volition of their own. So long as the Elector was secure on his throne, so long did the glamour of success last, but the spirit of the French Revolution was in the air, and when the power of the ruler waned then the influence of the scientific adviser was weakened, and he perforce turned to other fields.

Col. Benjamin Thompson, soldier, philosopher, statesman, as Gibbon is said to have called him, entered the service of Charles Theodore, Elector of Bavaria, in the spring of 1784, the King of England having graciously given his permission and added the dignity of knighthood. For fourteen years he gave the treasures of his inventive and truly great mind to his confidential friend and ardently grateful patron — a prince whose aims were high, and whose interest in the welfare of his subjects was sincere and who desired to remove abuses and to introduce economical improvements.

It speaks well for the moral effect of scientific pursuits that never once have we the record of an abuse of the absolute power, military and civil, which was put into Rumford's hands; the delight of seeing order come out of disorder and of accomplishing results by magic, as it were, seems to have satisfied the Count through this period, probably the happiest of his life.

His first endeavor was "to unite the interest of the soldier with the interest of civil society and to render the military force, even in time of peace, subservient to the public good." Therefore he made the situation of the men a pleasant one, with good clothes, light duties, but withal subject to a life of rigid discipline and of steady self-improvement, by means of schools and of habits of industry. They were employed on public works, and military gardens were introduced, a plot of three hundred and sixty-five square feet being put in charge of each man as his own while he remained in garrison, only he was to keep it in good condition. Thus the soldier left the service a more useful citizen than when he entered it.

This military force was then used to keep the country free from beggars, at that time an intolerable nuisance, by arresting all vagrants and taking them to places where they were obliged to work, but where they received pay for it in proportion to the quality of it and to their industry. As in the case of the soldiers, every effort was made to ensure good ventilation for the buildings, with clean surroundings, and to make the place and the work attractive and easy, so that the poor wretches would know what it meant to be clean and warm and physically comfortable. A part of their occupation was to prepare for themselves a good dinner, which was to be given gratis each day, and this led Count

Rumford to investigate the means of supplying cheap and nutritious food at the least cost to the State.

Among the results of these studies were the famous soups made of bread, peas, and barley, sometimes with the addition of potatoes, which are still known in Germany by Rumford's name. The cost of these was one penny a person a day for the portion of one and one-half pounds. To this was added seven ounces of rye bread, which was usually carried home for supper. Careful calculation indicates that the food value was as follows:

Rumford Soups.		Food Value in Grams, Per Pint or Pound.			Calories.
		Proteid.	Fat.	Carbo-hydrates.	
No. 1.	Peas . . . . Barley . . . . Bread	19.1	2.5	86.1	454.5
No. 2.	A portion of Peas and Barley replaced by Potatoes . . .	12.5	1.4	66.7	337.7

which, though it seems small, was enough to keep hunger from the door, and to afford a subsistence to the not very ambitious vagrants.

The economy of service and fuel made possible by the use of the best appliances is seen in the statement that dinner for one thousand persons was prepared by three cook-maids at a cost of four pence half-penny for fuel. A cord of soft wood cost then about seven shillings and hard wood twice that.

In all these plans no account was taken of the value of land or buildings, or the rent of the same, only the maintenance, and in this respect similar work in a free country must always differ from that under a military and despotic government, so that it is not true here that " the poor might be fed from a public kitchen for less than half what it would cost them to feed themselves."

Success in this first venture seems to have stimulated the Count to many of the researches which he undertook with such eagerness during these years. The fact that he had the resources of the State at his command, both men and money, and, moreover, persons under control on whom to try the effect of his discoveries, lent wings to his invention, so that results for which many men might have waited a lifetime in vain came to him within the year.

During this period, the Count having proved that seven-eighths of the fuel commonly used might be saved, designed several kitchens for public institutions, notably that for the hospital at Verona, the model of which, one-fourth size, was shown in the Rumford Kitchen in Chicago and is now at 485 Tremont street, Boston.

In 1795 a great effort was made to introduce potatoes, which seemed to Count Rumford an excellent food. This was one of the few points in which his science failed, since he seems to have considered the whole weight of the potato as nutritious. However, it was the Count who declared that he believed that water must become nutritious in the process of cooking soups.

The Count tried to introduce Indian corn into England, and with his usual love of order and minutiæ directed the manner of eating it so as to obtain the greatest pleasure from it. This caused so much amusement in America that it is to many persons to-day the one thing which the name of Count Rumford recalls.

Many devices for kitchen fireplaces and kitchen utensils are described in detail in his essays, and all the drawings are made with such care that the various articles can be reproduced with perfect accuracy, and all the directions for cooking can be followed in detail. It is an illustration of the Count's secret of success in all that he undertook; namely, minute attention to detail. Nothing was too small for him to note, and the housewife of to-day may well learn a lesson from the courtier, with an army at his beck and the treasure of a kingdom in his hand, spending days in determining the best temperature for developing flavor in beef, and in experiments of the most careful kind of the quantity and cost of fuel necessary for making tea for two persons and computing the waste in the ordinary methods. He devised portable lamps and gave much information about harmonies and contrasts in colors for helping ladies about their ribbons and apparel. The invention of the closed stove and the use of coal as fuel we owe to him, as well as the double-boiler to prevent burning of food during slow cooking over the fire. It is as true to-day as ever that "nothing is so ill-judged as most of the attempts that are so frequently made by the ignorant to force the same fire to perform different services at the same time," also "more fuel is frequently consumed in a kitchen range to boil a tea-kettle than with proper management would be sufficient to cook a dinner for fifty men."

Among Rumford's contributions to the luxuries of living is the essay on the excellent qualities of coffee and the best means of making it, a method which has not been improved in the one hundred years which have since elapsed.

For all these benefits it would seem fitting that American housewives should celebrate in 1914 the one-hundredth anniversary of the Count's death by some decided advance in the art of right living and the "science of nutrition," Rumford's own term for the study of food.

And all this he did from the abstract love of "knowing how," for Count Rumford was himself most abstemious. He drank nothing but water. He indulged himself in no superfluity, not even in a step or a word, and it was in the strictest sense that he used the term. His wants, his pleasures, and his toils were as exactly arranged as were his experiments. This was, without doubt, a means of helping him to devote all his energies most directly to good works. "By the happy choice of the subject of his labors he has known how to secure to himself alike the esteem of the wise and the remembrance of the unfortunate."

He called *order* the necessary auxiliary of genius, almost a subordinate deity for the government of this lower world.

The practical results of Count Rumford's experiments and the questions they aroused led to deeper studies as to the causes of various phenomena, and as the need for immediate application lessened, his attention was turned more and more to the scientific aspect, until in the second period, while his writings still showed the practical bent, they became more philosophical, and, biased by the theories of the time, they undoubtedly failed of so complete and rapid acceptance as his earlier work.

Deprived of the incentive of immediate application of his results, Count Rumford seems to have lost in a measure the zest which obstacles to overcome always gave him, and he turned his attention to securing the continuance of his most successful work in all the years to come. To this end he devised, inaugurated, and endowed institutions in England and America, which remain among the most useful to mankind, although no one of them has yet fulfilled all that its founder foresaw as possible.

On Feb. 15, 1797, Rumford wrote to President Willard, of Harvard College, and to Mr. Pearson, the secretary of the American Academy of Arts and Sciences, Boston, authorizing the transfer of stock to the value of $5,000 to the academy, adding, "It has ever been my most ardent wish to be of some use to mankind, to be able to flatter myself, when I am going out of the world, that I have lived to some useful purpose." In a letter dated Woburn, March 26, 1798, on the anniversary of Benjamin Thompson's birth, and one hundred years ago, Mr. Baldwin writes: "The business of this transfer is finally completed and the academy is in full possession of the most liberal and important endowment of any yet received."

The year 1798 was a most important one in Count Rumford's life. The Elector of Bavaria offered him the position of Minister at the English court, which, being still a British subject, he was not allowed to fill. Since the stress and turmoil of war and impending disaster rendered Munich a less desirable place of residence than hitherto, the Count bought a villa near London and busied himself for a year in developing the plans for the Royal Institution, the first meeting of the managers taking place March 9, 1799, and the first sitting March 11, 1800. This institution, founded for the investigation and diffusion of the knowledge of the application of science to the common purposes of life, has given to the world a Sir Humphrey Davy, selected by Rumford himself, a Michael Faraday and has exercised a profound influence in the development of science through all these one hundred years.

The state of the kingdom of Bavaria remaining unfavorable to philosophic study, the king allowed Rumford an annual pension of about $60,000, and as the king was then a vassal of Bonaparte it is supposed that this was paid only on condition that he resided in France, for during these years of 1798 and 1799 there was much correspondence with reference to the purchase of an estate in America, and the Government of the United States offered to Count Rumford, in September, 1799, the superintendence of the Military Academy, then just established, and the post of Inspector-General of the Artillery of the United States. He felt obliged to decline on account of "engagements which great obligations have rendered sacred and inviolable."

Therefore, after a year's residence in the Royal Institution, while it was being perfected, the Count made his home in France.

That he did not forget his native country is proved by the fact that he left an annuity of $1,000 and the reversion of his estate to Harvard College "for the purpose of founding a new institution and professorship, in order to teach by regular courses of academical and public lectures, accompanied with proper experiments, the utility of the physical and mathematical sciences for the improvement of the useful arts and for the extension of the industry, prosperity, happiness, and well-being of society." To the first Rumford professor, Dr. Jacob Bigelow, we probably owe the introduction of the word "technology," as descriptive of the new education or the application of principles first learned from experiment and founded upon theory, in distinction from technical or trade education, which deals only with the narrow field of application; and we may consider Benjamin Thompson, Count Rumford, together with Benjamin Franklin, his contemporary, as the founders of the modern school of engineering and applied science, which has made possible the remarkable progress of the century just closing.

THE RUMFORD KITCHEN LEAFLETS.

No. 2.

RUMFORDIANA.

By Miss S. Minns.

Every one who considers the subject of household comfort and economy must realize that we all owe a debt of gratitude to Count Rumford for his wise study of the problems of daily life. We do not know much more than he did in those far-back days. The principles he then laid down we still follow. In the practical application of those principles to every-day life, is where our great advance has been made. We have improved upon his inventions, but the principles remain the same.

For instance, he invented the cooking stove, steam cooking, double-bottomed saucepans, double boilers, while his ingenuity seemed to have no limit.

In his work for the poor of Munich we see the source whence we drew the foundation of our Associated Charities, a work of great usefulness, though our poor never seem to be so ignorant nor so miserable as those described in his account of the poor of Bavaria.

He was eminently fitted for the work he undertook by his clear judgment, his practical ability, his *chemical and scientific knowledge*, and by his great humanity. Yet he was much opposed and was even accused of cruelty. This was when he attempted to introduce among the poor the use of potatoes and Indian corn. It was said he wished to poison the people. Now the use of potatoes is world wide, and Indian corn, so scorned, is proposed

LUNCH ROOM IN THE RUMFORD KITCHEN, COLUMBIAN EXPOSITION, 1893.

as our national emblem. His chapters on the various ways of cooking it — his "hasty-pudding," his boiled Indian pudding, called by him "bag" pudding — are too long to be quoted, but ought to be reprinted for cooking recipes. Fried potatoes and potato "sallet" or salad seem to have originated with him, and we have many recipes of simple and savory dishes, which were either original or collected from his observations gathered in travel. Pea soup and its great nutritive power were well known to him and several pages in his works are devoted to its merits.

The Rumford Kitchen has chosen wisely its patron saint.

The few extracts from Count Rumford's Essays which are given here might be more than doubled. They are as practical and appropriate as if they had been written to-day instead of a century ago.

"The use of science is to explain the operations which take place in the practice of the arts, and to discover the means of improving them; and there is no process, however simple it may appear to be, that does not afford an ample field for curious and interesting investigation."

"Causing anything to boil violently in any culinary process is very ill-judged; for it not only does not expedite, even in the smallest degree, the process of cooking, but it occasions a most enormous waste of fuel; and, by driving away with the steam many of the more volatile and savory particles of the ingredients, renders the victuals less good and less palatable. To those who are acquainted with the experimental philosophy of heat, and who know that water once brought to be *boiling hot*, however gently it may boil in fact, *cannot be made any hotter*, however large and intense the fire under it may be made, and who know that it is by the *heat* — that is to say, *the degree* or intensity of it, and the *time* of its being continued, and not by the bubbling up or boiling (as it is called) of the water — that culinary operations are performed; this will be evident; and those who know that more than *five times* as much heat is required to *send off in steam* any given quantity of water *already boiling hot* as would be necessary to heat the same quantity of *ice-cold* water *to the boiling point,* will see the enormous waste of heat, and consequently of fuel, which, in all cases, must result from violent boiling in culinary processes."

"When good reasons can be assigned for the advantages which result from any common practice, this not only tends to satisfy the mind, and make people careful, cheerful, and attentive in the prosecution of their business, but it has also a very salutary influence, by preventing those perpetual variations and idle attempts at improvement, *undirected by science,* which are the consequence of the inconstancy, curiosity, and restlessness of man."

". . . We may, I think, venture to hope that those prejudices which prevent the introduction of these improvements will in time be removed."

"It is not obstinacy, it is that *apathy* which follows a total corruption of taste and morals, that is an incurable evil; for that, alas! there is no remedy but calamity and extermination."

"Experience, unassisted by science, may lead, and frequently does lead, to useful improvements; but the progress of such improvement is not only slow, but vacillating, uncertain, and very unsatisfactory."

"And with regard to the reputation of being a discoverer, though I rejoice — I might say, revel and triumph — in the progress of human knowledge, and enjoy the sweetest delight in contemplating the advantages to mankind which are derived from the introduction of useful improvements, yet I can truly say, that I set no very high value on the honor of being the first to stumble on those treasures which everywhere lie so slightly covered.

"On the first view of the matter, it appears very extraordinary indeed that any person should ever, in any instance, neglect to avail himself of an invention or contrivance within his power to obtain, that is evidently calculated to increase his comforts, or to facilitate his labor, or to increase the profits of it; but when we reflect on the subject with attention, and consider the power of habit, and then recollect how difficult it is even for a person to perceive the imperfections of instruments to which he has been accustomed from his early youth, our surprise that improvements do not make a more rapid progress will be greatly lessened.

"But there is a great variety of circumstances that are unfavorable to the introduction of improvements. The very proposal of anything new commonly carries with it something that is offensive; something that seems to imply a superiority; and even that kind of superiority precisely to which mankind are least disposed to submit."

"That I am not unreasonable enough to expect that all my recommendations will be immediately attended to, is evident from the pains I take to improve machinery now in use, of which I do not approve, and which is perfectly different from that I am desirous to see introduced.

"There are few, very few indeed, who do not feel ashamed and mortified at being obliged to learn anything new after they have for a long time been considered and been accustomed to consider themselves, as proficients in the business in which they are engaged; and their awkwardness in their new apprenticeship, and especially when they are obliged to work with tools, with which they are not acquainted, tends much to increase their dislike to their teacher and to his doctrines.

"There are some difficulties, no doubt, in changing the habits of a nation; but these difficulties have been too much exaggerated, and they have too often been an excuse for indolence.

"If anything really useful be proposed to the public, it can hardly fail to be adopted, if it be properly recommended; but so many new things, unworthy of notice, are every day proposed, that it is by no means surprising that little attention is paid to such recommendations"

"Nothing surely is so disgraceful to society and to individuals as unmeaning wastefulness.

"*I am happy when I find that improvement leads to economy; but I have always thought that excellence should never be sacrificed to paltry savings in anything, and least of all in those habitual enjoyments which are at the same time the comforts and consolations of life.*

"Many useful improvements have been proposed by ingenious and enlightened men, which have failed, merely because those who have brought them forward have neglected to give directions sufficiently clear respecting the details of their execution."

"There are two ways in which philosophers, as well as other men, may be excited to action, and induced to engage zealously in the investigation of any curious subject of inquiry, — they may be *enticed*, and they may be *provoked*."

ON THE DUTIES OF TRAVELLERS.

"Those whose avocations call them to visit distant countries, and those whose fortune enables them to travel for their amusement or improvement, have many opportunities of acquiring useful information; and in consequence of this intercourse with strangers many improvements, and more *refinements*, have been introduced into this country; but the most important advantages that *might* be derived from an intimate knowledge of the manners and customs of different nations — the introduction of improvements tending to facilitate the means of subsistence, and to increase the comforts and conveniences of the most necessitous and most numerous classes of society — have been, alas! little attended to. Our extensive commerce enables us to procure, and we do actually import most of the valuable commodities which are the produce either of the soil, of the ocean, or of the industry of man in all the various regions of the habitable globe; *but the result of the experience of ages respecting the use that can be made of those commodities* has seldom been thought worth importing! I never see *maccaroni* in England, or *polenta* in Germany, upon the tables of the rich, without lamenting that those cheap and wholesome luxuries should be monopolized by those who stand least in need of them; while the Poor, who, one would think, ought to be considered as having almost an exclusive right to them (as they were both invented by the Poor of a neighboring nation), are kept in perfect ignorance of them."

"The pleasure enjoyed in eating depends first upon the agreeableness of the taste of the food; and secondly, upon its power to affect the palate. Now, there are many substances extremely cheap by which very agreeable tastes may be given to the food, particularly when the basis or nutritive substance of the food is tasteless; and the effect of any kind of palatable solid food (of meat, for instance) upon the organs of taste may be increased almost indefinitely by reducing the size of the particles of such food, and causing it to act upon the palate by a larger surface. And if means be used to prevent its being swallowed too soon . . . . the enjoyment of eating may be greatly increased and prolonged.

"The idea of occupying a person a great while, and affording him much pleasure at the same time, in eating a small quantity of food, may, perhaps, appear ridiculous to some; but those who consider the matter attentively, will perceive that it is very important. It is, perhaps, as much so as anything that can employ the attention of the philosopher.

"The enjoyments which fall to the lot of the bulk of mankind are not so numerous as to render an attempt to increase them superfluous. And even in regard to those who have it in their power to gratify their appetites, it is surely rendering them a very important service to show them how they may increase their pleasures without destroying their health."

"It is a maxim, as ancient, I believe, as the time of Hippocrates, that '*whatever pleases the palate nourishes*;' and I have often had reason to think it perfectly just. Could it be clearly ascertained and demonstrated, it would tend to place *cookery* in a much more respectable situation among the arts than it now holds."

"That the manner in which food is prepared is a matter of real importance, and that the water used in that process acts a much more important part than has been hitherto generally imagined, is, I think, quite evident; for it seems to me to be impossible, upon any other supposition, to account for the appearances. If the very small quantity of solid food which enters into the composition of a portion of some very nutritive soup were to be prepared differently and taken under some other form, that of bread, for instance, so far from being sufficient to satisfy hunger, and afford a comfortable and nutritive meal, a person would absolutely starve upon such a slender allowance; and no great relief would be derived from drinking *crude* water to fill up the void in the stomach."

" . . . It seems to me to be more than probable that the number of inhabitants who may be supported in any country, upon its internal produce, depends almost as much upon the state of *the art of cookery* as upon that of *agriculture*.

" . . . But if cookery be of so much importance, it certainly deserves to be studied with the greatest care; and it ought to be particularly attended to in times of general alarm, on account of a scarcity of provisions; for the relief which may in such cases be derived from it, is immediate and effectual, while all other resources are distant and uncertain."

"Considering what circumstance in life, after the necessaries, food and raiment, contributes most to comfort, I found it to be *cleanliness*. And so very extensive is the influence of cleanliness that it reaches even to the brute creation.

"With what care and attention do the feathered race wash themselves and put their plumage in order; and how perfectly neat, clean, and elegant do they ever appear! Among the beasts of the field we find that those which are the most cleanly are generally the most gay and cheerful; or are distinguished by a certain air of tranquillity and contentment; and singing birds are always remarkable for the neatness of their plumage, and so great is the effect of cleanliness upon man, that it extends even to his moral character. Virtue never dwelt long with filth and nastiness, nor do I believe there ever was a person *scrupulously attentive to cleanliness* who was a consummate villain.

"Brute animals are evidently taught cleanliness by instinct; and can there be a stronger proof of its being essentially necessary to their well-being and happiness? But if cleanliness is necessary to the happiness of brutes, how much more so must it be to the happiness of the human race!

"The good effects of cleanliness, or rather the bad effects of filth and nastiness, may, I think, be very satisfactorily accounted for. Our bodies are continually at war with whatever offends them, and everything offends them that adheres to them and irritates them; and though by long habits we may be so accustomed to supporting a physical ill, as to become almost insensible to it, yet it never leaves the mind perfectly at peace. There always remains a certain uneasiness and discontent; an indecision, and an aversion from all serious application, which shows evidently that the mind is not at rest."

"Order and disorder, peace and war, health and sickness, cannot exist together; but *comfort* and *contentment*, the inseparable companions of *happiness* and *virtue*, can only arise from order, peace, and health."

THE RUMFORD KITCHEN LEAFLETS.

No. 3.

KING PALATE.

By Mary Hinman Abel.

King Palate was once monarch of a mighty realm. There was no one to dispute his sway, and, like all absolute rulers, he grew very lawless in his conduct. In fact, he did just as he pleased.

He had, in the good old days, only one care, that the tables should be well loaded for the daily feasts that he held with his subjects; sorrow came to the royal heart only when the fish sulked in the pond or the deer outran the hunter.

But there came a time when it was known that enemies lurked in his realm; a band of impish creatures now and then descended upon him and wrought all manner of mischief in his land. They were Indigestion, Dyspepsia, Gout, Liver Disease, Delirium Tremens, and a hundred others, big and little, and they grievously tormented his subjects and drove the king to his wits' end. All his skilled magicians were not able to drive away the enemy, though they brewed many a nauseous potion, and sought far and wide for charms to defend against these attacks.

But there was growing up in the court of the king a youth of wondrous promise. His name was Knowledge, and he had been brought as a child from a far land. It was even whispered that when he grew strong enough he meant to usurp the throne and drive King Palate quite out of the kingdom.

But no, though he sat not at the nightly revels, he obeyed the daily commands of the king with all courtesy, and spoke words of wisdom in his ear after each grievous visitation of the imps. "It is you, O King Palate, that have brought this sorrow on the land. These imps are your own children, born of Ignorance; it is under cover of your name that they do their evil. Suffer no more of them to go abroad, but let your subjects learn of me, who am come to be your prime minister. Alone you can never again reign in peace, nor am I wise enough to rule without you for the experience of the ages is yours, but together we may rule in honor and rid the land of its foes."

This was long ago when Knowledge was indeed but a stripling, and the old King called him a fool and an upstart and went his own way. But it was noticed that after each attack of the imps he listened with more patience to the youth. And now the youth has grown into a man and King Palate can no longer scorn him, although he still falls into a passion now and then and roars: "You are always weighing and considering, and you've even been known to change your mind! I, alone, am never in doubt." To which Knowledge replies, "Quite true; but you are to blame for the imps, and I am the only one who has anything to drive them away!"

On the whole, they are coming to be pretty good friends, and the land thrives as their quarrels lessen. The subjects are even hopeful that the imps may yet be turned out of the kingdom altogether.

THE RUMFORD KITCHEN LEAFLETS.

No. 4.

COMPARATIVE NUTRITION.

Revised for the Rumford Kitchen, by Edward Atkinson.

While my recent book upon "The Science of Nutrition"[1] was going through the press, a beginning was made in treating the subject of comparative nutrition.

When the twelve dietaries which have been given in this treatise had been prepared, it seemed probable that some use might be made of them in determining the relative cost of nutrition at the American standard in different States and countries. I could not, of course, expect to make anything but a crude beginning in this matter, because the habit of nutrition, if one may use this expression, varies greatly according to soil, climate, conditions, and wages.

In countries where meat is scarce, the chief source of nitrogen is found in a large relative consumption of cheese or of beans or other legumes. How far the price of a suitable day's ration may be equalized by the purchase of cheese or legumes in place of meat remains to be dealt with. For the moment a few comparisons may be interesting.

It will be observed that in the twelve dietaries given in the book the constants, consisting of grain, vegetables, and a modi-

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[1] "The Science of Nutrition." Boston: Damrell & Upham, School and Washington Streets.

cum of butter or fat, are uniform; they are computed in sufficient quantities to support life, and are named

THE LIFE RATION.

The variables, consisting mainly of meat, are given of different quantities, at different prices, and are named

THE WORK RATION.

All prices are given at retail for small quantities, except flour, which is assumed to be purchased by the sack or barrel.

Rations corresponding to Dietaries Nos. 1 to 4, those costing 12 to 13 cts. per day each, in Boston, Mass., have been computed in various places, with the following results:

Cost of 57 lbs. grain, vegetables, and fat, and 25 lbs. of cheap cuts of meat, 82 lbs. in all; sufficient for rations for 30 days, at 3,467 Calories per day, the standard of a German soldier on a war footing being 3,093 Calories.

Date. 1891.		Life Ration. 30 days.	Work Ration. 30 days.	Total. 30 days.
April.	Boston, Mass., U.S.A. (short crop of vegetables, 1890)	$2 31	$1 78	$4 09
November.	Boston, Mass., U. S. A. (vegetables abundant)	2 08	1 77	3 85
December.	Bismarck, N. Dakota, U.S.A.	1 43	2 42	3 85
September.	Paris, France	2 00	2 81	4 81
September.	London, England (in workmen's section)	2 16	2 52	4 68
November.	London, England (in West End shops),	2 42	3 60	6 02
October.	Madison, Wis., U.S.A.	1 70	1 77	3 47
September.	Beyreuth and Nuremburg, Germany,	2 52	3 76	6 28
October.	Topeka, Kansas, U.S.A.	1 54	1 53	3 07
December.	New Orleans, La., U.S.A.	2 40	1 92	4 32
October.	Lincoln, Neb., U.S.A.	1 38	1 78	3 16
October.	Ann Arbor, Mich., U.S.A.	1 87	1 86	3 73
1892.				
February.	Brussels, Belgium	2 53	3 93	6 46
January.	Dresden, Germany	3 14	3 30	6 44
March.	Munich, Bavaria	3 30	3 63	6 93

	Life Ration. Cents per day.	Work Ration. Cents per day.	Total. Cents per day.
Boston, Mass.	7 70	5 93	13 63
Boston, Mass.	6 93	5 90	12 83
Bismarck, N. Dakota	4 77	8 07	12 84
Paris, France	6 66	9 37	16 03
London, England	7 20	8 40	15 60
London, England	8 06	12 00	20 06
Madison, Wis.	5 66	5 90	11 56
Beyreuth and Nuremburg, Germany,	8 40	12 53	20 93
Topeka, Kansas	5 13	5 10	10 23
New Orleans, La.	8 00	6 40	14 40
Lincoln, Neb.	4 60	5 93	10 53
Ann Arbor, Mich.	6 23	6 20	12 43
Brussels, Belgium	8 43	13 10	21 53
Dresden, Germany	10 05	11 00	21 05
Munich, Bavaria	11 00	12 10	23 10

The two returns from Dresden and Munich show the effect of tne short crop of grain in 1891 upon prices.

I can of course claim only approximate accuracy for these comparisons. The personal equation will have a varying influence in obtaining prices. The habits of the people must be taken into view. In Boston, for instance, the tougher and coarser parts of beeves are sold for food; in Bismarck, North Dakota, they are probably put into the fat-rendering vats, not even being prepared for sale.

I have also been disappointed in the small number of returns received in reply to my circular, but yet hope to extend this inquiry, as there are now several associations in this country and in Europe which have taken up this matter in different ways.

Suffice it that even this beginning is very suggestive. It proves that where the nitrogenous element in food is abundant and cheap, labor is effective and wages are high. Where the nitrogenous element is scarce and dear, labor is not effective and wages are low.

Which is the antecedent and which is the consequent?

It will be observed that there is a much greater uniformity in the price of the life ration than of the work ration. May not this indicate a deficiency of nitrogen as the *cause* of low rates of wages?

Again, if one may venture upon a somewhat visionary hypothesis, another comparison may be made and another question may be asked.

Where the burden of armies and navies is heavy, nitrogenous food is scarce among the people, — the army must be sustained even if the poor workmen starve. Witness Russia at the present time. Why must armies be sustained?

The army and the naval forces of the United States number only about 30,000 men, and are all that we require. At the ratio to population of European armies and navies, making comparison only with the force in camp or barracks and paying no regard to reserves, our army and naval forces would number from 600,000 to 800,000 men; and since it takes the product of at least one man to support one worse than idle soldier, such a burden would be equivalent to setting apart 10 per cent. or more of all the men of arms-bearing age from the productive and constructive work in which they are now occupied, to waste the most valuable and effective portion of their lives in the destructive work of preparation for war.

The mere money cost of this system of militarism, which is eating away the vital force of most of the European states, is about $1,000,000,000 a year. I am aware that army drill and discipline is justified as a mode of education. What does it cost? In Germany women do the scavenger work, — sweep the streets, mix the mortar for the builders, and perform the hardest work of the field, — while the men, at the most productive period of efficiency, are obtaining the education thus claimed to be justified. France is a little better off, but many parts of Italy are worse.

It will be observed that the science of nutrition is not confined to the domestic kitchen or to the recipe book.

As the supply of food comes to half the cost of life or more, in many parts of this prosperous country, so the barbaric folly may be conceived of taxing the masses for the support of the classes by whom the military system is sustained and the military caste is supported in Europe.

The foregoing statements of the relative cost of nutrition must indicate that the proportionate cost of food to other elements in the cost of living is less in the Western States and cities than in the East or in Europe. In fact, the relation of food supply to the rate of earnings is even a more important factor than now appears. One can even predicate a rule on what is now known. It may be put in this form:

To him that hath food in abundance shall be given the power to gain more; from him that hath not shall be taken even that which he hath.

These considerations bring into view the importance of the problem of securing a supply of nitrogen at less cost. Our agricultural chemists and physiologists tell us that nitrogen is the most important, and at the same time the least abundant and most costly element in the nutrition of the plant, the beast, and the man. The atmosphere is four-fifths nitrogen and we can't yet catch it; the iron-smelting furnaces of this country are giving off ammonia enough to supply nitrogen to our fields, in large measure, and we waste it. We have begun to save the phosphatic slag of the furnaces for use as a fertilizer, and thus to convert iron ore into corn and wheat, — the next man will save the ammonia. In the meantime, the myriads of bacteria and microbes are being summoned to our aid, who, living in their little dwelling-places attached to the roots of clover, cow-pea vines, and other renovating plants, draw nitrogen from the air to supply the plant which, when turned under, renovates the soil.

The present need in this country is not so much of instruction how to earn as how to spend an income, especially a small one.

If the energy which corresponds to the present waste of food material could be spent for more adequate shelter, the evils of the slums would be abated and the bad tenements in the slums would be renovated. One may be warranted in estimating the present waste of food and fuel at five cents a day for each person, which is approximately twenty per cent. of the expenditure. To this we may add two cents a day, or less than half what is annually spent for liquors and tobacco — say seven cents a day in all. There are about 65,000,000 of us now, divided into 13,000,000 average families of five each.

At seven cents a day the measure of our waste of energy in converting good food into bad feeding, and upon liquor and tobacco at less than half their cost, amounts in each year to $1,660,750,000. If this waste of misdirected energy were converted into better methods of providing shelter, it would enable each family of five persons to spend $127\frac{75}{100}$ a year more for their dwelling-places than they do now.

Suppose the waste only four cents a day, — two cents on food and two on liquor and tobacco, — even that comes to nearly $1,000,000,000 worth of misdirected energy; and the waste is greatest among those who can spare it least.

I have said that the education most needed now is how to spend, more than how to earn. I find as much evidence of this in the present expenditures upon hospitals, college buildings, and school-houses as I do in the conversion of good food into bad feeding. In the ordinary practice of combustible architecture, of which this class of buildings are apt to be typical examples, I find hospitals in which the inmates are exposed to cremation before they are dead, covered in with crazy roofs which do not keep out the weather; college buildings which give the minimum of space and comfort at the maximum of cost, in which poor students can only be admitted by accepting charity; and finally school-houses in which about two in three are bad types of separate invention on different plans, each more or less unsuitable to its purpose, and costing from fifty to five hundred per cent. more than the sum for which a true typical school-house can be constructed if the motive of the work be light, air, and ventilation rather than outside appearances.

A typical school-house can be planned and specified in interchangeable parts, so that orders could be given for four, six, eight, and ten room buildings of good exterior design and exactly adapted to their purpose within, with the same absolute assurance of minimum cost that has been secured in the construction of the textile factory, the paper mill, and the machine shop of New England.

In the light basement of this school-house nearly or wholly above ground (a school-house ought never to have a dark cellar under it) provision may be made for the service of the building, for manual instruction, and for a cooking laboratory, in which instruction may be given in the simple principles of the Science of Nutrition and in the art of applying heat under due control and regulation to the conversion of food material into nutritious food. This can be done without encumbering the premises with costly stoves or ranges, but by making very simple provision for cooking the food, whatever it may be, in such a manner as to enable the boy or girl to carry back to the household such an example of right method as to make the common practice distasteful. If the true kind of cooking apparatus were set up, any kind of food could be dealt with, and in this way right methods might soon be brought into common practice.

THE RUMFORD KITCHEN LEAFLETS.

No. 5.

ON EXTERNAL DIGESTION, COMMONLY CALLED ALIMENTATION.

Written for the Rumford Kitchen by W. T. SEDGWICK.

THE digestion of food begins on its arrival in the mouth, but the digestion of food-stuffs begins much earlier than this. Alimentation, or the preparation of food for digestion within the body, is only another name for a long series of processes, essentially digestive, outside the body. From the raw materials or food-stuffs supplied by nature, until they become the appetizing morsels which we eat, the history of the stuffs which go to make our food is as long and as interesting as any that can be written of their shifting fortunes in the alimentary canal. To this set of processes and phenomena we apply the term *external digestion*, of which the following is an epitomized history.

Man finds in nature certain raw materials which contain his food, that is to say, certain stuffs available for his nutrition. Chemically these are mainly proteids, carbohydrates, fats, salts, and water. The raw materials are chiefly animal and vegetable substances, but partly mineral. The latter are mostly absorbable in the condition in which they are found, and therefore need no digestion; but with the raw materials of the plant and animal worlds it is very different.

Reduced to its lowest terms, one of the most difficult problems of our physical life is the preparation of certain stuffs, derived from plants and animals, for absorption, first into the common carrier, the blood, and finally into the living body substance. It is the ultimate incorporation of the absorbed material and its promotion to the living state which rebuilds the body and makes good the inevitable waste. This it is which constitutes the constructive phase of metabolism — our modern name for the whole series of remote and hidden processes of life itself.

The word "digestion" means, literally, to "carry apart, divide, or separate;" and in physiology this process of separation well applies, first, to mere subdivision or mechanical comminution, such as we have in the grinding of corn or the mastication of food; and, second, and more significantly, to the separation of the useful from the useless, of the wheat from the chaff, of the nutritious from the innutritious, and, especially, of the absorbable from the unabsorbable. Just as the lawyer makes and uses a "digest" of the laws, — the raw products of legislation, — so man makes and uses a digest of the raw materials which nature offers to him. And to physical and mechanical processes, which are as important as they ever were, art and science have added in recent years a knowledge of others essentially chemical; so that the best definition that we can give to-day of the whole process of digestion is a very broad one; viz., *The preparation of food-stuffs for absorption into the body proper.*

An important part of this preparation is done in a special tube, the so-called alimentary canal, perforating the solid body and open at both ends, lined by delicate surfaces. Here the partly digested food-stuffs are still further treated, for the most part chemically, with special reagents (like the gastric juice) secreted from the living walls of the tube; and here also the absorbable nutritive portions are taken up through the surfaces spoken of into the circulation, the refractory residue being rejected and passed out as waste. This tube, or alimentary canal, is, therefore, merely a convenient laboratory for digestion and a protected place for absorption, and although *things within the alimentary* *canal are not really within the body proper*, we may conveniently speak of that treatment of food-stuffs which goes on in the alimentary canal as *internal digestion*. Equally important, however, is *external digestion*, or that treatment of food-stuffs which takes place outside of the alimentary canal.

The first step in the whole process of digestion is the separation of the raw materials from their customary environment. The reaping of grain, the capture of animals, the gathering of fruit, the digging of roots or tubers, all are examples of this first great step in digestion, — the process already pointing towards absorption by the body, the result ministering to its nutrition. After the reaping of the wheat comes the threshing, which separates the grain from the straw; and then the winnowing, which divides the wheat from the chaff. Next the already much-digested seeds are pulverized by grinding, and refined by bolting, until at last we have the purified product in the form of flour, a beautiful white powder consisting largely of broken clusters of almost invisible starch-grains.

Up to this point agriculture and the mechanic arts have done the digesting; but now the housewife comes upon the stage and applies the chemistry of the kitchen. The food-stuff (flour) is not yet fitted for absorption; it is still only partially digested, and, able as the human stomach is, it cannot readily digest raw starch. Experience early taught man this, and invention how to help his own digestive powers by cookery — a further refinement of external digestion. By adding water, the commonest of chemical reagents, the flour-particles are first separated from each other, after which the starch-grains are thoroughly disintegrated by heat while they absorb water and burst. Agreeable flavors and tastes are developed at the high temperature of a hot oven, by means of the partial conversion of some of the original starch into caramel or other sapid substances, and, usually, the mass already made porous by "raising," now becomes brittle in baking. With only one step more, the changing of the unabsorbable starch to absorbable sugar, the work of starch digestion is ended. This last step, however, is not done outside the body, but is reserved for the internal laboratory, or alimentary canal. Thus, at last, the whole sheaf of wheat, after reaping, threshing, winnowing, grinding, bolting, yields a little flour, and the latter, after chemical treatment with water and fire, becomes bread. Surely we earn our bread by the sweat of our brow.

As with the grain, so, likewise, is it with fruits, roots, and tubers. The peach is plucked, or divided from the tree. Its centre and its circumference are rejected, and only the intermediate layer, either raw or after treatment with fire, is accepted as food destined to undergo further (internal) digestion. Dug or pulled and thus "carried apart" from the earth, potatoes or parsnips are seized upon for digestion. They are washed and peeled, and then heated, by boiling or baking or frying.

The ox or the sheep or the wild beast is likewise "carried apart" from its home, killed, skinned, decapitated, drawn and quartered; the whole process consisting in a separation or digestion of the more nutritious or useful portions from the less. In the kitchen or upon the table the flesh is separated from the bone and sometimes the fat from the lean, and only the most digestible portions are cooked, devoured, and finally internally digested and made absorbable.

Now, as in the case of starch, comes in the housewife's part, an external, chemical digestion, treatment by fire, which makes easy for the stomach a long step in the process towards perfect digestion. The quick, hot fire making more brittle the tender parts, the long slow heat for the separation of the fibres of the tougher portions, here find their scientific application. Accessories of the cook's art, to rouse an appetite for "good digestion" to "wait on," here, also, have their rightful place, but it is essential that every step taken shall be *forwards and not backwards*. Every process in the domestic food laboratory or kitchen, as well as elsewhere in this series, if properly carried out, must always make the food-stuff *more, not less, adapted to its end*; viz., absorption through the living walls of the alimentary canal to minister to human nutrition.

These are some of the processes of alimentation or external digestion, and, although they are plainly only forerunners of the, mainly chemical, processes which characterize the more often mentioned internal digestion in the alimentary canal, who shall say that they are less important? Viewed in this broader light, agriculture and a host of the humbler arts of life are ennobled, while cookery becomes not merely an art, but an important branch of physiological chemistry.

RUMFORD KITCHEN LEAFLETS.

No. 6.

WATER AND AIR AS FOOD.

BY ELLEN H. RICHARDS.

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WATER and air are the two great *carriers* of the world, without which life, as it is known on our planet, would be impossible. Growth and decay require the presence of moisture, and, in most instances, that of air also. To preserve any organic substance indefinitely it is only necessary to dry it completely and keep it dry; but preservation is not living, and life means change, and change means the presence of water and air.

I. WATER AS A FOOD.

If a food material may be defined as any substance which it is necessary to take into the body daily in order that life and health may be sustained, then water is a food of the first importance, since no metabolism or chemical change can take place in the body without it. It is an almost universal solvent, and as the digestive tract is a closed sac, only such substances as have been made soluble can pass through the walls. As a rule, dilute solutions dialyze more readily than concentrated ones, and sufficient water must be present in order that the necessary interchange may take place between the contents of the intestines and the blood-vessels and between the blood-vessels and the individual cells.

Since the blood is the carrier of provisions to all parts of the body, it must flow freely and must have the property of dissolving yet more material, since it not only carries food, but brings away the waste. It must be kept at about the same dilution in order to retain its solvent power.

The fluids and tissues of the normal human body contain seventy to seventy-five per cent. of water, and this amount is to be maintained in spite of evaporation and excretion, if the normal processes are to go on smoothly. In order to maintain this proportion, more or less water is to be taken according to circumstances. Each person must discover for himself the right amount, only it is, as a rule, safer to take too much than too little. The body has several ways of getting rid of an excess, but if its calls for more are not responded to it trenches upon its reserves to the detriment of the whole force.

One of the most important offices of water in the body, that of heat regulator, is apt to be overlooked. It goes without saying that the blood is a heat distributor. If the feet are plunged into hot water the whole body becomes warm; if the wrists are held on cold marble the whole body is chilled, because of the rapid circulation; but the consequence of the evaporation from the surface of the body of from one to three pounds of water daily is not so readily perceived. There is always insensible perspiration or evaporation, and if too much heat is produced, as in rapid walking or mountain climbing, perspiration is more or less abundant, and the rapid breathing also carries off a large amount of water, so that two pounds may be lost in an hour. The evaporation of this amount means the carrying away of nine hundred calories, or one-fourth as much as is furnished by a day's ration.

Few people realize the importance of an even temperature inside the body, and many if not most diseases are primarily caused by the lowering of the temperature, which often allows of changes inimical to health and which permits the attacks of various bacteria to which the body would otherwise be proof. The use of the chicken incubator has helped to emphasize this fact, but man is in need of the same uniformity of temperature all his life. He is reckless of himself. Besides, if he is to be a cosmopolitan and dwell in any or all climates, he must be able to bear all changes with impunity. Therefore, he must have means of keeping up the requisite warmth without especial exertion.

Water, having a greater capacity for heat than any other substance, holds it, and by its evaporation carries it off. Who does not know that a profuse perspiration relieves fever? But who stops to think that the relief is caused largely by the cooling due to the rapid evaporation of the water? Indeed, it is by some considered that the condition known as fever is caused by the inability of the body to evaporate sufficient water. It is evident that the organisms which grow at fever heat cannot multiply as fast when the temperature is lowered. Water, then, and plenty of it, is necessary for life. There have been instances of long fasting successfully carried out if plenty of water was supplied.

To the practical question of how much water the daily ration shall contain, and when and in what form it shall be taken, there are various answers. Since the human body is about seventy-five per cent. water, and since food is destined to keep up this ratio, it seems clear that the food should have at least this amount, and that if about two pounds of dry food are taken, six pounds or three quarts of water must go with it, and this is not far from the truth.

As to the form in which it is to be taken, it is evident that it depends on the character of the food eaten. If the meal consists of fruit, which has eighty or ninety per cent. water, no more water is needed. If the meal is largely of vegetables, the same is more or less true. If the cereals, as rice, corn, and wheat, are eaten in the form of mush, little or no water is needed in addition to that used in preparing the porridge. The same is true of soups; but since bread contains fifty per cent. or less, crackers twenty per cent. or less, cheese and eggs thirty per cent., it is patent that much more water must be taken in some form.

The time of taking the water also depends largely on the character of the food eaten, for, as we have said, too concentrated solutions do not undergo the necessary chemical changes or pass the membranes, so that there must be enough water present in the circulation. A hearty meal of crackers and cheese calls for much additional liquid. The common prejudice against drinking at meals seems to be due to bad habits of washing down the food, mouthful by mouthful, without proper mastication. The secretion of saliva is normally abundant, and if water enough is already present in the body to admit of the secretion, more will not be needed to moisten the food at that stage.

It is generally acknowledged by physicians that too little fluid is taken rather than too much, and the great benefit derived from treatment at mineral springs is often quite as much due to the amount as to the kind of water; that is, so far as the cure is due to water at all, and not to regular habits, exercise in the air, better mental condition, faith in the cure, etc.

Many diseases are directly due to too great concentration of the fluids of the body, and are to be counteracted by the imbibition of larger quantities, for a time at least. To have sufficient water present is the *rationale* of water cures, especially that form which prescribes the drinking of a cupful of hot or cold water half an hour before meals. This not only washes out the stomach, but also furnishes the medium for the active secretions, ptyalin, gastric juice, etc., in quantity. On the other hand, excess lies in the path of this as well as other things, and what is a rule for one is not a rule for another. However, if one finds that the taking of a pint of water will relieve that sense of oppression and indigestion which sometimes occurs an hour or two after a meal, and that only favorable effects follow, the inference is that too little was taken with the food. There is little danger of taking too much clear water. The drinking of other liquids may be easily overdone. The richer the food, the more liquid is craved, and to drink wine instead of water with long, heavy dinners is a dietetic error for which many men and women pay with their lives. If wine is taken, it should be, as was intended by the gourmet, only a sip of the right kind to prepare the way for the full enjoyment of the flavor of the next course.

The temperature of the water to be drunk is often a vexed question. This may be left to the individual, for the quantity taken (one-half to one pint) at any one time can have but little influence upon the temperature of the fourteen pints of blood circulating rapidly about the seventy or more pounds of water in the tissues which are maintained at a temperature of nearly one hundred.

For experiment two tumblers of ice water have been slowly swallowed and promptly siphoned out, and found to have attained a temperature of ninety-five degrees in five minutes. It is true that *it is possible* to swallow ice water so rapidly and in such quantities that the stomach receives a momentary chill and disturbance sets in, but this is no reason why all ice water should be forbidden.

Dr. Gilman Thompson summarizes the uses of water in the body as follows: [1]

1. It enters into the chemical combination of the tissues.

2. It forms the chief ingredient of all the fluids of the body and maintains their proper degree of dilution.

3. By moistening various surfaces of the body, such as the mucous and serous membranes, it prevents friction and the uncomfortable symptoms which might result from their drying.

4. It furnishes in the blood and lymph a fluid medium by which food may be taken to remote parts of the body and the waste material removed, thus promoting rapid tissue changes.

5. It serves as a distributor of body heat.

6. It regulates the body temperature by the physical processes of absorption and evaporation.

2. AIR AS A FOOD.

Air is so important to animal life that breathing is not left to caprice. The animal *must breathe*, not two or three times a day, as it eats and drinks, but every second or two, and it cannot re-

[1] "Practical Dietetics," p. 31.

frain at will for any length of time, as it may from eating. The lung capacity of the human animal, in a great measure, governs the length of life and the state of health. How foolish, then, to waste life by breathing bad air! No one physical requirement can be so readily increased as the breathing capacity. Right habits of breathing should be formed in childhood, so that a sufficient supply of this food may be obtainable without exertion.

The so-called food-stuffs need not only water to dissolve them, but oxygen to "burn" them, or, in scientific phraseology, to effect the chemical changes needful for their assimilation. About two thousand cubic feet of air need to pass through the lungs of an adult daily in order to furnish oxygen in sufficient quantity. If there is lack in this most important food-stuff (and nothing else can take its place), starvation as truly results as if other food were withheld, for the changes required for nutrition cannot take place, and furthermore incomplete decomposition occurs, which may result in more or less poisonous products.

Fresh air — air with its full quota of oxygen — is, then, a prime requirement in nutrition. This air should also be clean, free from dust and noxious gases, but the discussion of this factor belongs to general sanitation rather than to the food question.

It may be profitable to consider in detail how the oxygen of the air serves as a food and how much is required. All force or energy comes from the sun, the wind, the water-fall, and chemical action. Energy results from the union of oxygen with carbon (burning of charcoal, anthracite coal) or with carbon and hydrogen (burning of wood, bituminous coal, gas, oil, etc.), or the union of oxygen with other elements in combination with carbon, hydrogen, etc., as in the burning of animal matter, etc. This union is commonly called combustion and the result is heat, light, or electricity, which may be utilized in any needed manner by means of the engine or the dynamo.

Human force, *energy*, whether shown in walking, climbing mountains, singing, talking, breathing, or thinking, is produced by this chemical union of oxygen with other elements, and by no other known means. If this is true, then it is of the utmost importance that this union shall be as complete as possible if the full allowance of human energy is to be reached, and since all work and thought are the products of this power or energy it is a question of economics as well as of health to determine how much work it is possible to obtain from the human machine. Outside the human body 1 gram of fat requires about 3.4 grams of oxygen to complete the chemical change; 1 gram of starch requires about 2.7 grams of oxygen; 1 gram of white of egg probably requires at least 1.5 grams of oxygen.

A day's ration for an adult is commonly considered as about —

Grams of fat, 125; grams oxygen	425
" starch, 450; "	1,215
" albumen or its equivalent, 125; grams oxygen	187
Total grams oxygen	1,827

We have no reason to suppose that any less oxygen is required to complete these changes within the body. On the contrary, all the evidence we have goes to show that just as much is needed. The air is the chief source of this oxygen. A certain amount is in combination with the food materials, but that has in most cases already given up all the energy of which it is capable, so that we may reject this small amount.

The weight of oxygen above given is that contained in 6,000 liters of air, or in 228 cubic feet, but as it is found that of the twenty-one per cent. of oxygen in the air only two or three per cent. is abstracted by the lungs, while a given volume of air remains in them, this quantity must be increased to about 2,000 cubic feet in the twenty-four hours. This is probably below rather than above the required amount.

If the air, instead of containing its normal amount of twenty-one per cent., contains only nineteen per cent., not even three per cent. is abstracted, and the number of respirations is increased in the effort to make up for the lessened amount. This involves increased work on the part of the muscles, and this again demands more oxygen, until the system ceases to struggle and lapses into torpidity. It is therefore of the utmost importance to the human body to have sufficient food of this kind, and especially to the bodies of growing children, and most especially to students, since in repose the respirations are not so deep nor so rapid as in the case of bodily activity. It is also evident why exercise in the open air is an appetizer, and why it stirs up the fire, as it were.

Some experiments most carefully made indicate that nearly twice as much oxygen is taken into the tissues during the night as during the day, and therefore the food-stuff is used up in greater amount while we sleep, provided there is a current of air passing through the sleeping-room.

From observation and experiment the author believes that much of the headache and lack of appetite, especially in women and children, is due to insufficient ventilation in sleeping-rooms. Many an otherwise careful mother starves her children in this most important particular.

THE RUMFORD KITCHEN LEAFLETS.

No. 7.

SOME POINTS IN THE CHEMISTRY OF PROTEIDS.

Written for the Rumford Kitchen by JOHN J. ABEL.

THE proteids and substances so closely allied as to be classed with them are, next to water, the chief constituents by weight of the human body. Roughly speaking, the human body is sixty-five per cent. water, fifteen per cent. proteids and proteid-like bodies, while the remaining twenty per cent. is made up mainly of fat, a few per cent. of mineral constituents, and smaller quantities of other substances, such as the carbohydrates and extractives. When separated by chemical means from the salts, fats, and other substances with which they are closely bound up in living tissue, the proteids are seen to be non-crystalline in form, and easily affected by heat and chemical agents. In the body itself they must be thought of as existing either in a kind of solution in its fluids, as for example in blood, or in a more viscous condition in its tissues of firmer structure, but as soon as life is extinct many of them take on the more solid or coagulated form.

Many varieties of proteids are to be found in the various tissues. Thus, from the muscles may be isolated myosin and muscle-albumen; from the blood, serum-albumen, fibrinogen, paraglobulin, and haemoglobin; from the brain, neurokeratin and nuclein; from connective tissue and bone, collagen or gelatine-giving material;

from the network of glandular structures, elastine and reticulin; from the hair and skin, keratin; and from the milk, casein.

These proteids and proteid-like bodies are all ultimately derived from the proteids built up by plants out of very simple inorganic constituents. The animal organism has the power of splitting up proteids that have been consumed as food, and of modifying them in many ways, so that varieties very different from those originally digested are deposited in the tissues; but it can not, like the plant, build up proteid anew out of, we might almost say, the chemical elements themselves. The animal body, then, takes its proteid either in the form of plant proteid or plant proteid previously transformed into animal proteid. Plant and animal proteids, though closely related, are by no means identical.

Only a few chemical elements enter into the composition of proteids. All contain carbon, hydrogen, oxygen, and nitrogen, and most of them also sulphur; several contain phosphorus in addition, and a few, iron or copper. Their general percentage composition varies within the following limits:

Carbon	50.0 — 55.0 %
Hydrogen	6.8 — 7.3 %
Nitrogen	15.4 — 18.2 %
Sulphur	0.4 — 5.0 %
(Phosphorus	0.42 — 0.85 %)
Oxygen	20.8 — 24.1 %

With the help of such analytical data, chemists are wont to establish by calculation what is known as the lowest empirical molecular formula of a substance, and by taking into account certain physical and chemical data arrived at in other ways, this empirical formula is changed into what is called a rational formula, one representing the molecular magnitude and the molecular structure of the substance analyzed. For proteids, however, not even a definite empirical formula has been arrived at in spite of the innumerable ultimate analyses that have been made of various proteids, and the chief reasons for this are the difficulty of determining the chemical individuality of a given proteid or of its compounds, and the uncertainties introduced by minute analytical errors in the case of substances presumably containing so large a number of atoms in their molecule. An older formula, based on the analysis of purified white of egg that had been treated with strong caustic soda, and representing the lowest empirical formula, is $C_{72} H_{112} N_{18} S O_{22}$. Other analyses of so-called crystalline proteids, or more properly speaking, of loose compounds of proteids and mineral constituents, have led to formulæ representing very high molecular weights. Here, too, such difficulties present themselves that we must confess that we have no notion whatever of the true molecular weight of the proteids, and it goes without saying that we are equally in the dark as to their molecular constitution. So many chemists of repute, however, are working in this field that we may hope to see in the near future light thrown on this important question of biology.

In the absence of chemical data of a higher order, it has become necessary in the interests of medicine, biology, and other sciences, to classify these bodies in accordance with their behavior toward heat, acids, alkalis, metallic compounds, distilled water, dilute saline solutions, etc. Thus, serum-albumen, one of the chief proteids of the blood and egg-albumen are classed together, for they are both soluble in distilled water and in dilute solutions of common salt, and both coagulate on being heated to from 50°—80° C. A closely allied class to which casein belongs are insoluble in distilled water and in weak solutions of common salt, but soluble in weak alkaline solutions and not coagulable when their pure alkaline solutions are heated. Two other classes constituting the albumoses and peptones result from the action of the digestive juices on the proteids of our food. These are in general extremely soluble in water and behave very differently toward precipitating reagents from those already named.

By the application of such chemical tests the proteids proper are classified into albumins, globulins, nucleo-albumins, albuminates, fibrins, albumoses, and peptones. In addition to these there are other constituents of the body that we have referred to as proteid-like substances, which, while differing among themselves more decidedly than the groups that we have just named, yet resemble the proteids so much that they must be brought into connection with them. Some of these allied proteids contain a non-proteid residue like sugar in close combination with them. These are known as mucin, hæmoglobin, keratin, elastin, reticulin, collagen, gelatin, etc., and still other representatives are found widely distributed in the animal world.

Not only are the proteids that have been absorbed from our food variously modified within the body and built up into its structure as has already been intimated, but they are also constantly undergoing destruction as part of the material that furnishes the various forms of energy required. The final or refuse products of this destructive process are water, carbonic acid, and certain nitrogenous substances, chief among which is one called urea. This substance is excreted by the kidneys, and in the case of adults about an ounce is eliminated every twenty-four hours. But a large number of other nitrogenous substances, all derived from proteids, and all playing a more or less important rôle in the upward or downward chemical changes to which proteids are subjected, are also met with in the tissues and fluids of the body. Some of these other nitrogenous substances are uric acid, xanthin, sarkin, guanin, adenin, leucin, tyrosin, kreatin, and taurin. Many of these are, furthermore, of interest since we take them in considerable quantities every day with our meats, soups, etc., as natural physiological stimulants. Meat extracts, such for instance as Liebig's extract, afford a most convenient source for their preparation and study, notably for kreatin and sarkin. The active principles of tea, coffee, and cocoa are chemically intimately related to those nitrogenous "extractives" of meat to which the name of the xanthin group has been given.

The chemical steps involved in the formation of these various substances within the body tissues are still largely a matter of mystery. In order to elucidate the manner in which proteids may break down or may be reconverted in the body, chemists have treated them with strong acids, alkalis, and other chemical agents under various conditions such as high temperatures and high pressure. The artificial decomposition of proteids in the laboratory has yielded us many of the intermediate products referred to, and, taken into account along with the results of physiological experimentation, has furnished us with at least a rough sketch of the chemical history of proteids from the moment of their entrance into the alimentary canal to the appearance of their fragments lodged in the tissues or circulating in the fluids of the body. To attempt this sketch here would however take us beyond the scope of this leaflet.

THE RUMFORD KITCHEN LEAFLETS.

No. 8.

THE DIGESTIBILITY OF PROTEID FOODS.

Written for the Rumford Kitchen by R. H. CHITTENDEN.

IT is a well-known fact that proteid or albuminous foods are absolutely essential for animal life. Hence, no diet can be considered as complete without a certain proportion of such food-stuffs, of either animal or vegetable origin. Further, in order to have the various kinds of proteid food economically utilized by the system, they must be ingested in a form readily digestible, or assimilable by the organism.

Digestibility, therefore, plays an important part in determining the relative dietetic value of the different varieties of proteid foods. Or, more broadly, it constitutes a very important item in ascertaining the true nutritive value of any food. If, of two foods possessing a like composition, one be more easily digestible, that one, though containing no more available nutriment than the other, is in virtue of its easier digestibility more valuable as a food-stuff, and in one sense more nutritious, as well as more economical for the system. The ease with which a proteid food can be utilized to supply the needs of the body depends, therefore, not only upon its intrinsic qualities, viz., whether it has been derived from the animal or vegetable kingdom, and upon its chemical and other peculiarities, but also, to a great extent, upon the way in which it has been prepared for digestion.

Proteid foods are rendered available for the needs of the body mainly through the action of the digestive juices. These convert the insoluble food-stuffs into soluble and diffusible products, capable of being directly absorbed by the circulating blood. The two juices having this functional power are the gastric and pancreatic fluids, the former performing its work in the stomach, and the latter in the small intestine. Both accomplish essentially the same object in a somewhat different manner, viz., the conversion of the insoluble proteids into soluble albumoses or proteoses, and peptone, which are taken up from the alimentary tract by the blood and distributed to all parts of the body, where they may be utilized according to their several functions in nutrition. It is thus easily conceivable that while one class of proteid food-stuffs may be somewhat resistant to the digestive action of the acid gastric juice, it may be more readily attacked by the alkaline pancreatic juice; or the reverse may be true. In any event, the full utilization of the ingested food-stuff by the system depends in great part upon the completeness of its digestion by these two digestive fluids.

As a general rule, the proteids of animal origin, as of beef, mutton, eggs, etc., are more easily digestible than those derived from the vegetable kingdom. This is partially due to the nature of the animal proteids; but another factor of even greater moment is the large admixture of extraneous matters ordinarily associated with vegetable proteids. Thus oatmeal, wheat-flour, potatoes, etc., contain a comparatively small amount of proteid matter, admixed with a large bulk of starchy material and some cellulose. Hence, in a purely vegetarian diet, a large bulk must be consumed in order to obtain even the minimum amount of proteid food required. In other words, the nitrogenous or proteid matter is so diluted by large masses of cellulose and starch that an excess of work is thrown upon the alimentary organs, which not only causes discomfort, but is a physiological loss, entailing the working over by the system of large quantities of material, in order that the required amount of proteid matter may be obtained. By this it must not be understood that vegetable food is undesirable, for such is certainly not the case. Starchy foods are particularly valuable, and a necessary part of a normal diet, the cereals especially when properly prepared being very completely digested and absorbed; but it is physiologically injudicious to depend entirely upon vegetable food for the necessary proteid matter. The latter is far more economically (from a physiological standpoint) obtained from animal foods, where it exists not only in a much more concentrated form, and as a consequence is more readily digestible, but the proteid matter itself is more quickly and completely assimilated than the vegetable proteid, even under equally favorable circumstances.

It is a well understood fact, however, that the digestibility and best utilization of food depends greatly upon a reasonable variation in the character of the dietary. Too great sameness, especially if long continued in, may even lead to an actual impairment of the digestive organs. Hence, the instinctive desire common to mankind in general for variety in the daily diet rests upon physiological grounds well worthy of recognition.

One of the most important conditions modifying the digestibility of animal proteid foods is the manner in which the muscle fibres are bound together, determining, as it does, the extent of their mechanical subdivision on reaching the stomach. Thus in the various kinds of meat, the short and delicately fibred muscles are obviously more readily digestible than the longer and tougher fibres, which plainly offer greater resistance to disintegration. It is on this account that the breast of a young chicken, for example, is so easily digestible, the short tender fibres easily breaking apart and thus exposing more surface to the action of the digestive fluids. For a similar reason, the short flaky muscles of the more digestible varieties of fish are easily assimilated. Further, the presence or absence of fat exercises a marked modifying influence upon digestibility, — as a general rule it may be said that lean meat is more readily digested, in the stomach at least, than fat meat, although the nature of the fat present, and the manner of its distribution are important factors. Thus, the presence of a hard or difficultly fusible fat, as in mutton, tends to retard the digestion of the proteid constituents of the meat more than the presence of a softer or more readily fusible fat, such as is found in beef. Again, the intimate mingling of fat with the individual muscle-fibres, as in the tissues of the eel and lobster, tends to check the rate of digestibility. The same effect is seen in certain kinds of fish flesh; thus, in the shad, the white meat, with its greater freedom from incorporated fat, is nearly ten per cent. more digestible than the dark and fatter meat of the same fish.

More important from a dietetic standpoint is the effect of cooking or preparation of proteid foods on their digestibility, and in this connection it must be remembered that digestion in the broad sense of the word is a complex process, dependent upon the harmonious working of several closely allied processes. By way of illustration it may be mentioned that a given food-stuff may owe its lack of digestibility either to an inherent resistance to the solvent action of the digestive juices, or more indirectly to the fact that its ingestion fails to cause the requisite flow of the necessary digestive secretion. Now, one of the effects of cooking is to improve, or rather to develop, an agreeable flavor in the food, thus increasing its palatability and causing a pleasurable stimulation of the sense of taste. This at the same time leads to a greater outpouring of the needed digestive juices, thus furnishing the means for more rapid and complete digestion. Further, the very increase in palatability incidental to proper and intelligent cooking leads to a more thorough mastication of the proteid food, while at the same time the cooking tends to facilitate its separation and mechanical subdivision. This latter, as already stated, greatly aids the digestive process by enabling the different digestive secretions to come into more intimate contact with the individual particles. This tendency towards disintegration and general softening incidental to cooking is due mainly to the complete or partial hydration of the connective tissue-fibres by which the muscle tissue is held together, into gelatin, which is far more readily digestible and assimilable than the collagen itself.

In all methods of cooking meats, as indeed all forms of proteid food, whether by boiling, roasting, or broiling, the proteid or albuminous matter undergoes more or less complete coagulation. This, however, is essential in any process of cooking by which a rich and appetizing flavor is to be developed, and if not accomplished at too high a temperature offers no obstacle to easy digestibility; indeed, as has already been stated, owing to the conversion of the collagen of the surrounding connective tissue into gelatin, digestibility may be even increased. At the same time, it is well to remember that raw beef, for example, if very finely divided by chopping, is somewhat more easily dissolved by the gastric juice than when coagulated by cooking. All things considered, however, proper cooking unquestionably tends to increase the general digestibility of proteid foods. At the same time it alters the consistency and constitution of the food-stuff, giving to it an odor and taste which would otherwise be wholly lacking, and, no less important, causes the destruction of disease germs or other related organisms possibly present.

The many methods of preparing proteid foods for consumption need hardly be considered here; they have little bearing on the direct digestibility of the various food-stuffs, except so far as they modify the degree of coagulation of the proteid matter, the mechanical subdivision of the tissue, and the removal or addition of admixed fat. More important, however, is the indirect effect on digestibility incidental to the degree of palatability produced, with the corresponding degree of stimulation of the secretory processes by which digestion is so greatly augmented.

Palatability and digestibility go hand in hand, and the intelligent preparation of a so-called cheap or tough piece of meat, for example, may result in as digestible and nutritive a product as the more careless preparation of a piece of tenderloin.

THE RUMFORD KITCHEN LEAFLETS.

No. 9.

PROTEID OR ALBUMINOUS FOOD IN OUR DAILY FARE.

Written for the Rumford Kitchen by MARY HINMAN ABEL.

How strange seems the fact, when we first learn it, that a Roman feast and a Lenten fast, a Delmonico dinner and the lunch of a wayside beggar, all contain the same few simple elements of nutrition! The French *chef* may mix and flavor as he will, yet his dish contains besides flavoring matters, water, and certain salts, only proteids, fat, and carbohydrates, — the same elements that are found in the wayside lunch, — and it is only as proteids, fat, and carbohydrates that the human body can use food, whether that body be that of prince or peasant. So this is nature's democracy, food is food, for a' the wit of cooks! This is not saying that the cooks are of no account, only there is a greater cook, the sun, to whose work we owe the foundation of all. With wonderful skill he makes these few simple principles to appear with varied forms and flavors. The common man gives thanks for a hundred cereals and fruits, but the starch of the potato and the starch of the rice is essentially one and the same, and the chemist finds no difference between the sugar of the pear and that of the peach.

To the unlearned man every food stands by itself and is only to be judged by its taste; but science has reduced this seeming complexity to order, and opened our eyes to see that the "kindly fruits of the earth" have differing values for us, — we have learned to look behind the husk of the wheat and the rind of the orange.

So much the chemist has done for us, and we turn now to the physiologist to learn what use the human body makes of these aliments.

As to the proteids, it is known that they serve various purposes in the body — in small amounts in the repair of the tissues, and to a far larger degree in the performance of the various functions, much as do the fats and carbohydrates.

Let the scientist examine for us the muscles of a man. Three-fourths will be found to be water, and of the dried residue more than two-thirds is made up of the substances classed with the proteids. Now, since there is daily waste going on in all the body structures, the original amount of proteid must be kept up in some way if the individual is to retain health and working power, and this state of balance between the income and the expenditure is called by the scientists, "nitrogenous equilibrium."

The importance of keeping this part of the expense account square is evident. As the albuminous part of our muscles and of the glandular and other structures wastes away it must be rebuilt out of the proteid in our food; nothing else can be substituted.

The question next arises: How rapid is the waste in the albuminous tissues of the body, and how much proteid food is needed daily to replace it? The great chemist Liebig held that when a man worked, his muscles and other albuminous tissues were consumed, that they were the fuel rather than the engine. But this view is no longer held by most scientists; it is thought rather that the albuminous tissues rust away but slowly, and that the real activity is in the combustion going on throughout the engine, where the fat and the starchy foods form the true fuel. This view would call for much less proteid food for the repair of the machinery, only sixteen grams a day being the estimated need for this tissue building, while Voit's standard dietary requires for a grown man at moderate hard work 118 grams of water-free proteid. This, together with 56 grams of fat, and 500 grams of carbohydrate, was found in many instances to be sufficient to keep a workingman of average weight in good bodily condition, thus showing that the tissue waste was made good, and that the other proteid needs of the body had been met. This so-called standard dietary is meant only as a broad average, but it gives a fairly good basis of calculation for those who must furnish food for families and institutions. This amount of proteid is now held by scientists to be greater than absolutely necessary. A woman, also of average weight, requires about $\frac{1}{5}$ less. For American needs the proteid requirement for a man at work is placed by Professor Atwater at 125 grams,[1] an amount to be found in about $1\frac{1}{2}$ pounds of butcher's meat, lean and without bone, or in 1 pound of cheese, or in 24 eggs. One and one-eighth pounds of dried peas or beans would also furnish it, or about $2\frac{1}{4}$ pounds of best white flour, represented by 4 pounds of home-made bread. That is, if the workman in question could eat the required amount of any one of these foods his proteid need would be satisfied, and his system would be kept in that condition called "nitrogenous equilibrium;" but since he must have a mixed diet, and draw his proteid food from different sources, we come to the next question: Are all of these proteids alike in composition, and put to the same use in the body? May we feed on meat or wheat, according as purse and taste may dictate?

The different animal and vegetable proteids — the white of egg, the fibrin of blood, the casein of milk, the legumin of peas and beans, and the gluten of grains — are, according to the analyst, almost identical in the percentage of the elements composing them; but they have chemical differences nevertheless, and whether the system can make equal use of them is yet under discussion. It is certain that meat albumen, for instance, is more easily and completely digested than vegetable albumens, as they are ordinarily prepared; it is also associated with agreeable and stimulating flavoring matters that doubtless increase the flow of the digestive juices, so that whatever be the reason, meat is a very welcome addition to the food of most people, and contributes to the sense of physical well-being. In armies and navies the

[1] 125 grams = 4.4 ounces.

world over, the meat and fat ration is increased in time of siege, attack, or other occasion for extra exertion and with the best effect on courage as well as on endurance.

Liebig puts it thus: "It is certain that three men, one of whom has had a full meal of beef and bread, the second of cheese, and the third of potatoes, regard a difficulty from entirely different points of view."

But meat-eating in excess has its darker side as physicans assure us, and everything seems to favor the mixed diet, much as it is chosen by the majority of healthy people. A great number of statistics gathered in European cities went to show that on the average one-third of the daily proteid was drawn from animal sources. One-third of the 125 grams that has been chosen as our daily proteid need, or 41 grams, would be represented by ½ pound of meat without bone, or, better chosen, ¼ pound of meat, 1 pint of milk and two eggs. This would certainly be considered in our country a low average for animal food; the mechanic eats much more meat than this dietary would allow, and in most families of well-to-do people it is more nearly two-thirds of the daily proteid that is drawn from animal sources.

It is rash to dogmatize on these points. Climate, occupation, and individual requirements must be taken into account; but it is of use to know that great numbers of people live and thrive on this smaller proportion of animal food and that the average army diet in Europe contains even less.

It would seem to be in the line of intelligent economy for our people to learn to take a larger part of their proteid food from vegetable sources than they now do, but such a change will require not only more intelligent choice among vegetable foods, but also better methods of cooking them.

Proteid food seems to be among nature's costliest products. The grains yield a much smaller percentage of proteid material than of starch, and often, as in the case of wheat, it is so closely adherent to the husk as to be separated with great difficulty, thus offering to the miller a problem that has taxed all his invention.

In the same way the richer yield of proteid found in the ripened pea and bean exists in connection with a tough cellulose that is about as digestible as wood shavings. Most other vegetable growths, such as fruits and garden vegetables, contain only small portions of this food.

Animal tissue, to be sure, is rich in proteid material; but animal food must always be costly. Therefore, considering our absolute need of this food, and that it is less easily obtained than the other elements, it is plain that the poor man's proteid, how much he needs, where he shall get it, and how it shall be cooked, is rightly a question of much importance to scientist and philanthropist.

THE RUMFORD KITCHEN LEAFLETS.

No. 10.

THE CHEMISTRY OF THE FATS AND CARBOHYDRATES.

Written for the Rumford Kitchen by IRA REMSEN.

THE physiologist tells us that the food of man consists of proteids, carbohydrates, fats, salts, and water. To the chemist these names convey clear ideas, but for those who are not learned in chemical matters, they need explanation. In this short article an attempt will be made to explain what is meant by fats and carbohydrates. The former term is familiar, and yet it is not easy to define it. In one important chemical book occurs this definition: "Fats are neutral substances of animal or vegetable origin which leave upon paper a transparent spot which does not disappear on long exposure to the air." Plainly that does not help us much. The chemist says a fat is a substance which can be decomposed into an acid, and a substance belonging to the class known as alcohols; but not all substances of which this statement is true are fats. The fact is that the name "fat" was used long before the nature of fats was determined, and it was applied at first only to the common animal fats with which every one is familiar; later it was applied to other natural substances of similar properties, whether of animal or vegetable origin; and at present the group of fats includes a large number of substances, all of which can easily be recognized as similar to the ordinary animal fats. The principal fats are beef-suet, mutton-suet, hog's-lard, butter, fish-oil, palm-oil, cottonseed-oil, and olive-oil. While these substances differ markedly from one another in many respects, they have some properties in common, and in ordinary language we should say that they are all greasy, and no definition can give a clearer idea of a fat than that. We may define light as "an effect produced upon the retina by vibrations in the luminiferous ether," but the result of this is simply to make us yearn for the word "light," which satisfies our needs.

So much for definition; but what are these fats? Those mentioned above are mixtures of various simpler substances well known to the chemist, but little heard of outside the laboratory. Thus beef-suet consists of three substances,—palmitin, stearin, and olein; and mutton-suet and hog's-lard contain exactly the same things, only in different proportions. Fish-oil contains olein and palmitin with small quantities of other substances. Palm-oil contains principally palmitin and olein. Cottonseed-oil contains mostly olein and some palmitin. Olive-oil contains essentially the same fats as cottonseed-oil, with small quantities of other constituents. While the above fats, then, are made up essentially of the three compounds olein, palmitin, and stearin, butter, on the other hand, consists of at least eight different fats, among which are palmitin and stearin. Of the three common fats stearin melts at the highest temperature, and olein is semi-liquid at the ordinary temperature. The consistency of any mixed fat depends, therefore, in general upon the proportions in which the three ordinary constituents are contained in it. That fat which contains the largest proportion of stearin melts at the highest temperature, and that which contains the largest proportion of olein melts at the lowest temperature.

The answer to every question suggests other questions. What are palmitin and stearin and olein? It has long been known that, when a mixture of these fats is treated with lye, soap is formed. A careful study of this process has shown that another substance is formed at the same time. This is *glycerin*. These facts may be expressed thus:

$$\text{Fat} + \text{lye} = \text{soap} + \text{glycerin}.$$

The fat as such completely disappears. Again, it is known that when a fat is subjected to the action of superheated steam, two products are formed, viz., glycerin and an acid; as, for example, stearic or palmitic or oleic acid, or all three together. This we may represent in the case of palmitin by the following equations:

Palmitin + water = palmitic acid + glycerin.

In the case of stearin the equation is:

Stearin + water = stearic acid + glycerin.

And, finally, in the case of olein it is:

Olein + water = oleic acid + glycerin.

Now practically all fats when treated in this way — that is, by superheated steam — are decomposed into glycerin and some acid or acids. To take one of the most complicated cases, butter yields glycerin, and not only palmitic and stearic, but myristic, arachic, butyric, caproic, caprylic, and capric acids. Chevreul, the French chemist, who recently died at the age of one hundred and three years, was the first one to show the relations between the fats on the one hand, and glycerin and the acids on the other. He showed further, that by starting with glycerin and the proper acids, the fats can be made artificially. The preparation of palmitin, for example, is represented by the following equation:

Palmitic acid + glycerin = palmitin + water;

and similarly in the case of the other fats. If glycerin and the acids that enter into the composition of fats could in turn be manufacture cheaply, a fat-factory might be established. But nature provides these substances infinitely more cheaply than they can be manufactured at present, and the prospects of a fat-factory would be most gloomy from the financial point of view. The artificial preparation of fats is, however, a perfectly feasible operation, though expensive.

Our inquiries may, of course, be pushed further. We may now ask, What is glycerin, and what are these acids that enter into the composition of fats? These questions can be answered, but, for the present purpose, the answers are not of much importance, and they need not, therefore, be given. It should, however, be stated that the acids, as well as the glycerin, consist of only three elementary substances; viz., *carbon*, *hydrogen*, and *oxygen*, which are held in combination in different proportions and in different ways.

Having shown thus in a general way what fats are, it only remains to point out, also in a general way, what properties they possess in addition to those already mentioned. They are not volatile, but undergo decomposition when heated; they are insoluble in water, but easily soluble in ether, bisulphide of carbon, and benzine. When pure they are colorless and inodorous. When strongly heated they yield a number of products, among which is one called acrolein. This has a most penetrating odor, and its vapor acts upon the eyes causing the secretion of tears. Those who have been in kitchens during the frying of meats have no doubt noticed the effect of this substance upon the eyes. Contact with the air causes fats to become rancid. The change is essentially the same as that caused by superheated steam; that is to say, the fat is partly decomposed by the moisture of the air into acid or acids and glycerin. The change is most familiar in the case of butter. Some of the acids set free by the decomposition of this fat have markedly disagreeable tastes, which are more or less familiar to every one.

And now the *carbohydrates*. As this term is generally used, it designates a large group of compounds found in nature. They are among the most important constituents of plants, while a few are also found in animals. The word "carbohydrate" refers to the fact that these substances all contain carbon united with hydrogen and oxygen, which are in the same proportion as in water. The carbohydrates may be conveniently divided into three groups, according to their composition. These are:

1. The *glucose group*. — The principal members of this group are dextrose or grape sugar, levulose or fruit sugar, and galactose.

2. The *cane-sugar group.* — The principal members of this group are cane-sugar, sugar of milk, and maltose.

3. The *cellulose group.* — The principal members of this group are starch, cellulose, gum, and dextrin.

The *glucose group.* — All these substances have the same composition, which is represented by the chemical formula $C_6 H_{12} O_6$. The best-known member is the one called glucose or dextrose or grape-sugar. This occurs very widely distributed in the vegetable kingdom, particularly in sweet fruits, in which it is found together with an equal quantity of levulose or fruit-sugar. It is also found in honey, with cane-sugar and some levulose. It occurs, further, in blood, in the liver, and in the urine; and in diabetes the quantity contained in the urine is largely increased. Glucose is easily formed from several other carbohydrates by boiling these with dilute acids or by the action of ferments. Thus, when cane-sugar is treated with dilute acids or with certain ferments, as, for example, ordinary yeast, it is converted into a mixture of glucose and levulose, the mixture being known as invert-sugar. The ferment acts further upon this mixture, resolving each of the sugars into alcohol and carbon dioxide or carbonic acid. Starch and cellulose yield glucose when boiled with dilute acids. The formation from starch is carried on in the large scale for the purpose of manufacturing glucose. Dilute sulphuric acid is generally used. The excess of acid is afterward removed by treating the solutions with chalk, and filtering. The filtered solutions are evaporated down to a syrupy consistency, and sent into the market under the names "glucose," "mixing syrup," etc., or to dryness, the solid product being known in commerce as "grape-sugar." Glucose crystallizes from concentrated solutions, usually in crystalline masses which have much the appearance of cane-sugar in the granulated form. It is sweet, but not as sweet as cane-sugar. According to careful estimations, five parts of glucose are required to produce the same sweet taste as is produced by three parts of cane-sugar.

Glucose has recently been prepared by artificial methods in the laboratory, but the process employed is extremely complicated and expensive.

Levulose or *fructose* or *fruit-sugar* are names applied to the other prominent member of the glucose group. As has been stated, it occurs in nature in sweet fruits together with glucose, and it is formed together with the latter by boiling cane-sugar with dilute acids and by treating it with ferments. It is now prepared in crystallized form, and has about the same sweetening power as cane-sugar. In diabetes, cane-sugar is an objectionable article of diet, for the reason that, in the body, it is decomposed, yielding glucose as one of the products, and the presence of this substance aggravates the symptoms of the disease. At present levulose is manufactured for use by diabetic patients, and comes into the market under the name of *diabetin*. Whether the use of this substance in diabetes is of advantage or not, is perhaps not yet fully decided by the evidence available, though it appears to be of value.

The *cane-sugar group*. — The composition of the members of this group is represented by the formula $C_{12}H_{22}O_{11}$. Cane-sugar, the principal member, occurs very widely distributed in nature, in sugar-cane, sorghum, the Java palm, the sugar-maple, beets, in the blossoms of many plants, in honey, etc.

It is obtained chiefly from the sugar-cane and from beets, beet-sugar being identical with cane-sugar. Sugar crystallizes from water in well-formed, large monoclinic prisms, as seen in rock candy. When heated to about 400°, sugar loses water, and is converted into the substance called *caramel*, which is more or less brown in color, according to the duration of the heating and the temperature reached. The change which sugar undergoes when it is treated with dilute acids and with ferments has already been described. Cane-sugar itself does not undergo fermentation. Though cane-sugar readily breaks down into dextrose and levulose, no one has as yet succeeded in causing these two to unite and form cane-sugar.

Sugar of milk or *lactose*, as the name implies, is found in milk.

It occurs, in fact, in the milk of all mammals, and is obtained in the manufacture of cheese. It crystallizes, and has a slightly sweet taste. Its composition is represented by the formula $C_{21} H_{22} O_{11} + H_2 O$. Sugar of milk ferments under certain circumstances, and is thus converted into lactic acid. This acid causes the milk to thicken, by coagulating the casein contained in it. The souring of milk is a result of this fermentation.

The *cellulose group*. — Starch and cellulose, each of which has the composition represented by the formula $C_6 H_{10} O_5$, are the two substances most abundant in the vegetable kingdom. *Cellulose* forms the groundwork of all vegetable tissues. It presents different appearances and different properties, according to the source from which it is obtained; but these differences are probably due to substances with which the cellulose is mixed. The coarse wood of trees, as well as the tender shoots of the most delicate plants, all contain cellulose as an essential constituent. It forms the membrane of the cells. Cotton-wool, hemp, and flax consist almost wholly of cellulose. *Starch* is found everywhere in the vegetable kingdom in large quantity, particularly in all kinds of grain, as maize, wheat, etc.; in tubers, as the potato, arrow-root, etc.; in fruits, as chestnuts, acorns, etc. In the United States starch is manufactured mainly from maize; in Europe, from potatoes.

Starch in its usual condition is insoluble in water. If ground with cold water, it is partly dissolved. If heated with water, the membranes of the starch-cells are broken, and the contents form a partial solution. On cooling, it forms a transparent jelly called *starch paste*. By boiling with dilute acid, starch is converted into dextrin, maltose, and glucose.

In the above brief sketch, only the principal carbohydrates have been presented. There are many other compounds belonging to the group, but most of these are of subordinate interest in connection with the subject of food.

THE RUMFORD KITCHEN LEAFLETS.

No. 11.

THE DIGESTION AND NUTRITIVE VALUE OF THE CARBOHYDRATES.

Written for the Rumford Kitchen by W. H. HOWELL.

THE starches and sugars which we include under the term "carbohydrates" constitute a very important element in many of our ordinary foods, especially those of vegetable origin. The starches are insoluble, and the object of digestion in the long run is to convert them into soluble sugar so that they may be absorbed into the blood and be utilized by the cells of the body. The sugars of our food, on the contrary, are soluble to begin with, and in all probability some of them may be absorbed into the blood directly without undergoing any change, while others, ordinary table sugar (cane sugar), for example, undergo a conversion before or during absorption into glucose (grape sugar), which is the particular variety of sugar found in the blood. It is evident from this preliminary statement that as far as the starches and sugars are concerned the more difficult task for the digestive organs lies in the transformation of the starches. The digestion of these bodies begins in the mouth. By the act of mastication they are more or less thoroughly mixed with the saliva, and are thus brought into contact with a peculiar substance known as ptyalin, which constitutes one of the elements of the salivary secretion. This ptyalin belongs to a group of bodies to which the general name of unformed ferments or enzymes has been given. One or more of these substances are found in each of the digestive secretions, and each is characterized by some peculiar change or reaction which it causes. The distinguishing property of the ptyalin is that it acts upon starches under certain conditions and converts them to sugar. As a matter of fact, the conversion to sugar is not complete; what actually takes place is that the starch disappears and in its place are found sugar, a particular form of sugar known as maltose, and dextrin. The change is a simple one from a chemical standpoint, consisting essentially in the addition of water to the molecules of starch, a process known to the chemists as hydration. In this case the ptyalin plays the part of the hydrating agent, that is, by its agency the molecules of water are brought into union with the molecules of starch. The change may be expressed by an equation of this kind:

$$\underset{\text{starch}}{3\,(C_6H_{10}O_5)} + \underset{\text{water}}{H_2O} = \underset{\text{maltose}}{C_{12}H_{22}O_{11}} + \underset{\text{dextrin,}}{C_6H_{10}O_5,}$$

although the reaction which actually occurs is probably more complicated. Since our food is held in the mouth for a few moments only, it is not probable that any considerable amount of the starch undergoes this change; much the larger portion is swallowed without alteration. The swallowed food being more or less thoroughly mixed with saliva, the action of the ptyalin on the starch might therefore be continued and completed in the stomach were it not that the secretion of the stomach (gastric juice) is acid, and it is known that under such conditions the activity of the ptyalin is suspended or destroyed altogether. Whatever portion of the starchy foods reaches the stomach undigested suffers no further alteration of a chemical nature from the gastric juice itself. After a certain interval the stomach contents are ejected into the small intestine. Here they meet with the secretion of the pancreatic gland. This secretion, like the saliva, contains a ferment capable of transforming starch to sugar, or, to be more accurate, to sugar and dextrin. What remains of the starch, unless an excessive quantity or an indigestible variety has been eaten, undergoes this alteration during the slow passage of the food along the intestinal canal. The mucous membrane lining the intestinal cavity is richly supplied with a network of capillary blood-vessels, and the end-products of the pancreatic digestion pass into the blood circulating through these vessels.

This act by which the products of digestion enter the blood-stream constitutes what is called absorption. In the case of the substances about which we are now talking, namely, sugar and dextrin, absorption takes place directly into the blood circulating in the walls of the intestine. One of the errors of statement frequently met with in elementary text-books of Physiology is the assertion that all absorption from the intestinal canal is accomplished by means of the lacteals, or absorbents, a system of lymph vessels which form a rich network in the intestinal wall, but whose absorbing function seems to be limited mainly to the fatty constitutents of the food.

It has been shown that there is present in the mucous coat of the intestine a ferment capable of transforming maltose and dextrin into glucose (grape sugar), and it is probable that while these products are being absorbed, or after absorption takes place, this final change is made. We are justified, therefore, in saying that the starch of our foods enters the blood in the form of sugar (glucose). The blood, passing away from the intestines and carrying in it, after each meal, a new quantity of sugar, is distributed to the liver before reaching the heart. During its passage through the liver much of the newly received sugar is again abstracted from the blood and stored up in the liver cells in the form of starch, glycogen, or animal starch, the process in this case being the reverse of what occurred during digestion, the sugar losing water from its molecule and passing back to the form of starch. This reverse change of dehydration seems to be connected with the properties of the liver cells.

In a similar way some of the sugar is stored up as glycogen in the muscular tissue of the body. It seems, therefore, that the new quantities of sugar added to the circulation at each meal are not at once consumed by the body, but are in part, at least, stored up as glycogen. During the intervals between meals or in longer fasts this store of glycogen is slowly given off to the blood in the form of sugar (glucose) in such quantities that the proportion of sugar in the blood remains always practically constant, about 1 to 1.5 parts per thousand. The ultimate fate of this sugar is that it is taken into the substance of the cells composing the body, and there undergoes oxidation with the formation of carbon dioxide gas and water, and the liberation of energy. Just as sugar may be burnt outside of the body with the production of carbon dioxide and water, and the liberation of heat, so it is burnt, though more slowly and indirectly, inside of the body, with the formation of the same end-products, and the production of heat or some other form of energy. The nutritive value of the carbohydrates, therefore, lies in the fact that they furnish energy to the body, and this energy may be manifested in the animal heat of the body, in the work done by a contracting muscle, in the activities of the brain, etc.

As energy producers the carbohydrates are weight for weight less efficient than the proteids and much less efficient than the fats; but this disadvantage is offset, as far as the fats are concerned, by the easier digestibility of the carbohydrates. In the nutrition of the body proteids are indispensable; a diet of carbohydrates alone, or of carbohydrates and fats, if long continued, will result in starvation. But if carbohydrates and fats are present in the diet a smaller amount of proteid will suffice for the needs of the body, and in a mixed diet of this character it has been shown that the fats and carbohydrates may be interchanged according to a definite ratio without altering the total amount of available energy contained in the meal. The cheapness, ease of digestion, and palatableness of the carbohydrates make them the most abundantly used of the food-stuffs. It should be added that it has now been demonstrated that when used in excess of the actual needs of the body, the carbohydrates may be converted into fat and stored up in this form. It has been found impossible to change carbohydrates to fats in the laboratory, and indeed it is difficult to suggest a series of reactions such as might take place in the body which would lead to this result. For this reason physiologists for many years have doubted the possibility of such a change occurring in the body. It was supposed that carbohydrates are good fattening foods because they form a material easily consumed by the body, that is, easily burnt or oxidized. In consequence of this property the proteid constituents of the food which are oxidized with more difficulty were protected, the necessary energy of the body being obtained from the consumption of the carbohydrates, while the fat of the well-nourished animal came from the proteid thus conserved. It is not necessary in a short article like this to enter into the details of the experiments which have seemed to disprove this view. It is perhaps sufficient to say that it is now generally believed that the body has the power either of consuming the carbohydrates directly, or of building them up into the more complex fats. In the latter case the material is of course saved in the form of adipose tissue for future use. It follows from this that in a diet intended mainly for fattening purposes there should be a large proportion of carbohydrates in addition to the necessary proteids. Indeed, this fact has long been known and utilized by stock-farmers in fattening cattle. On the other hand, a diet intended to reduce fat is usually characterized by a small proportion of carbohydrates. The value of starches as foods depends largely upon the condition in which they are eaten. Raw starch, for example, is converted to sugar by the salivary and pancreatic secretions with great difficulty as compared with the same substance after thorough cooking. It follows from this that if eaten in an uncooked condition there is a greater possibility of the starch escaping digestion and being lost to the body. It is not the food that is eaten, but the food that is properly digested and absorbed, that nourishes the body. Cellulose, also, the form of starch found in the fibrous and cellular tissue of vegetables, passes, for the most part, through the alimentary canal without undergoing digestion, and is therefore of little nutritive value.

THE RUMFORD KITCHEN LEAFLETS.

No. 12.

THE PLACE OF FATS IN NUTRITION.

By Mary Hinman Abel.

It is well known that when an individual has in the diet a sufficient amount of proteid food, as furnished by meat, milk, eggs, and the gluten of cereals, the rest of the required nutrients may consist of fat, sugar, and starch, in proportions that vary widely, according to climate, occupation, and other circumstances.

The adaptability of the human system in this regard is remarkable. Thus we know that people in extreme northern latitudes live for long periods of time entirely on meat. Nansen in his overland journey lived for months on bear meat, although on the "Fram" his diet included bread and other vegetable foods, with considerable sugar. In both cases he kept health and strength.

We know of no people, on the other hand, who do entirely without fat, although some, as the poorer classes of China and Japan, reduce this principle to a very low figure, perhaps one-tenth of what is used by the average European, while they take in its place large quantities of carbohydrate food, chiefly in the form of rice.

Civilized man seems to use with proteid food both fat and starch, choosing to replace some of the latter by sugar whenever it is obtainable.

Food proportioned in this way, according to personal choice, permits great latitude in cases of robust health. The system seems to allow a sort of free trade between fats and carbohydrates, by which a deficiency of one is balanced by excess in the other, and an average struck over days and weeks.

But in special cases the adjustment of the two requires more care. For instance, the infant cannot get on without both fat and sugar in about equal quantities. Very little change can be made from the proportions found in the mother's milk, and according to this recognized standard cow's milk is "modified" to imitate human milk.

The ordinary individual in this latitude eats about one-fourth as much fat as of starch and sugar together. This amount may be increased for the outdoor worker, or the mountain climber, while the sedentary man or the woman of leisure will do better with less. A pound of fat furnishes more than twice as many heat calories as a pound of starch and is, therefore, as a condensed heat and energy producer, well fitted to meet the needs of hard workers and of dwellers in cold climates. It is worthy of remark that in Europe the army ration of fat is always increased for heavy marching or fighting.

In what forms shall fat be taken? It should be remembered that all fats used as food are much alike, chemically considered, and when absorbed in the body do the same work. Fats differ chiefly in their flavor and the ease with which they melt in the mouth, both of which circumstances affect our estimate of them as foods, and without doubt, also, their availability in the system.

Cream is doubtless the most highly digestible form of fat, and nothing can take its place for the young child. It is needed in the building of the tissues, in keeping up body temperature, and providing for the constant activity of the young organism. Cream as supplied in milk is most useful to children of all ages; butter comes next in value and should be liberally supplied, as children seldom relish meat fat. Delicate children and anæmic persons are often seen to improve greatly in condition when large amounts of palatable and digestible fats are introduced into the diet. It is even claimed that cod liver oil is to be reckoned as a food rather than a medicine, and it sometimes comes to be greatly relished. Delicately cooked bacon is often used in its place. Vegetable oils, as found in cocoa, in olives, and in nuts, and the highly important though small proportion in grains, are usually well digested. Nuts should be well chewed and taken in connection with other food, as bread, or ground and mixed with fruit or cereals, as in many prepared foods now on the market. So eaten, nuts should be counted as a valuable food which may take the place of some substantial dish, rather than as a luxury to be eaten at the close of an already full meal.

Among animal fats cream is doubtless the most digestible and butter ranks next, and the yolk of egg presents it in an exceedingly useful form. Freshness is a matter of great importance with all three. Cream, thanks to the patent separator, can now be obtained as fresh as milk, and recently made butter is everywhere obtainable. If eggs are not perfectly fresh they should not be given to a child or to a person of delicate digestion, for with every day of age they lose something of their high nutritive value.

The fat of meat shows striking differences. Interstitial fat, or that which lurks between the fibres and is not generally recognized as fat, is more digestible than solid or lump fat, perhaps on account of its minute subdivision. Mutton fat, on account of its high melting point, is less well used than is beef fat. Cooking has considerable effect on the digestibility of fats. By softening the cellular structure which encloses the globules of fat in the fat of meat, it facilitates digestion; but if a high degree of heat be applied and the fat be scorched, it becomes highly irritating to a delicate stomach.

This is also true of any liquid fat that is browned for the making of brown gravies, etc.

The fat of marrow bones is of fine flavor and digestible, and might be more used than it is.

It should be noted that the question of fat in the diet does not take care of itself, especially with the poor. The well-fed man takes his ration of fat in many unsuspected forms, in minute quantities in connection with lean meat, in rich sauces, in the many dishes seasoned with butter and cream. The man who lives on plainer fare may in reality take less fat in his three meals, although it is more in evidence in the form of fat meat or a thick layer of butter or bacon fat on his bread.

The principal foods furnish fat in the following proportions:

Meat (spoken of as lean)	5–12 per cent.
Eggs	12
Milk	3–4
Butter	80–90
Cheese	8–30
Green vegetables	0.3
Nuts	53–66
Wheat	1–2
Rye	1–2
Oats	4–5
Corn	5–6

LUNCH COUNTER AT THE BOSTON LATIN SCHOOL.

THE RUMFORD KITCHEN LEAFLETS.

No. 13.

THE FOOD OF SCHOOL CHILDREN AND YOUNG STUDENTS.

Written for the Runford Kitchen by Ellen H. Richards.

The accompanying diagram, showing approximately the amounts of the three chief classes of food-stuffs which are required for human nutrition at the different ages, points most clearly to the great importance of care during the school age. When children are free to roam they forage for themselves to a great extent, and although they may eat unwisely, yet such is their power of assimilation, that comparatively little harm comes of it. They satisfy their hunger and grow strong through incessant activity.

But children in school are more or less like animals in captivity, and the question of their food should be as carefully studied. For our town and city schools particularly, there are inevitable difficulties to be overcome only through a wise adjustment of facts to the conditions.

The long distance to be travelled by some necessitates leaving home early; therefore the breakfast is often hurried for fear of being late to school. Owing to a lack of fresh air in the sleeping-rooms the morning appetite of many children is capricious, and therefore the breakfast taken is insufficient in quantity, or inadequate in quality, even when time enough is allowed.

The thoughtful mother puts up a luncheon, usually of the things her child likes best: cake, pies, and cookies. The careless mother may or may not fill the luncheon basket.

The child is a young animal as well as a young scholar, and at an age when all other young animals eat almost constantly while awake, and sleep half the time in periods alternating with those of eating, this young creature goes in haste to school, sits in a fixed position, if not in a cramped one, breathes more or less vitiated air for four or five hours a day, with comparatively short intervals of exercise, and very little of that out of doors.

Comparatively few mothers really know how much children eat, for, as was said above, they forage for themselves to a great extent, and if a luncheon is put up for the child it often happens that it is eaten up hours before it was supposed to be required, and then there is nothing left for the regular luncheon time, and the child goes hungry for too long a time. Four meals a day are recommended as best for children, and the school lunch should serve as one of these.

The need of some better provision for the food of young children, who are kept so far away from the base of supplies for so many hours of the day, is imperative; for insufficient nutrition (a very different thing from insufficient food) has quite as much to do with the frequent breaking down of the child as over-stimulation in study; in fact, over-stimulation in study is probably possible only in the case of an insufficiently nourished scholar. The healthy, rosy-cheeked child is too much of an animal, contented with life, to be driven to over-exertion in study.

An examination of the diagram will show that the actual weight of food which a child two to four years old needs is already about one-fourth that of the active working age. The rapid rise in tissue-forming albuminoids, and in the activity-giving carbohydrates from the tenth year after a slight equilibrium from the fourth to the tenth is most instructive. At the age of nine or ten, then, just when the child is in the grammar school, begins a period of great activity which seems to exert a marked influence in perfecting the development belonging to the next stage. A child of twelve to fifteen requires as much food in actual weight as a person in the prime of life at fifty to sixty, and only a little less than a hard-working man. Insufficient food at these ages causes more serious consequences than at a later period.

The confinement of the child in the school-room for long at a time should not be tolerated during these years; and not only a recess but a suitable luncheon should be insisted on when children leave home by or before eight o'clock, and do not reach home until half-past twelve or one or even two o'clock.

It is time that a vigorous protest was made against the claim that over-study in school is the cause of all the evils of school life. Let a careful examination be made of the facts as to food and exercise before a universal condemnation of our intellectual methods of education is allowed.

It has for a long time been considered desirable that a good nutritious hot luncheon, or some bread and milk, should be served in the middle of the morning; but the way to the practical attainment of this has not seemed open. The chocolate and cakes sold at many of the school-houses help slightly; but there is need for something more systematically planned.

This question of ways and means has come up in reference to the plan which is growing in favor in New England at least, of bringing the children to a central graded school, instead of having a number of ungraded schools in widely separated sections of the town.

The penny dinners of the English schools are out of the question in America, not on account of the cost of material, but on account of our standard of living, and consequently the increased cost of serving food in an acceptable manner.

Sufficient and nutritious luncheon *can* be furnished to the pupils of a large school for from three to five cents each, but from our present knowledge, it would require about a ten-cent luncheon to satisfy the taste of the American scholar.

In order to help solve this question, among others, luncheons were served daily for the winter of 1892–3 to the pupils of the Boston Normal School of Gymnastics. This was done at the request of Miss A. M. Homans, the director, whose long connection with the School Kitchens, as well as her present interest in physical training, led her to a just appreciation of the value of this factor in education; and to her enthusiasm and efficient management the success of the plan is due.

Although these students were young women, and not grammar school children, yet a general method of procedure has been outlined, and a suggestion, at least, obtained of some possible methods of obtaining the desired results.

The composition and food value of these luncheons may be studied from the following table, showing one month's supply.

The practical results of suiting the taste of the pupils within the stipulated price of fifteen cents per luncheon delivered at the school-house were obtained before the theoretical calculation of the actual values was made. The figures show that it is possible, with such a knowledge of the composition of food-stuffs as the manager of the New England Kitchen, Miss S. E. Wentworth, possesses, to approximate very closely to required conditions without an elaborate series of analyses or computations.

The luncheon is designed to furnish one-fourth of the total food value for the day.

For comparison is given one-fourth of the two standard rations.

	Proteid.	Fat.	Carbohydrates.	Calories.
Voit ration . . .	24.5 grms.	14 grms.	125 grms.	742
American ration .	31.2 "	31.2	114	882

STATEMENT OF ONE MONTH'S LUNCHEONS SERVED TO STUDENTS (WOMEN) FIVE DAYS IN THE WEEK, BEGINNING FEBRUARY 1, ENDING FEBRUARY 28, 1893.

		Ounces.	Food Value in Grams.			Calories.
			Proteid.	Fat.	Carbohydrates.	
Feb. 1.	Beef Broth	9.4	26.3	20.4	128.4	817.5
	2 Rolls	4.0				
	Gingerbread	4.0				
	Butter	0.7				
Feb. 2.	Baked Beans	8.4	26.3	35.6	131.4	979.3
	Brown Bread	4.2				
	1 Roll	2.0				
	Butter	.7				
	1 Orange	5.5				
Feb. 3.	Escalloped Meat	10.0	32.2	26.8	138.8	942.5
	Rolls	4.0				
	Butter	0.7				
	Apple Sauce	5.3				
Feb. 6.	Vegetable Soup	9.7	20.0	20.9	92.1	648.2
	Rolls	4.0				
	Butter	0.7				
	Apricot Sauce	6.0				
Feb. 7.	Potato Soup	9 6	15.0	24.9	131.5	826.1
	Rolls	4.0				
	Butter	0.7				
	2 Baked Apples	8.0				

		Ounces.	Food Value in Grams.			Calories.
			Proteid.	Fat.	Carbohydrates.	
Feb. 8.	Pea Soup .... Rolls .... Butter .... Apple Cake	9.8 4.0 0 7 4.0	23.6	35.4	126.1	935.3
Feb. 9.	Beef Hash .... Rolls .... Butter .... Apple Sauce........	6.4 4.0 0.7 5.3	33.1	24.0	136.5	911.8
Feb. 10.	Oyster Soup........ Rolls .... Butter .... Prune Sauce	9.6 4.0 0 7 5.3	20.9	25.9	108.0	762.5
Feb. 13.	Beef Croquettes ..... Potato Croquettes .. Rolls .... Butter .... Baked Apples.... ...	4.0 4.0 4.0 0.7 8.0	16.8	22.7	111.4	738.8
Feb. 14.	Fish Chowder....... Rolls .... Butter .... Orange	10.0 4.0 0.7 5.5	22.2	30.0	101.2	778.1
Feb. 15.	Tomato Soup .... Rolls .... Butter .... Doughnuts	9.7 4.0 0.7 3.5	19.1	26.3	103.0	739.0

		Ounces.	Food Value in Grams.			Calories.
			Proteid.	Fat.	Carbohydrates.	
Feb. 16.	Escalloped Fish Rolls Butter Baked Apples	4.0 4.0 0.7 8.0	26.8	24.0	109.8	777.2
Feb. 17.	Baked Beans Brown Bread 1 Roll Butter 1 Orange	8.4 4.2 2.0 0.7 5.3	26.3	35.6	131.4	979.3
Feb. 20.	Corn Soup Rolls Butter Apple Sauce	9.6 4.0 0.7 5.3	13.6	23.1	107.0	704.2
Feb. 21.	Beef Broth Rolls Butter Gingerbread	9.4 4.0 0.7 4.0	26.3	20.4	128.4	817.5
Feb. 22.	Baked Beans Brown Bread 1 Roll Butter 1 Orange	8.4 4.2 2.0 0 7 5.5	26.3	35.6	131.4	979.3

STATEMENT OF ONE MONTH'S LUNCHEONS. — *Concluded.*

		Ounces.	Food Value in Grams. Proteid.	Fat.	Carbohydrates.	Calories.
Feb. 23.	Escalloped Oysters... Rolls .... Butter .... Buns	4.5 4 0 0.7 5.0	24.0	34.0	115.2	880.3
Feb. 24.	Tomato Soup....... Rolls ... ... Butter .... Baked Apples	9.7 4 0 0.7 8.0	15.0	19.5	108.4	681.8
Feb. 27.	Potato Soup ... . Rolls .... Butter .... Lemon Jelly........	9.6 4.0 0 7 6.0	19.1	24.9	139.7	875.9
Feb. 28.	Pea Soup .... Rolls .... Butter .... Apple Cake....... ..	9.8 4.0 0.7 4.0	23.6	35.4	126.1	935.3
	Average	.... ..	22.8	27.1	120.2	827.4

This table illustrates the combinations which proved successful in the case of this set of individuals. A still more instructive table would be that showing the combinations theoretically far better which failed to please the taste; but until a wider range of experience has shown how far local prejudice may be overcome by a little patience and education, it is not worth while to emphasize the failures. All that is here intended is to show that it is possible to serve nutritious and palatable luncheons to large numbers of people, with a sufficient variety to keep up the appetite. In the spring, a change was made to some lighter dishes, and a further study of possible variations is in progress. No other accessory — such as tea or coffee — was served in this case. With a few slight changes in the way of substituting less costly stews for the oysters, these luncheons could be served in quantity for a large school for 10 cents each.

Those interested in this question will find two most valuable papers on the growth of school children, by Dr. Henry P. Bowditch, one in the eighth annual report (1877, page 275), the other in the twenty-second annual report (1891, page 479), of the State Board of Health of Massachusetts.

The curves here given, showing the increase in height and weight of Boston school-children, coincide in a very marked degree with those on the accompanying diagram.

It is, however, characteristic of the hitherto prevailing feeling in regard to food, that, in this exhaustive paper, no mention is made of the influence on the physical development of children which food exerts; and yet no question is of more importance both for the school committee and for the teacher to consider.

It may be argued that the school has no right to interfere with the home life and habits; but surely the director of physical training has a right to refuse to allow girls to exercise in corsets, and has not the teacher as much right to refuse to urge on in study a starved boy? The schools are potent factors in developing the general ideas of the people, as well as in teaching arithmetic to the children; and with the increasing sociological tendencies of the times an ever-widening field of influence is here offered.

THE FOOD OF STUDENTS.

Second only in importance to the food of the child is that of the youth in the secondary school and the college.

A glance at the accompanying diagram will show that during the years of student life the normal development of the body requires an excess of food, and that, if the brain is not to be developed at the *expense* of the *body*, a jealous watch must be kept over the food of the young brain-worker.

This care must take into consideration two points — sufficient *quantity* and *availability;* for it is not what is eaten, but what is *digested*, which nourishes, and the young student cannot well afford two hours of rest after each meal to allow the hard work of the stomach to be finished before that of the brain begins.

If double work is required of a horse, he is given double feed. All work is one; work means expenditure of energy, whether in thinking or in lifting weights; the only source of human energy is the food which is assimilated and made a part of the body tissues (a very different thing from the food eaten).

This fact is now perfectly well established, and it should be recognized by all educators, that *good thinking*, like *good rowing*, *requires proper feeding.*

THE DIETARY OF THE COLLEGE STUDENT

Should be a subject of careful study by every college faculty, and as great care should be exercised in selecting the steward, who is in fact to determine the mental standard of all the students, as in selecting the professor of Greek or history. When the academic world becomes convinced of the importance of this factor, we shall see a race of American students far outstripping all others.

It would be of great advantage to have a friendly rivalry in regard to this side of college life.

What should be the quantity and character of the food of the American college student?

It depends upon many circumstances, chiefly upon whether there is a necessity of economy in time, in money, or in mental power.

It is because of the remarkable adaptability of the Anglo-Saxon race to climate and to food that it has been able to girdle the globe. Hence it has come to be a belief that man could eat anything and everything, and that his food was of less consequence than anything else. Certain unmistakable signs, however, point to the fact that there is a limit to this adaptability, or at least to the speed with which it may be safely accomplished. The latter is the more probable reason. A family is now able to entirely change its surroundings in a few days to a degree which formerly required years to accomplish.

In order to gain even a little light on this question, another experiment was tried during the same year (1892), in order to determine the amount and character of food taken by students at hard work (mostly young men of 18 to 22) when they had a certain range of choice. A lunch-room patronized by between three and four hundred was furnished with the same soups, bread, rolls, and baked beans as those sent to the young women. In addition, pies, cakes, cold meats, and salads were furnished; also coffee, milk, and chocolate. Instead of a definite luncheon for a fixed price, each portion was served separately and the student made up his own list, thus giving a wide range of selection. For a term or half-year, beginning September 26, 1892, and ending January 9, 1893, a careful account was kept of the food used.

Although the figures must be accepted as only approximate, owing to the fact that the composition of the pies, cakes, etc., made outside the New England kitchen can only be estimated and not accurately calculated, yet they are sufficiently correct to furnish a basis for further work. The average amount spent for lunches was 21 cents — ranging from 15 to 30 cents.

The average food-value per person was:

Proteid.	Fat.	Carbohydrates.	Calorics.
29 gms.	37.3 gms.	106.6 gms.	894.8 gms.

The proportion of the proteid to fats is very suggestive, and confirms Prof. Atwater's views that far more fat is eaten in America than Germany. This is well shown by a comparison of these figures with those given on the diagram for the same ages. Americans seem to eat far more fat and sugar, and consequently less starch, than the average German. How far this is due to climate and to habit, or to the fact that it is not necessary in this country to live so largely on bread, remains to be studied. It should however, be considered in providing for American students.

The experiment has continued now for three years on the same lines, and may be considered to prove that a limited variety of uniformly well-prepared food will be taken even by that capricious animal, a young student.

In connection with the marked increase of the sugar and fat there arises another vital question in physiological chemistry. The old adage, "After breakfast walk a mile, after dinner sleep awhile," was founded on experience in the time when starch in the form of more or less heavy bread, and of potatoes and fat in the form of pork, was the chief source of the carbohydrates and fat taken. Does the same hold true at this date, when the more readily assimilated butter replaces pork, and when the already partly digested sugar replaces a part of the starch, and when the light, fine wheat-bread taxes much less the power of digestion? In other words, how far is it physiologically correct to encourage brain workers to omit the after-dinner rest by furnishing them with a noon meal which will not so tax all their bodily powers as to leave nothing available for mental work? For my own part, I believe that whatever may be the case for the morning and evening meal, the character of the food taken during the working hours of students should be such as to sustain the supply of force-producing material in the blood, without requiring a large per cent. of the force already at hand to convert the food eaten into new force-producing material.

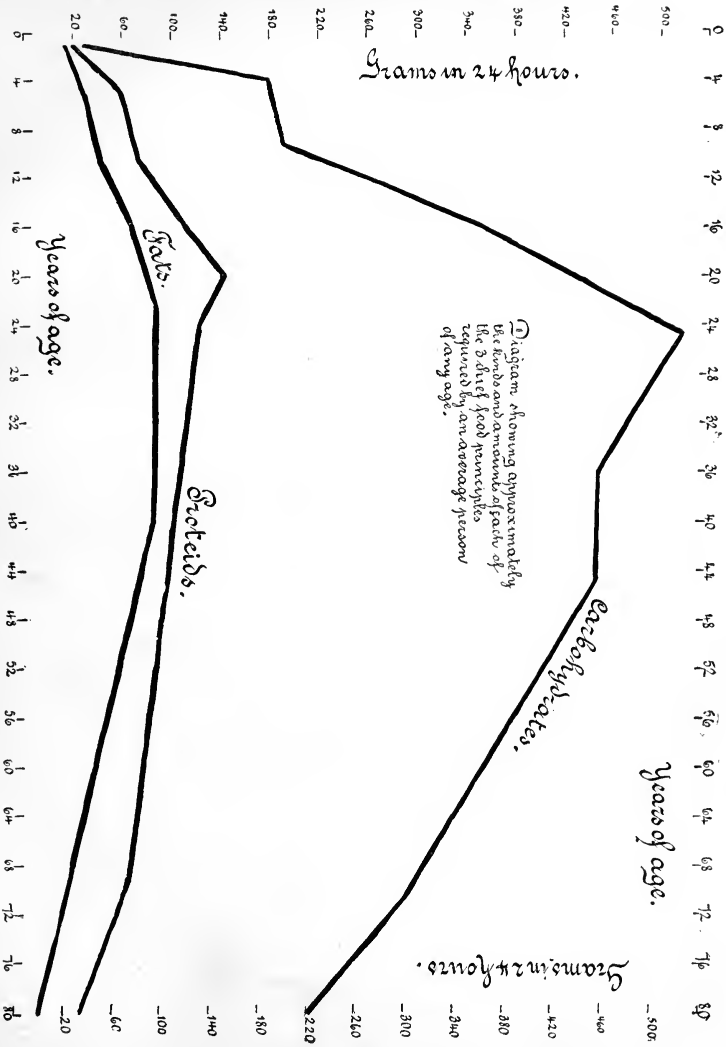
Herein lies a new problem in the conservation of energy, and of that most productive of all forms of energy, that of human thought.

Until this law is apprehended and applied, we do not know of how much the American student may be capable.

This diagram is only an approximate statement of observed facts. The value of such generalizations lies in the number of observations upon which they are based, and in this case they are too few for a final decision. Further, the facts are from German sources almost exclusively, because no others gave the whole series; and it seemed better to adhere to a uniform standard of calculation in view of the great gaps in our knowledge. It is given in this imperfect state in order to induce a fuller study of the question.

From what we do know of the American standards, it seems probable that the curve of carbohydrates would be less marked, and that the curve of fats would be nearly coincident with that of the proteids except in that part showing the amount from the 10th to the 20th year if drawn to represent American practice.

The steepness of the curve of carbohydrates shows the need of a full supply of the material which serves as the source of power for the very great activity of youth. The child naturally runs all day long; the activity, the amount of work done, is enormously in excess of that done in after life, aimless though it may seem. It is none the less work because it is work of heart and lungs, and muscular exercise in play. It is useful work, in that it builds up a structure for the grown man to use; it is the building time, and the building can not be well made, strongly put together, without it. This intense activity is required for the metabolism of the tissue, which is also rapid, as will be seen by the curve of proteid. If the weight of the individual at different ages were taken into account, this would be even more marked.


Grams in 24 hours.
Diagram showing approximately the kinds and amounts of each of the 3 chief food principles required by an average person of any age.
Carbohydrates.
Proteids.
Fats.
Years of age.
Years of age.
Grams in 24 hours.

THE RUMFORD KITCHEN LEAFLETS.

No. 14.

PROPHYLACTIC AND THERAPEUTIC VALUE OF FOOD.

Read at the meeting of the American Public Health Association, Chicago, Oct. 19, 1893, by Ellen H. Richards.

The views now held concerning the causation and prevention of disease lead us to hope that a new era is dawning for the study of food in its relation to health and sickness.

Mrs. Abel has chosen for the motto of the series of Rumford Kitchen Leaflets the following saying of Donders, which was first quoted by Voit: "He who works with all his strength on the development of our knowledge of food and nutrition, and who also persistently strives to apply the results of investigation, is working on a broad basis for the development of mankind."

No body of men can be more interested in the application of scientific knowledge to daily life than the members of the Public Health Association, or more keenly alive to the liability to mistake on the part of enthusiasts, and certainly no body of men can so warmly sympathize with those who are striving to bring well-known facts into general circulation in the face of difficulty and discouragement. As Count Rumford so well stated it: "The slowness with which improvements of all kinds make their way into common use, and especially such improvements as are the most calculated to be of general utility, is very remarkable, and forms a striking contrast to the extreme avidity with which those unmeaning changes are adopted, which folly and caprice are continually bringing forth and sending into the world under the auspices of fashion."

But Count Rumford worked almost alone and far in advance of his time, while we can count on the sympathy and support of scores of able men, and it is for that reason that we appeal to you for coöperation, suggestion, and criticism. The world at present needs most of all what I have elsewhere called a standard of health, a normal "well-being."

Given a well-built, smoothly-working bodily machine placed under good conditions in a wholesome environment, and it is chiefly a question of good food as to how nearly the standard can be kept up.

As a good workman can do better work with a poor tool than a poor workman can do with a good tool, so a man with skill derived from knowledge can often make better use of a body crippled by accident or inheritance than his neighbor can of a perfect equipment. Many a structure is strengthened by a brace here and a bolt there until it long outlasts a better-built one: so the right kind and quantity of food, with rigid abstinence from irritating or clogging substances, may so strengthen a weak heart or a feeble constitution that the natural term of life may be reached in comparative comfort. On the other hand, the delicately adjusted machine may be thrown into disorder by a very slight indiscretion which may not matter for once, but which, repeated, wears a groove which deepens more and more until it is in danger of stopping the machinery.

A great need of the present time is a better standard of health, a test measure of the duty (used in the engineering sense) of the human body. The engineer knows how much his engine is intended to do, and he chooses that fuel and that lubricant which will enable the task to be accomplished. Each human machine has a certain capacity of work, a certain load under which it works best; each individual can, generally speaking, if he will, control this load or strain so as to get the full duty of the machine. Here also it is fuel and lubricant, that is, food and enjoyment of work.

To be well means to have good spirits, good temper, and a certain elasticity or capacity to do more than the normal without passing the limit of recovery. In this "well-being," this "feeling like a fighting cock," in homely phrase, lies, in the main, as we believe, the secret of resistance to disease. Therefore to keep the body in good working condition seems to be also to render it most resistent to the inroads of disease. The power of accommodation is such in this delicate machine that the most diverse substances can be utilized, and the range of substances found useful for human nutrition is very wide, so wide that man has jumped to the conclusion that it made no difference what he ate; and while to a certain extent this may be true in a state of robust health and active exercise, it is far from it when once the balance has been disturbed and the machinery is working badly, so that, in the case of inherited weakness or of accidental disability, food becomes of more importance, and the cause of public health would gain much and public temper still more if this fact could be generally recognized.

It is the day of "small things" — quantities formerly considered insignificant are now held responsible for great disorders.

An excess of food over the supply of chemical agents in the alimentary canal causes imperfect decomposition, and leads to irritability, if it does not leave poisonous products, to be more or less absorbed into the blood; a danger the greater because often quite unsuspected.

This intimate connection of good food and good temper might be emphasized to advantage both in school and in society.

The *prophylactic value of food is then to keep the human body in a high condition of health.* For this there seems to be no general rule, since individual idiosyncrasies and mental conditions exercise a marked influence on capacity for utilization of nourishment. The main object to be gained is to establish a higher standard of health in the community, to make as widely known as possible the fact that much of the ill-health now prevalent is needless, that a little self-denial, a little more attention to the rules of hygiene, a little more living in the open air, would cause a large part of the disturbances of health now so common to disappear.

Self-indulgence and a deep-seated superstition that medicine can take away all evil consequences lead men to swallow the pill and throw away the sound advice which usually accompanies it.

A man will attribute a headache in the morning to anything rather than to the dinner of the night before.

Drugs, however useful in emergencies, can never take the place of the daily food; if that is clean, wholesome, and right in kind and quantity, there is little chance for disease to find a foothold; but once let the normal life be disturbed, and the importance of the food taken rises rapidly.

The *therapeutic value of food* it is hardly possible to estimate. It is often the one determining factor in the question of recovery — more often than one likes to think in view of the ignorance and carelessness so often seen in feeding the sick.

Still more in sickness than in health, food should be such that it furnishes sufficient nourishment, but not more than can be *assimilated* by a system weakened by disease.

A knowledge of the right proportions of the essential food substances, and of the absolute quantity or food value of the food given to the very sick, is necessary to the physician, if not to the nurse. How many a life has been lost because of a lack of this knowledge the world will never know.

Therefore, we believe that when medical schools teach so thoroughly the principles of physiological chemistry and of the science of nutrition, already well known, that the physician becomes perfectly conversant with the food values of the different articles of food which he prescribes, and with the appearance they present when they are properly prepared, then the percentage of recovery will be largely increased.

At present there are comparatively few persons who are called upon to feed the sick to whom a glass of milk or a pound of beef represent any definite amount of food materials. Still fewer who can tell how much food-value a glass of lemon jelly or wine whey represents, and yet the adult patient is dependent upon the attendant even more than the week-old infant for the requisite nutrition.

The time is surely ripe for some definite experiments in this line, and as it is so often the first step that costs, the first plunge that gives the cold chill of disenchantment or disappointment, I venture to make the next step, that of criticism, easier, and have given in the following tables some suggestive combinations, in the hope that some one favorably situated and philosophically inclined may carry on the investigation.

From the experiments made by the best investigators, it seems probable that only about one-third of the daily ration is available for kinetic force; that is, that only about one-third of the total energy contained in the daily food can be utilized in digging trenches, carrying bricks, climbing mountains, designing bridges, or writing poems and essays.

The other two-thirds is used up in the internal work of the body, the action of the heart, lungs, and the production of the large amount of heat necessary to life.

If this is the case, then we may make out a life ration, or that amount of food which is necessary in order to keep the human machine in existence without any special accomplishment of either body or mind, and a work ration which includes the amount of food required by the human machine in order to produce results either physical or mental.

For this climate, and for the habits of our people, I have estimated this life ration as approximately:

Proteid.	Fat.	Carbohydrate.	Calories.
75 grams.	40 grams.	325 grams.	2,000

And the maximum and minimum work ration as:

Proteid.	Fat.	Carbohydrate.	Calories.
125 grams.	125 grams.	450 grams.	3,500
110 "	90 "	420 "	3,000

An examination of the actual dietaries of some of the very poor who eat just enough to live, without doing any work, shows that in twelve cases the average was:

Proteid.	Fat.	Carbohydrate.	Calories.
81 grams.	88 grams.	272 grams.	2,257

The forty-eight grams of fat would thus seem to be the chief source of the little energy these people showed. However far out we may be in this calculation, it will serve its purpose as a working hypothesis to enable us to determine the true standard. Taking this as a basis, I have made out the following tables of some dietaries for the sick, that is, for the generality of cases where no very wide departure from normal diet is required, only where a lessened quantity and a liquid form is indicated.

These tables show how difficult it is to secure sufficient food in a liquid form, and how important it is to turn some of our scientific study in this direction.

The full allowance of three quarts in twenty-four hours must be taken of nearly any sort of liquid food, and no one kind is sufficient in itself, so that a variety is required.

For instance, three quarts of milk would give

Proteid.	Fat.	Carbohydrate.	Calories.
102 grams.	108 grams.	132 grams.	1,953

which is about the right amount of calories, but far too much fat and too little carbohydrate according to most authorities.

It would be necessary to use skimmed milk, and the danger of partial decomposition or deterioration of the milk while waiting for the cream to rise is a serious objection to general use unless milk from the centrifugal separator can be had. On the other hand, if three quarts of beef broth or consommé were given, the patient would have only —

Proteid.	Fat.	Carbohydrate.	Calories.
123 grams.	3 grams.	. . .	532

This would furnish too little fat and no carbohydrate, and only about one-fourth of the total amount of heat necessary. The soup as made at the Munich Hospital is much better, as it contains —

Proteid.	Fat.	Carbohydrate.	Calories.
21.6 grams.	21.6 grams.	108 grams.	730

One pound of lean steak and three-quarters of a pound of rice (weighed uncooked) yield the full life ration.

To illustrate how little these points are appreciated we have only to turn to one of the best of invalid cookery books just published, and find that the rations which are given as guides to nurses, when the physician has left the food to their judgment, prove far too low. For instance:

Proteid.	Fat.	Carbohydrate.	Calories.
24.5 grams.	28.5 grams.	65.6 grams.	631
66.5 "	23.5 "	83.5 "	831

These are only one-half, or even one-third enough, according to theory, and the amount of liquid is also below the standard.

I was pleased to find in an article by Dr. W. Prausnitz, on the food of German hospitals, calculations giving results not very different from those arrived at by myself.[1] He gives as the standard:

	Proteid.	Fat.	Carbohydrate.	Calories.
For a man,	110 grams.	50 grams.	350 to 400 grams.	2,350
For a woman,	100 "	50 "	300 to 350 "	2,100

The following tables will serve as a summary of the points which I have attempted to illustrate. It is to be remarked that food prepared for the very sick should be nearly all digestible, while that for the well person contains at least 10 per cent. and more frequently 15 per cent. of indigestible material.

[1] Ueber die Kost in Krankenhäusern mit besonderer Berücksichtigung der Münchener Verhältnisse. Von Dr. W. Prausnitz, Deutsche Vierteljahrschrift fur öffentliche Gesundheitspflege 1893. Band 25. Seite 563.

ESTIMATED LIFE RATION.

	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
For one day	75	40	325	2,000

ESTIMATED WORK RATION, MAXIMUM AND MINIMUM.

	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
For one day	125	125	450	3,500
	110	90	420	3,000

A COMMON INVALID RATION, TOO LOW IN CARBOHYDRATES.

	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
1 pint beef juice, containing 7 per cent.	31.5	. . . . . .	. . . . . .	129
1 pint whole milk	17	18	22	325.5
1 quart flour gruel made with whole milk	18.2	18.2	38	397.9
2 quarts of liquid. Total,	66.7	36.2	60	852.4

AN IDEAL RATION WITH SOLID FOOD.

Material.	Amount.		Proteid.		Fat.		Carbohydrates.		Calories.
	Grams.	Ounces.	Grams.	Ounces.	Grams.	Ounces.	Grams.	Ounces.	
Bread	453.6	16	31.75	1.12	2.26	0.08	257.28	9.04	1,206.82
Meat	226.8	8	34.02	1.20	11.34	0.40	. . .	. . .	243.72
Oysters	226.8	8	12.52	0.44	2.04	0.07	. . .	. . .	70.01
Breakfast Cocoa . .	28.3	1	6.60	0.23	7.50	0.26	9.60	0.34	135.42
Milk	113.4	4	3.63	0.13	4.42	0.16	4.88	0.17	75.55
Broth	453.6	16	18.14	0.64	18.14	0.64	90.72	3.20	613.21
Sugar	28.3	1	. . .	. . .	. . .	. . .	27.36	0.96	112.17
Butter	14.17	½	0.14	. . .	12.27	. . .	. . .	. . .	118.62
Total	. . .	. . .	106.80	. . .	57.97	. . .	389.84	. . .	2,574.60

A COMMON INVALID RATION, TOO LOW IN PROTEID.

	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
1 pint beef broth or consommé .	20.5	0.5	. . . . . .	88.7
1 pint dried fruit soup	. . . . . .	. . . . . .	50	205
1 pint lemon whey	. . . . . .	21.5	79	521.7
1 pint Imperial Granum, containing 3 ounces	6.8	0.4	64	294.0
2 quarts of liquid. Total,	27.3	22.4	193	1,109.4

A RATION RICH IN PROTEID — AFTER ACUTE DISEASE.

MATERIAL.	Amount, grams.	Am't, ounces.	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
Bread	453.6	16	31.75	2.26	257.28	1205.81
Meat	453.6	16	64.04	22.68	. . . . .	487.62
Milk without cream .	453.6	16	29.02	18.00	39.00	444.48
Coffee or tea with cream	453.6	16	4.60	3.25	1.14	53.43
Butter	14.17	½	0.14	12.27	. . . . .	118.62
Sugar	56.7	2	. . . . .	. . . . .	54.72	224.35
. . . .	. . . .	. . . .	129.55	58.46	352.14	2,746.12
Less 10% for indigestibility	. . . . . .	. . . .	12.95	5.84	35.21	274.61
Total	. . . . . .	. . . .	116.60	52.62	316.93	2,534.31

AN IDEAL RATION OF LIQUID FOOD.

Material.	Amount.	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
Beef broth or consommé .	1 pint	20.5	0.5	. . . . .	88.70
To which has been added one large egg, minus shell	2 oz.	7.1	6.8	. . . . .	91.67
Dried fruit soup	1 quart	. . . . .	. . . . .	100.	410.00
Lemon jelly	½ pint	6.5	. . . . .	12.5	77.90
Whole milk	1 quart	34.0	36.0	44.0	651.00
Rice or arrowroot	3 oz. (dry)	6.3	0.3	67.2	304.11
Grape sugar, or Some one of the prepared foods (dry)	4 oz. (dry)	2.5	. . . . .	100.0	420.25
Total	2.5 quarts to 3.0 quarts, according to how the rice is given.	76.9	43.6	323.7	2,043.63

A WORK RATION FOR A PROFESSIONAL OR LITERARY MAN.

	Ounces.	Proteid, grams.	Fat, grams.	Carbo-hydrates, grams.	Calories.
Bread	16	32.	3.	258.	1,216.6
Meat	16	50.	30.	. . . . .	481.0
Butter	1	. . . . .	25.	. . . . .	230.0
Sugar	4	. . . . .	. . . . .	110.	451.0
Milk	8	18.	18.	22.	329.6
Oysters	4	7.	1.	. . . . .	37.8
Soup	4	4.	3.	. . . . .	44.0
Potatoes	6	3.	. . . . .	38.	168.1
Eggs	3	10.	9.	. . . . .	123.8
Oatmeal	2	1.	0.5	4.	25.1
Cream	1	1.5	6.5	1.	70.1
Fruit	8	0.5	. . . . .	50.	207.1
Additional liquid, tea, coffee, or water	30				
Total	. . . . .	127.0	96.0	483.	3,384.2

THE RUMFORD KITCHEN LEAFLETS.

No. 15.

SOME SUGGESTIONS ABOUT NOURISHMENT IN ACUTE DISEASE.

By Francis H. Williams.

Abstract of a paper read before the Massachusetts Medical Society, June 10, 1891. Revised by the author for the Rumford Kitchen.

There are few questions in the treatment of disease which have to be decided so often during the daily routine of practice as those which concern the proper support and nourishment of the patient; and, further, there are not many things connected with the care of patients which are so difficult.

It is not easy to find a person competent to prepare suitable food; it is, therefore, the more incumbent upon the physician to be able to give proper directions as to its preparation.

The chief thing is to take pains, and those who can do this are rare people, whether physicians, relatives, or nurses. This is why less is accomplished than there should be in the support of the sick. If we wish to succeed in avoiding nausea, vomiting, and loss of strength and even loss of life, we must learn to offer nourishment to our patients in a suitable form.

Let me recall to your minds a few of the principles to be kept in view in feeding patients acutely ill.

Foods may be classified as follows:

1. Water.	4. Sugars (fruits).
2. Salts.	5. Starches.
3. Fats.	6. Albuminoids.

The classes of foods known as starches and albuminoids are the ones which require the most care to offer to a patient in a proper form.

Water is of prime importance. Consider for a moment the composition of the body of a man weighing 154 pounds. He is 108 pounds, or about two-thirds, water.

It does not follow from this that we need give every patient several pints of water a day; by no means, but it is fair to infer that water, of a suitable temperature, should not be denied the sick, and that patients too young, too delirious, or too ill to ask, should not be neglected in this regard. The physician should see to it that water is offered the thirsty economy in all cases, nature demanding it though the patient makes no request. The amount depends on the character of the diet and the disease.

Salts are present in small proportion in most foods, and are essential constituents of our diet.

Fats as a rule are not tolerated by patients acutely ill, and their use should be limited to such forms as are finely divided, as in milk or yolk of egg (and even in milk it may be necessary to reduce the amount of fat by skimming off the cream).

Common sugar must be changed into grape sugar before it is assimilated.

Grape sugar and maltose are very soluble and easily absorbed, and for this reason seem a very desirable form in which to give nourishment.

Fruits are refreshing and valuable to give variety to the diet and to contribute water, which they contain in large proportion. Most fruits contain 85 to 90 odd per cent. of water, some sugar, and the citrates, malates, and tartrates of potassium. Other fruits, such as grapes and bananas, contain sugar in considerable proportion, to 15 per cent., and their value as foods is not to be despised; bananas contain starch also.

Among dried fruits, dates and figs contain 60 per cent. of sugar and 6 per cent. of albuminoids.

The value of certain fruits for persons who are predisposed to uric acid, gravel, and concretions in the bladder I shall not discuss here, though it is well worthy of attention.

Though we take foods into the stomach in the solid form, it is necessary that they be made soluble before they can be assimilated. The classes of foods which we have thus far considered are readily absorbed; namely, water, salts, fats, and sugars; they are all liquid or readily soluble substances. In the remaining classes, starches and albuminoids, we have foods with which there are several steps to be gone through before they can be taken up by the system.

With all starchy foods, like grains, potatoes, and rice, it is necessary to break the starch granules by heating or to change them by fermentation, and before the starch can be absorbed it must be converted into a soluble substance, such as dextrine, which is the same in composition as starch, or into starch sugar or maltose. Starches, therefore, are not absorbed as such, but must first be rendered soluble.

Uncooked starches vary very much in the rapidity with which they may be converted into sugar by the action of the saliva. After thorough cooking, all starches require nearly the same time. It is, therefore, important to have starchy food well cooked before it is given to patients.

As regards *albuminoids*. Wholly without albuminoids, unless the disease is of short duration, the patient cannot exist. Since they are imperatively needed, they should not be omitted from the diet, even where digestion fails almost completely.

Albuminoids are complex in composition and decompose readily, and in their preparation more care is required than with any other kind of food. To avoid decomposition, they should always be fresh; and to prevent losing the albuminoids by coagulation, they should not be heated to too high a point.

To prepare meat foods properly, two things must be borne in mind: 1st. The albuminoids of meat coagulate when heated to boiling. 2d. To obtain a good flavor, the meat must be subjected to a temperature much above the coagulating point of albumen. It is, therefore, necessary to resort to two procedures, one which has for its object to extract the flavor, the other to extract the albuminoids without coagulating them.

If we treat meat with boiling water, we get beef-tea, which contains only a small percentage of solids and almost no albuminoids. This applies to all clear boiled beef-tea. This liquid is of service in two ways: its taste and odor are agreeable, and together with the heat of the hot water, which acts as a stimulant, it makes a valuable article for use in the sick-room, — not as a food, but as a flavoring.

Some of the extracts of meat made with hot water may be used instead of ordinary beef-tea, thus saving much time. Liebig's and other extracts of beef contain no fats or albumen and a little gelatine. It is desirable to use only a small amount of extract, say one-third of a teaspoonful to a teacupful of hot water, as too much gives an unpleasant flavor.

Now as regards the juices of meat which contain albuminoids in solution.

From raw meat one cannot obtain as much juice as is easily expressed from the same amount of meat which has been previously heated. The reason is this: the envelope enclosing the muscular tissue is a tough substance, which swells and dissolves when heated, yielding gelatine, and thus after broiling, the liquid portions of a steak flow out readily. A steak when well broiled swells; if it is cooked too long, the albuminoids coagulate, it loses moisture, shrinks, and becomes tough.

A slightly broiled steak may be cut into square pieces and the juice extracted by a press or by squeezing or twisting in a piece of cotton cloth.

In administering beef juice, great care should be exercised to avoid heating it above 136 degrees F., at which point its albumen coagulates in flakes.

Beef juice, though fourteen times as rich in albuminoids as beef-tea, is so raw in flavor that it is rejected by many palates. To overcome this objection, it is only necessary to add a proper quantity of any solid extract of beef of good flavor to make it delicious, — about the size of an almond to an ounce of beef juice. Thus by a union of two bodies, one rich in albuminoids and the other rich in flavor, we get something that is superior to either.

Beef juice is an excellent article of diet where solid food cannot be given. A pound of meat yields about four ounces of juice; it therefore costs about five cents an ounce. It is somewhat troublesome to prepare, and should not be kept long.

Soluble albumen, such as is contained in expressed meat juice, is absorbed in the rectum to nearly the same extent as complete peptones. Albuminoids in solution are not precipitated in the stomach and afterwards dissolved, except in the instance of casein of milk, which, as already said, is first coagulated and then dissolved.

Being accustomed to prescribe meat juice, I was much pleased to find on sale a preparation of it manufactured by a well-known firm. I hoped in this to realize all the advantages of beef juice, without its inconveniences. An analysis of this preparation which was made for me was disappointing, as it was found to contain only one-third of one per cent. of albuminoids, compared with 7 per cent. in beef juice; it had also more salt than is desirable, — 12½ per cent. This is mentioned to illustrate the advantage of using foods which are prepared at home, in preference to those made by manufacturers, of which the composition must be taken on trust. This preparation costs thirty-five cents per ounce, though it is only one-twentieth as rich in albuminoids as beef juice costing about five cents.

If one cannot conveniently get albuminoids from meat, a very nutritious broth may be made by means of hot water into which an egg has been stirred. To do this we may heat three ounces of water to not above 149 degrees F., and stir into it a raw egg. The liquid is milky if we use the yolk; clear if only the white is used. It has little taste, which is an advantage with many patients, or it may be flavored with beef extract.

Liquid at a temperature of 149 degrees is apt to burn the tongue. 140 degrees F. is as hot as one can drink a liquid, and 122 degrees F. is a very comfortable temperature for a hot drink.

When these experiments were begun, it was feared that a temperature sufficient to coagulate albumen might be so low as to be lukewarm; but a few tests showed that any temperature which can be borne in the mouth will not coagulate albumen (though these two temperatures differ by only a few degrees).

It is interesting to compare the composition of four liquids containing albuminoid constituents:

Beef tea,	Beef juice,	Raw egg with 3 ℥ water,	Milk,
about ½%.	about 7%.	about 5% alb.	4% alb.
		6% fats.	4% fats.
			4% sugar.

In all of these we get a good proportion of salts.

It may happen that the digestive organs cannot tolerate eggs, or raw milk. But by means of powders which contain pancreatic ferments — such as Fairchild's peptonizing powders — milk may have its albumen converted into diffusible albuminoids or peptones. In the ordinary process of peptonizing milk, both of these bodies are formed, but the proportion of peptones is small.

Meat albuminoids are converted by the stomach into bodies which are soluble or diffusible, and these substances when artificially produced have been regarded as calculated to render great service in invalid feeding.

It is known that an increased secretion of urea appears after the administration of peptones, just as it does after the ingestion of unaltered albumen, and that the chemical composition of peptones differs little from that of ordinary albuminous bodies. They have the manifest advantage of being easily and immediately absorbed. Peptones, so far as we yet know, may be used during short periods of extreme exhaustion, when perhaps few other albuminoids could be assimilated.

Many preparations have been offered for sale which purport to be peptones, but which really contain only a small amount of them. Many such preparations are soluble in water, but have a very disagreeable odor and unpleasant taste.

So much in outline for the various classes of foods. Let me now direct your attention to a few suggestive points about the feeding of patients.

Since acute disease is accompanied by fever, we must consider the effect of feeding in cases where the temperature is febrile in character; also, the amount of food, its quality and quantity, together with other conditions affecting its absorption.

In acute disease accompanied by fever, what are the conditions? The body loses weight, urea especially is increased, and carbonic acid and water are excreted in larger amount than in health. All of this loss is not dangerous if allowed to go on for a few days only, and if the amount does not exceed certain limits.

But to replace these losses, we are at a disadvantage as regards the ability of the system to assimilate food. In fevers, the appetite is small, or may be completely lost. The saliva, the gastric juice, the pancreatic fluid, the bile, are less efficient in action or are diminished in amount during high temperature. The stomach is very sensitive, in part perhaps through sympathy with the increased sensitiveness of the nervous system as a whole.

If there is much hyperæsthesia of the digestive tract, as in typhoid, in peritonitis, in dysentery or gastro-enteritis, one must be careful not to give too much food, and it should be in liquid form, and partly predigested.

It is not, however, the administration of food, but the administration of unsuitable food that we have to fear, and also the giving of nourishment in quantities and at times unsuited to the digestive powers of the patient.

One should not give the patient what he cannot digest, nor should we give him less than he can assimilate. The attendant must have a constant watch over the condition of the patient's powers of digestion, and carefully adapt his food to his capabilities, especially during convalescence.

Our attention should be devoted not only to what is put into the alimentary canal, but also to what goes out. For example, if curds of undigested milk are found in the stools of a typhoid patient, the quantity of milk should be diminished, or it should be diluted.

Every careful observer of the sick will agree that many patients are starved in the midst of plenty, simply from the want of attention to the ways which alone make it possible for them to take food.

For example, if the patient has a fever with remissions or intermissions, it is of the first importance to remember that the ability to digest food at these times is greater, and the more nourishing portions of the diet should be given during the remissions and intermissions.

The physician should never lose sight of the patient's likes and dislikes; one cannot diet a patient from a book, or from the chemical composition of foods. On the other hand, it is incumbent upon the physician to know how to choose such a variety in diet as to include both what is palatable and what will afford a proper amount of nourishment.

It has been one of the aims of this paper to show that the preparation of some valuable foods is entirely in our own hands, and that we need not be dependent upon manufactured preparations, of whose composition we are often ignorant; and further to emphasize many details concerning the nourishment of patients, which, though well known and often repeated, are also too often overlooked.

Among other authors, I am indebted to Munk & Uffelman, to Bunge's Physiological Chemistry, and to the recent books on Food by Church and by Yeo, and especially to Mrs. Richards, instructor in Sanitary Chemistry in the Massachusetts Institute of Technology, who kindly made the analyses of beef juice.

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THE RUMFORD KITCHEN LEAFLETS.

No. 16.

GOOD FOOD FOR LITTLE MONEY.

By Ellen H. Richards.

The question is often asked, "What shall I buy as food for my family which will give them the best nutrition, that is, the best health?" Another question is often added, "How much must I spend for this food?"

It is very easy to answer both these questions *theoretically*. From careful investigations made in different parts of this country it has been found that anywhere in America within reach of the railroads sufficient flour, cereals, beans, pork, or bacon, with a modicum of vegetables in season, and fresh meat at least twice a week, if taken from the cuts less in demand, may be had for from 7 to 10 cents per person daily. With less care and knowledge, 12 to 15 cents will give good and sufficient food.

But to answer the questions *practically* is a different matter, for the method of cooking these staple articles, and, more, the methods of combining and flavoring them, are of more importance than either kind or cost. We may set these wholesome and nutritious dishes before our family, but "all the king's horses and all the king's men" cannot get them down their throats if, for any reason, they have acquired a taste for the more highly flavored, the imported, or the hot-house products. The lavish display of fruits and vegetables, often out of season, in our markets and on our restaurant tables, is as surely a temptation to intemperance in eating as the array of bottles in a liquor saloon is a temptation to indulgence in drinking.

A higher rule of life than the mere gratification of taste, regardless of health and pocket, must prevail if either temptation is to be resisted. Therefore it is useless to begin reform in the food of such as regard the pleasure of the moment above the good dimly seen in the future. Only by appeal to the higher impulses, and by an education which shall form wise habits from childhood up, can any considerable reform be effected.

Good food means to the average person that to which he was accustomed in his childhood. All else is an acquired taste. To the Yankee returning from Europe, baked beans and brown bread are as fully relished as is the rye bread and goat's-milk cheese by the Swede returning to his native land, or rice and ducks' livers by the Chinese. We all consider that food good which we like to eat — that which looks attractive and which pleases our palate for the time, while we ignore in the most ostrich-like way the consequences of such eating, as if we had no further concern with food when once it has passed the palate, or as if we considered food as a means of pleasure only.

Not until we believe with the positiveness of a creed that health is desirable above all else, and that food has more to do with health than has any other one thing, shall we be willing to restrict ourselves to what is *good for us*, believing also that only that is good for us which enables the human machine to work to its fullest capacity without friction or breakdown.

The human body lives, moves, and works and so wears out and needs repair, but it cannot be taken off and sent to the dressmaker as are our clothes, nor can it be sent to the repair shop like an old locomotive. It must do its own repairing while its activities are still going on. It is a machine, but it is more; it is a living, growing, working machine.

Only those who have an ideal before them, and desire intensely to accomplish what they cannot accomplish unless this human machine is in perfect working order, will give the necessary time and thought to its proper care.

The pity of it is that so often the realization of what we want to do comes only after the machine has been so injured by careless usage as to be forever crippled; hence, the necessity of training children from the first to like what is good for them.

Good food for man is such material as can be converted within the body into such compounds as the human body can use, first, for keeping itself warm enough to live; second, for repair of daily waste, and in children for growth; and, lastly, for the production of surplus energy to be used in walking, thinking, sewing, digging, and breathing. In other words, good food for man is that which makes blood and bone, muscle and brain, and gives power to work and think and play.

Coal is not good food for man, although excellent for the furnace and locomotive. Saltpetre, rich in the nitrogen essential to life, is not food for man, although grass and corn grow luxuriantly when enriched by it. Hay and fodder corn do not furnish man the food he needs, but cows thrive upon them.

Starch, found in cereals, in rice and potatoes, contains only half as much carbon as coal, and yet, when cooked and eaten in any of these forms, furnishes man with power just as truly as coal feeds the locomotive.

Man eats the flesh of the cow which fed on the grass and corn which grew by aid of the saltpetre. Mineral substances from the air, water, and soil are food for plants; plants are food for animals; man, being an animal, finds his food in certain parts of plants, in fruits, in nuts, and in the flesh of other animals.

Since milk is the food of all young mammals, its composition may be our guide as to the right *proportion* of food materials. It is approximately 87 per cent. water, 5 per cent. sugar, 4 per cent. fat, 3.5 per cent. nitrogenous substances, .5 per cent. mineral salts. That is, nearly three times as much fat and sugar as of casein or nitrogenous substances. The fat and sugar together are nearly three times as much as the weight of the casein or nitrogenous substances. As the young animal grows older, starch in rice, flour, and oatmeal takes the place of the sugar of milk; and the gluten of wheat, the legumen of beans, albumen of eggs, and meat, take the place of the casein or curd of milk. An almost infinite variety of substances, products of the plant and animal world, is offered upon which man can live.

We must begin, however, to count the cost, since most of us wish to spend money for that which is not meat, and are willing to take a little pains and care to get that which we want very much.

This is the secret of the thrifty German housewife, whose food is nearly always well proportioned both to the income and to the needs of her family. For her it goes without saying that the boy must have his trade and money to start in it; the girl, her dowry; and the whole family set great store by music and the little treats on holidays. She therefore cheerfully practises in her marketing the daily economies which alone make this fuller life possible, and the family is not only far happier, but also in better health than would be the case if they had been treated to goodies instead of concerts.

How shall we economize and yet have good food? It is a false notion that *cheap* food is *poor* food. Wheat and oats, barley and corn grow in sunshine, fanned and watered by wind and rain, with a little of man's labor in sowing and reaping; therefore, while they furnish all the elements of good food for man, they cost little money. Whatever means labor and time and risk, costs proportionally more. Oats and corn will keep indefinitely; fruit and meat must be eaten at once, and hence are dear foods if they are carried any distance and kept any time. Who has not thrown away three-fourths of a barrel of apples bought cheaply and mourned at the dearness of the remaining fourth?

These chief reasons for the relative cost of food materials cannot be too strongly emphasized, since it is not the intrinsic value of the substance used as food for the human body but considerations quite outside which determine the money cost.

Strawberries must be picked berry by berry and packed carefully, while with the best of care and the quickest of trains a large proportion of the fruit spoils.

Bananas can be picked in bunches of 100 pounds, brought long distances, and kept many days. Wheat flour is cheaper than potatoes because nearly all the labor of raising and transferring it is now done on a large scale by machinery, so that 2.5 cents a pound is an average price.

Potatoes are ¾ water and are a cheap food only when they are less than 1 cent a pound about — 40 cents a bushel.

In the case of meat, the animal not only has fed on the vegetables, oats, and corn which man might have eaten, or on grass from land on which food for man might have grown, but it has also taken the time of man to feed and build barns for shelter. (Texas meat is cheaper because the cattle range the plains uncared for.) Moreover, only certain portions of the animal are used for food. An ox weighs alive about 1,300 pounds. About one-third of this is blood, hide, horns, hoofs, entrails; another third is edible meat nearly free from bone; while the other third is edible meat with bone and tendon. The six or seven hundred pounds of good edible meat must, therefore, sell for enough to pay for the ox and the labor of preparing the meat; the loss by spoiling being offset by the price the refuse will bring when sold for various purposes.

There is more nutritive value in eggs at fifteen cents or less per pound than in meat at even five cents a pound. Beef, too, must be less than five cents per pound to compare in food value with flour, oatmeal, or cornmeal, or with beans or peas.

However, it is not enough to set cornmeal and beans, shin bone or neck before the family; the cook must prepare these simple viands so that they will be appetizing as well as wholesome. If one combination does not suit, try another. For instance, many families will eat pea soup with relish when a little tomato is added, or oatmeal cooked with baked apples or stewed prunes. Cornmeal, rice, and hominy acquire a good flavor when they are cooked in meat broth, with a soup bone or chicken bones; beans and peas may be cooked with a ham bone or a little pork. The New England baked beans have a little molasses added as well as the pork. A small quantity of the flavoring substances, while it adds little to the nourishment, goes a long way toward making these good foods of low cost tasty and attractive.

There seems to be no other way of preparing the cereals so cheaply and appetizingly as in some form of bread, and no other food admits of so many combinations, — bread and cheese, bread and ham, bread and eggs, bread and sausage.

The art of the cook consists in making a little of that which costs much money go a long way in flavoring much really better food which otherwise may be rather tasteless. The good cook will not allow her children to answer, as one little boy did when asked what nutritious food was, "something to eat what hain't got no taste to it."

GOOD FOOD FOR LITTLE MONEY.

Oats, peas, beans, and barley grow,
Wheat and corn and rice for you,
Meat that's cheap, and eggs when low;
Milk with cream, without it too;
Wholesome cabbage, and greens, a few
To cook in the pot with the simmering stew;
And Erin's tuber, in seasons good,
When the price is low for this starchy food.

These are things that first we buy
When the purse is low but courage high.
We do our work with muscles firm,
And bide the day till the tide shall turn,
But chops and roasts are not for us,
Nor eggs in winter; nor fruit the first
Of the seasons' gift; and small our share
Of that which rewards the gardener's care.

M. H. A.

The following tables may help in the application of the preceding principle:

Table I.

FOOD SUBSTANCES RICH IN

Nitrogen.	*Starch.*	*Fat.*	*Sugars.*	*Salts, Acids, Flavors.*
Cheese,	Rice,	Cheese,	Molasses,	Vegetables,
Beans,	Wheat,	Meats,	Syrups,	Fruits,
Peas,	Corn,	Eggs,	Preserves,	Green Relishes,
Eggs,	Oats,	Milk,	Fruits.	Condiments.
Meats,	Barley,	Corn,		
Milk.	Rye,	Oats,		
	Beans,	Wheat,		
	Peas,	Rye,		
	Potatoes.	Barley.		

Table II.

FOOD MATERIALS IN RELATION TO COST.

For 5 to 15 cents per person, daily, the food may be chosen from	*For 15 to 30 cents per person, daily, the food may be chosen from*	*For 30 to 100 cents per person, daily, the food may be chosen from*
Potatoes,	Beef and Mutton or any meat not over 25 cents per pound,	Choice cuts of Beef, Mutton, or other meats,
Rye Meal,	Wheat Bread (purchased at the baker's),	Chickens,
Corn Meal,	Suet,	Green Vegetables, Garden Stuff, and Vegetables out of season,
Wheat Flour,	Butter,	Preserves,
Barley,	Whole Milk,	Confections,
Oats,	Cheese,	Cakes,
Peas,	Dried Fruits,	Tea,
Beans,	Cabbage and other vegetables in their season,	Coffee.
Salt Codfish,	Sugar,	
Halibut Nape,	Fish,	
Any meat with little bone, at 5 cents per pound,	Bacon,	
Oleomargarine,	Some Fruits in their season.	
Skimmed Milk.		

THE RUMFORD KITCHEN LEAFLETS.

No. 17.

THE STORY

OF THE

NEW ENGLAND KITCHEN.

PART II.

A STUDY IN SOCIAL ECONOMICS.

PREFACE TO PART I.

THE story of the New England Kitchen, which Mrs. Abel has so charmingly told in the following pages, is remarkable for two things: the new and valuable information which has been acquired, as the result of the daily work of the Kitchen, and the short time which has sufficed to put the enterprise on a business basis.

It is well to emphasize the causes of this success, that the lessons in social science and practical philanthropy be not lost. A large part of the credit is due, as the readers of this report will easily divine, to Mrs. Abel's hard work, as well as to her unusual ability, enthusiasm, and ready tact. So fully has Mrs. Abel been identified with the project from the beginning, that it is not easy to think of its successful issue without her aid. But ability and enthusiasm alone would not have sufficed to work out the problem undertaken in starting the New England Kitchen, which was, namely, an *experiment* to determine the successful conditions of preparing, by scientific methods, from the cheaper food materials, nutritious and palatable dishes, which should find a ready demand at paying prices.

Mrs. Abel would doubtless give as the principal secret of her success, that she had everything necessary for the experiments, without giving a thought to the cost. The work of the investi-

THE NEW ENGLAND KITCHEN, PLEASANT STREET, BOSTON.

gator is not at its best if he has to worry about the ways and means. In the New England Kitchen the selection of the apparatus and material and the employment of labor have been without restriction. Without this freedom to carry on the experiments as seemed wise and prudent, the results detailed in the accompanying report could not have been attained.

The philanthropy of the scheme rests in the experimental stage of the development of the New England Kitchen. Whether the business can in the future take care of itself to the profit of those who conduct it remains to be seen; but, in any event, kitchens of this kind cannot fail to be of great advantage to multitudes in moderate circumstances, who have hitherto been unable to buy good, nutritious, and tasteful cooked food.

For a charity that feeds the hungry there is no lack of the bounty of good people; but it is safe to say that not many could be found who would be willing to give liberally and unrestrictedly to carry on a scientific experiment in the hope of learning how the people might be better fed.

ELLEN H. RICHARDS.

BOSTON, Oct. 1, 1890.

EXTRACT FROM PART I.

REPORT

TO

MRS. QUINCY A. SHAW,

CONCERNING THE FUND USED IN THE

NEW ENGLAND KITCHEN.

By Mary Hinman Abel.

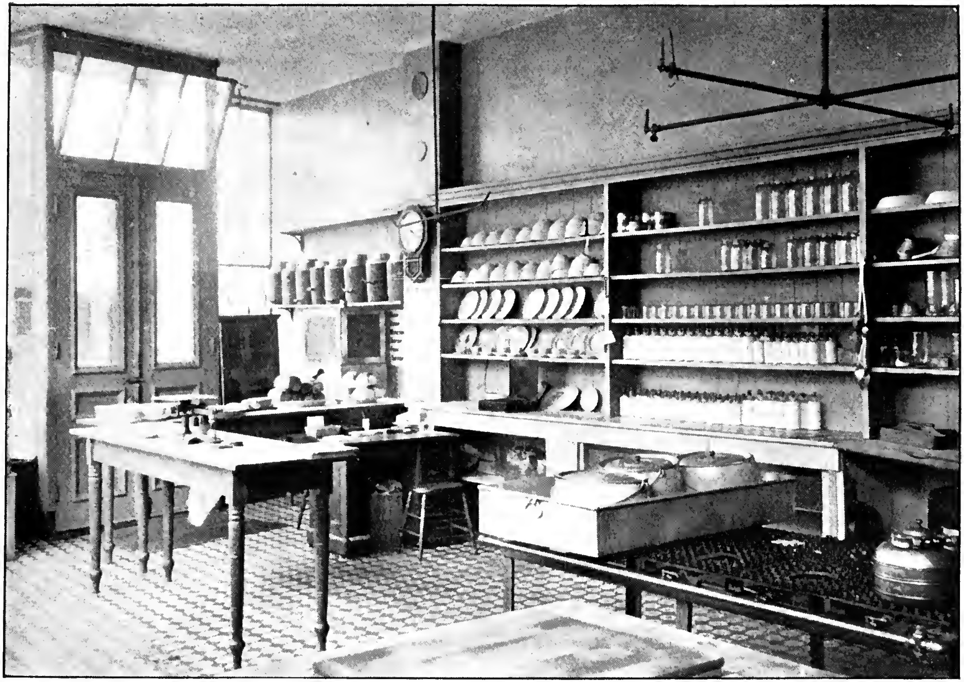
JANUARY 1 TO JULY 1, 1890.

It was understood that this fund was to be used in making an experiment never before, to our knowledge, attempted in this country; namely, in the cooking of our cheapest and most nutritious food materials by better methods than are commonly in use, and to sell the same at moderate prices for consumption at home.

It was also understood that, if possible, an eating-room should be opened, particularly for men, as a rival to the saloon.

Except for this general outline, those who took the fund in charge were left free to work according to their discretion; and it was agreed that the business of the New England Kitchen, between January and July, should be, first of all, the collection of facts as to the actual condition of the food supply of the masses, in order that more effective work for its improvement might be undertaken than was possible in the present fragmentary state of our knowledge; it being certain that much time and money used for charitable objects are often wasted for lack of a sufficient body of facts as a foundation.

We must know how people live, how they cook, and what they buy ready cooked, what peculiar tastes and prejudices they have, in order to lay out any satisfactory plan of reform.



THE NEW ENGLAND KITCHEN, PLEASANT STREET, BOSTON.

PART II.

A STUDY IN SOCIAL ECONOMICS.

THE STORY OF THE NEW ENGLAND KITCHEN. (*Continued.*)

Report to MRS. QUINCY A. SHAW concerning the work from July 1, 1890, to May 1, 1893.

BY MARY HINMAN ABEL.

THE first part of the story, as also the report of the scientific work on which the Kitchen was founded, ended with the expiration of the six months of trial. Success seemed to be in sight, but it was not yet assured. It was still doubtful if the food would prove acceptable for long periods, and if the increased quantities could be made with the same characteristic flavor and quality; nor did we know how far people would be willing to accept new ideas as to food, nor how much trouble they would take to supply themselves with more healthful products. An answer to these questions must be the first step in deciding what should be the future of the Kitchen.

At the end of three years from the starting of the Kitchen, several of these points are settled, and it will perhaps be instructive to state definitely just how far the Kitchen has justified its foundation, how far and in what directions it has succeeded, and in what directions it has failed to accomplish the work which was hoped for it.

First, the standard dishes *can* be made every day alike. Not that they always are, for the Kitchen is not yet beyond the range of "accidents," the household word for carelessness. But it is demonstrated that the food can be prepared with a degree of uniformity far beyond that attained in any ordinary cooking, and that helpers *can* be found who will interest themselves in the success of the work and who will take pride in it.

Second, the standard dishes continue to be as popular as at first, and their cosmopolitan character is demonstrated in the fact that for three seasons a school lunch-room patronized by three hundred daily, has been supplied with the same food that is sold over the counter to the people of Pleasant street. Professors and students alike take these dishes. Smaller schools and groups of working men and women, of various classes, to the number of three or four hundred more, are also supplied from the Kitchen.

The most gratifying testimony, however, comes from the regular customers, who say, when offered a new dish, "I never tasted that, but everything you have here is good and I will try this." This feeling of confidence in the preparations is the best proof that the general standard is kept up. It has been characteristic of the Kitchen that friends once gained are kept.

The beef broth of the first month's trial is still the staple article, and is recognized now by scores of physicians. Invalids send long distances for it, strangers and sojourners in hotels and apartment-houses find in it life and strength, and if ready means of distribution were at hand and telephone connections arranged, the beef broth, together with other broths and beef juice, would make a business by itself.

The evaporated milk adopted in the spring of 1890 is still the only milk used in the Kitchen. It is sold in increasing quantities for the use of children and invalids, and it remains still as we at first announced it, the very best milk obtainable for the price. In not a single case has it been known to disagree with invalid or child to whom it has been given.

A minor point, but still of importance in the smooth running of the Kitchen, is the fact that the tradesmen and dealers have finally discovered that the Kitchen standard for raw material is invariably a high one, and they have ceased to try to foist inferior articles upon us. This saves a great deal of worry.

A more searching question is this: What progress does the Kitchen make in improving the diet of the class that most needs it, the illy nourished poor that fill the tenements of large cities? To this a more qualified answer must be given. The poor of our cities are very largely of foreign birth, and each group of people, whether they be Irish, Scandinavian, North or South German, Russian, or Italian, have brought with them strong national tastes. They like the dishes to which they have been accustomed, and they like no other. And each group is not large enough in any one locality to support a Kitchen of its own kind.

Through the careful study of the actual dietaries of these people now being carried on under the auspices of the College Settlement Association, it is hoped that some light may be thrown on the best way of helping them.

EDUCATIONAL.

The educational part of the work is the most difficult to gauge. It is true of this as of all silent preaching by example; the direct results are hard to trace; but they slowly make the way ready for changes that, when they come, astonish the most sanguine. We know that it is good for people to daily pass and sometimes enter a cleanly, pleasant place where the cooking processes open to their inspection only serve to recommend the food, where their wants are cheerfully met, and where, they hardly know how, they get hints for more healthy living. We have, in fact, found a distinct improvement in the cleanliness of our customers. For the first six months nearly every dish brought for food had to be washed. Now a dirty dish is rarely presented, and then generally with an apology.

We have started a sort of hot-water mission, or rather the people started it by first asking for what we should never have thought to offer, and now the whole neighborhood draws on our supply of hot water, and this means a great deal for health and cleanliness, especially in the summer months.

In November, 1891, a sort of annex to the Kitchen was started in a newly fitted shop across the street.

The first work done was on bread. A Middleby Oven was set up in one end, and Mr. Case's Health Bread, made by a rule to be found on page 84 of "The Science of Nutrition," was turned out as its first product.

Bread, rolls, corn-bread, and buns were added from time to time, each one being the result of a series of carefully conducted experiments.

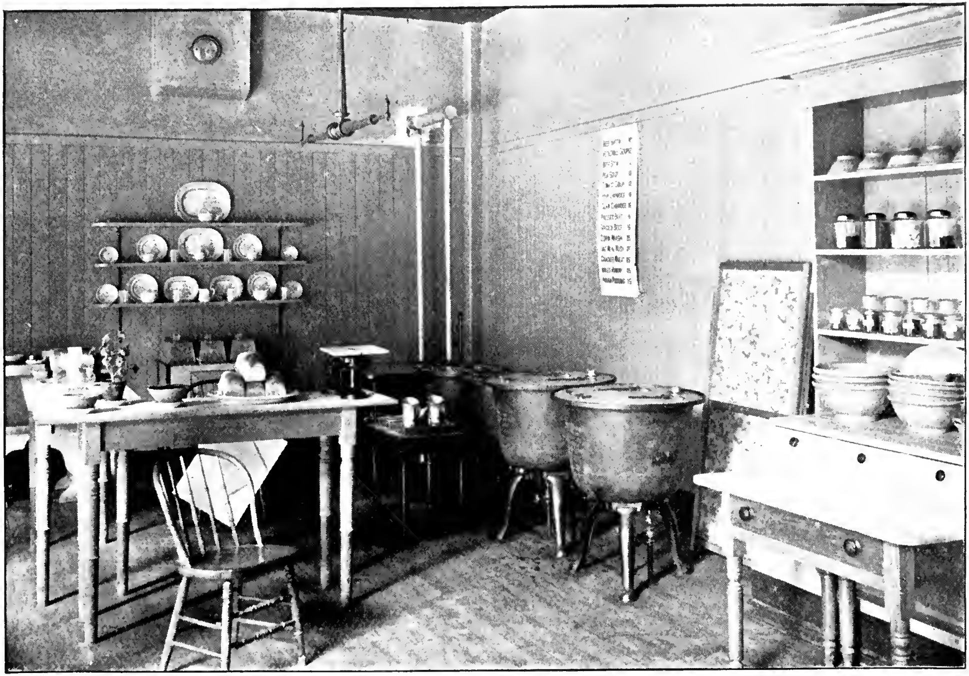
In January, 1892, classes were formed under the charge of Miss Daniell, for the study of economic and sanitary cooking. These lessons were illustrated by the dishes prepared in the Kitchen. During the winter, classes from a medical school, some forty students in all, came for practice in cookery for the sick.

Miss Daniell also gave a course of lectures to the nurses in the Massachusetts General Hospital. The work was continued through the winter of 1892–3, and Miss Daniell gave both courses in New York, under the auspices of the New York Infirmary for Women and Children.

In the spring of 1892 the proposition was made to the Kitchen to furnish the model school-luncheon that should be satisfactory in both taste and nutritive value. The list of foods cooked in the Kitchen was not complete enough to meet this requirement, being only designed to furnish a main dish for the family table. Therefore a skilled cook, willing to work under directions, was employed for a month to experiment on dishes suitable to the purpose. A list giving a continued variety for three weeks was thus filled out, and the luncheon delivered at a cost of fifteen cents.

This we consider one of the crowning successes of the Kitchen.

Other propositions have been made for the delivery of the Kitchen foods on a large scale, showing that its scope is only limited by its ability to fill these requirements.



THE NEW ENGLAND KITCHEN, SALEM STREET, BOSTON.

PARTIAL FAILURES AND THE LESSONS TO BE LEARNED FROM THEM.

What we have said so far applies especially to Pleasant street, where the first Kitchen was started, and where the population is mostly composed of intelligent German and Irish Americans, Nova Scotians, and Americans. A branch was tried among the negroes of the West End, but it failed to gain any foothold.

The Kitchen which was opened in November, 1890, at Salem street, North End, is in the midst of Russians, Portuguese, and Italians, — a population that greatly need the better living the Kitchen could give; a population which does not buy groceries largely, as evinced by the absence of shops; a population that does buy ready-cooked food, as shown by the abundance of pie-stands and bake-shops. The Kitchen was located opposite a popular bakery which it did not attempt to rival, but which it was hoped would contribute customers.

After two and a half years of hard work in the neighborhood, we must face the fact that the sales do not support the place. Those who come, do so regularly, but the number of those who are intelligent enough to appreciate the nature of the food is too few. The location is not central enough for delivery to a large number of schools, and the institutions upon whose support we counted have not responded; it was hoped, for instance, that the day nurseries would have been glad to take the food. The plant, therefore, is to be utilized for other work.

Another side was studied in Olneyville, the manufacturing suburb of Providence, where the factory hands are largely French and Irish. So far this is the most incorrigible of all the communities. One good-natured, affectionate Irish mother, when pressed to take an Indian pudding home to her children, replied, "My boy says, 'Oh! you can't make a Yankee of me that way!'" Here is the difficulty in a nutshell, and all workers should take note of this national feeling. The same thing is met with in our cooking in the public schools. It would be possible, of course, in each locality to study the different national dishes, and then, following their appearance and flavor, to improve their nutrition; but each dish when perfected and approved would find but a limited number of buyers at best, in no case sufficient to support a Kitchen of each particular type. In the mixed nationalities and varied tastes of the inhabitants of our cities is found one great obstacle to the success of an institution like the New England Kitchen. All the people cannot be reached. It is only possible to settle upon certain dishes as nearly standard as may be, and then to bring them within reach of as many people as possible, feeling full confidence that the number will increase.

Another thing learned has been that we must meet the people half way; when pork and pepper are left out of pea soup people will not eat it. No one thing has been so severely criticised as the use of pork in some of the dishes; but the results have justified it. It enters into the food of the common people nearly the world over. They are accustomed to it, and the flavor it gives is appetizing. However the question may stand for the wealthy, it is doubtful if the poor man in this country can get on comfortably without pork.

All this experience led to the following instructions when the Kitchen in New York was opened, and this may be said to embody the plans at present:

REQUIREMENTS FOR A SUCCESSFUL KITCHEN.

1. A locality of wage earners, not of the very poor; the very poor are not those reached, at least in the beginning. If on a thoroughfare, so much the better.

2. A neighborhood of Germans or English, Catholics or Protestants, not of Italians or Jews.

3. While in the midst of wage earners, it should be accessible to a section of apartment-houses, for this will not only help to support it, but the appearance of the well-to-do at the counter beside the others, has an important bearing on the whole problem.

4. The place itself must be light and *well ventilated*, with a northern exposure, if possible, on account of the heat of the summer sun.

5. It must be large enough to permit most of the operations to be carried on in sight of the customers. Cleanliness and thoroughness, as well as economy, should be inculcated rather by means of the eye than of the ear. Indirect teaching is often more potent than rules and maxims.

6. Every part, cellar and all, must be capable of being *perfectly cleansed*. There must be large sinks and plenty of hot water for the large utensils, plenty of water faucets, and large and perfect drains.

7. A cool dry cellar which can be ventilated for the storing of vegetables is desirable, or even necessary unless a great deal of ice is to be used.

8. The outfit should be simple, but sufficient in quantity and of good quality; i.e., no cheap dish-towels which only half dry the dishes. Good work is demanded of the help, and good materials should be given to work with.

9. The help in the Kitchen should be responsible, self-respecting men and women who are *willing to learn new ways, even if they do not see the use of them*, and who, *once taught, can be trusted* to carry out orders. If higher wages must be paid to secure this, it will be found to be made up in economy of superintendence.

10. The standard of the Kitchen products must be maintained. If a careless maid has used a lot of poor fish in the chowder, the whole must be thrown away. The Kitchen cannot afford to sell a quart of an inferior article. It is false to its mission if it practically says, "We have things right *sometimes*." This stand once taken, it will be found that but little is wasted.

11. The dishes must have a high nutritive value; they need not in all cases have *all* the elements of nutrition in the right proportion for a daily ration, for they are to be taken home to eat with other things; but they should, in all cases, approximate the perfect dietary.

12. A "cosmopolitan flavor" must be obtained; that is, the dish must please a large number of people in order to be widely salable. This flavor must be obtained from the food materials themselves as far as possible, and whatever is added should be cooked in the slow process in order that harshness or crudeness of taste may be obviated. People like "tasty" food, and well-flavored food is that which is eaten day after day with appetite.

13. Nothing injurious must be used in any process; neither must the prejudices or whims of a few people be allowed to interfere with the work of the Kitchen.

14. Having the right dishes rightly prepared, there comes the problem of serving them to the greatest number with the greatest benefit, and here the *real work* of the *Kitchen* comes in. *This is* to *teach* the *people to live more wisely*, both as to quality and cost; to accustom them to the taste of good food, so that they shall, after a time, wish to learn how to prepare it in their own homes; to prove to them that the cheapest food well cooked and properly seasoned is really better than more costly material poorly prepared.

15. Above all, let there be no patronizing of the customers. A kindly interest, friendly advice when asked, unobtrusive teaching of higher ideals, should be always in mind. Much can be done with the children of the neighborhood, and in time classes may be formed to teach them, but *not until they are asked for*.

Following these instructions, a Kitchen was opened in New York in December, 1891. New York being a more central place, this Kitchen has been visited by great numbers of men and women, representing work in many sociological lines, and the work and methods of the Kitchen have led to improvements in the food of prisons, schools, hospitals, diet kitchens, and many other institutions. Sanitarians, educators, associated charity workers, and others, have united in admiration of our success and in praise of our methods. From the naval officer who applied his cambric handkerchief to the inside of the coppers to test their cleanliness to the cook trained in her own way to judge of results, nothing but praise is heard of this effort to meet the food requirements of our people according to the light that science now affords. Had testimony been wanting to prove to us that the New England Kitchen is unique, it would now be supplied.

To sum up results, several things uncertain two years ago we may now consider proved:

That food cooked in large quantities can be kept up to a certain standard.

That the food is liked by people of quite different tastes and liked day after day, thus justifying the many experiments that have been made on its composition and flavor. This popularity has, however, important limitations, as we have before said, especially among the poor.

That the educative value of such a Kitchen in any neighborhood, though more difficult to prove, is vouched for by many facts that have come to our knowledge. When the teaching of cooking in the public schools is based on these methods, we shall have a strong hold on the rising generation.

FUTURE OF THE KITCHEN. CAN IT BE MADE SELF-SUPPORTING?

The question now arises, On what basis can such a Kitchen be carried on? Can it be made self-supporting?

The Pleasant-street Kitchen has been self-supporting for about a year. That is, at the end of the first two years the commercial success began to come. Interest on the plant is not yet covered, but improvements, repairs, etc., have been met, and this in spite of the fact that the problem of distribution has not been solved, and a portion of the trade has been diverted to Salem street in the endeavor to put that branch on its feet. Greatly conducive to this result have been the large sales to the lunch-rooms before mentioned. This demand has been steady as well as large, and the cost of delivery being no greater than for a small quantity, the profits have been considerable.

It was found that not until the sales from the Kitchen reached $900 a month could it be said to pay expenses. At $1,500 it is now doing well, with little more expense for service.

During the whole history of the Kitchen the business side has not been made prominent. It has been sought first to ascertain whether the food of the mass of people could be improved by means of such Kitchens. The work has been throughout experimental in character. But the question is now being asked of us from people in other large cities, "How shall we start a Kitchen?" We are able in reply to give directions as to the best location, the proper fittings with cost of the same, and to outline the management that according to our experience will lead to the best results. But by reference to these directions, it will be seen that it is taken for granted that the Kitchen should be a model hygienically, that it should furnish an object lesson in cooking, and that it should be served by persons capable of carrying on the educative work where there is opportunity. The expenses hardest to meet have always been the rent and the service, both of which are necessarily large in order to carry out this present plan. A business whose profits give a thrifty margin beyond its expenses may be able to carry a philanthropic attachment, but the price of the Kitchen foods was meant to cover little more than the cost of production. The profits then are inconsiderable, and the number of articles on which the profit is made is small if compared with any ordinary business.

Whether a restaurant could be profitably run in connection with these Kitchens remains yet undecided, with the evidence largely in favor.

Even before the Kitchen became as well known and esteemed as it now is, business men saw a future for the manufacture and sale of the foods, and offers have been made for the recipes, methods, and "good will" of the Kitchen, but we need no experience to assure us that if the Kitchen was started as a money-making enterprise merely, the quality of the food would soon deteriorate, nor do we believe in separating the sale of food from the educative function of the Kitchen.

The Pleasant-street Kitchen has brought itself to the self-supporting line while paying large rent, and with very few labor-saving appliances.

It would seem that the time had come for a new departure. The Kitchen as an experiment should be discontinued, and on the foundation of facts and experience that it has gathered, there should be started a system of Kitchens operated with all labor-saving appliances. Even in large cities one central station would be at first sufficient, from which food could be sent in large quantities to selling stations; the cost of transportation being small compared with that required for the duplication of steam-boilers and other appliances. The patronage of schools and other large establishments should be sought, and the attention of physicians should be called to the beef broth and other foods.

It seems probable that a restaurant might add the needed factor for success to the small Kitchen. The Berlin *Volks Küche* also started to supply cooked food to be carried away, and it was not until the restaurant was added that its real success began.

But it has not yet seemed feasible for the New England Kitchen to make the experiment on such a scale as would be necessary for reliable conclusions. It would have required a large outlay as to plant, and such a command of trained helpers as has been at no time at our disposal, and moreover the complete list of dishes necessary has only lately been filled out.

Here is a large field. The thing needed now is to establish a stock company with a board of directors, scientific and medical men, and have a delivery system for the choice foods for the sick, and for the bread, having thus a high standard always maintained and a guarantee of the quality; such an enterprise as that in Copenhagen for the supply of pure milk, started by Mr. G. Busck, Consular Report No. 135, December, 1891.

FINANCIAL BASIS OF A FOREIGN KITCHEN.

The way in which a "Volks Küche" (People's Kitchen) in Amsterdam meets its rent may here offer a suggestion. The friends of the movement made a call for a loan of 32,000 gulden, or about $12,800, at 3½ %. It was taken mostly by people interested, though 3½ % is not a bad rate for Holland. With this sum a dilapidated house was bought and refitted, and the apartments on the two upper floors were immediately rented for a sum nearly sufficient to pay the interest and repairs.

In these European soup-kitchens it often happens that all expenses except that of superintendence are met at once. Service costs about one-fourth what it does here. The places chosen are very poor and cheap, and the furniture of the barest description. In our country, people would needs be very hungry to frequent so unattractive a place, but in the large European cities these soup-kitchens are thronged by people who can get there the small list of their familiar dishes better cooked than they could cook them in their own homes. The public kitchen in Europe aims to change no tastes, to teach no lessons, the food of the people in most cases being as wisely chosen as it can be for the money they have to spend.

The German *Volks Küche* and the French *Fourneau Economique*, though furnishing hints that were very useful at the starting of the New England Kitchen, have as their sole aim the furnishing of the identical dishes to which the people are accustomed, at a price low enough for slender purses.

Having carefully studied the business side of the question and the methods that will lead to success, and having established a list of standard dishes sufficient to start such a Kitchen, we should like to consider that part of the subject closed, and proceed to outline the future of the New England Kitchen as an observation and experiment station.

THE KITCHEN AS AN EXPERIMENT STATION.

The use of money for experiment in pure science has long been considered defensible, and our laboratories have a firm place in the educational system. More and more does the practical worker turn to the laboratory expert for the principles that must underlie his work, the dyer goes to the chemist for his colors and his mordants, the builder to the physicist to know the strain his materials will bear. It is a newer claim, and one that will not be so readily granted, that experiment is as much needed to lay the foundations of a wise philanthropy. Such statements as these are commonly met—we quote from a magazine article by a well-known writer: "To be an experimental chemist one needs to have mastered chemistry, but to be a scientific philanthropist no technical course of study is required." But what is a scientific philanthropist? Is the type so well known among us? We have, it is true, made great advancement on the times when the nobleman threw his gold to hungry peasants in the streets; but, on the other hand, modern civilization brings ever graver questions, and we can but feel that the greatest wisdom must guide the hand that is to interfere with the pitiless, but often beneficent law, that ordains the survival of the fittest. To feed the hungry and clothe the naked no longer fills our duty to our fellow-man: it is now no less than to extend indefinitely the knowledge and means of the healthy and happy life. How shall a given sum of money do the most good to a community, is a question that is now often asked, and only our ignorance can make its answer seem easy.

Engineering has been said to be the only real science, for the proof is sure. If the bridge breaks, no argument will convince us that the builder is a master. But many other branches of work are approaching this same certainty of proof, and sociology, using, as it may, the results of all sciences, feels the spirit of the time, and requires that critical examination and proof from evidence which must direct all wise effort. A scientific philanthropist who deserved the name would require more training, both general and technical, than any chemist.

Perhaps the greatest stimulus that modern philanthropy has received has come from that close study of the poor and criminal classes started by the Toynbee Hall Movement in East London. Two distinct lines of work seem to characterize it. First, men and women give to their less fortunate fellow-beings personal influence and sympathy, the only help whose giving enriches both giver and receiver, and interferes with no natural law. Second, a body of fact, a mass of real evidence, is being collected regarding the needs and habits of those who are to be helped. All American followers of this movement have worked more or less in the same spirit, and the Andover Settlement in Boston avows as its first object the study of existing conditions.

It is a part of the New Philanthropy to recognize that the social question is largely a question of the stomach; temperance workers are coming to feel that they cannot make headway if they ignore the importance of proper nutriment to the body, for with monotonous food is apt to go whiskey to whip up the digestion; the Teetotum Club in New York, having established a pleasant room with games as a rival to the saloon, knew that before they opened their doors they must be ready to supply food and drink, and they turned to the New England Kitchen in Hudson street for the food. Mission workers of all kinds are coming to feel that their weak point is in the commissariat. Even with the money in hand, they are unable to command such food as ought to be possible out of the abundant raw material that this country affords. To all these, and many more the work of which the New England Kitchen has been the centre offers reliable and solid help, and more and more this help is appreciated.

The New England Kitchen took up one definite and very practical line of work, — the collection of facts as to the food of the people. What were the food materials used, and what their nutritive value? What were the favorite dishes? Was the food cooked at home or bought ready cooked? What relation does the food question bear to the alcohol question? What was the food of little children whose parents worked and ate elsewhere during the day? What were the causes of the mal-nutrition observed in whole classes, as among sewing-women? The Kitchen Counter has been the vantage-ground from which these observations have been made, and they have been the basis for whatever we have accomplished. These observations cover a wide field, but they are not exhaustive, nor could they be with the time that has been given to them. Could this study be continued with the help of college settlement workers, the associated charities, district nurses, and others, and the results carefully sifted and recorded, an amount of information would soon be at hand which would be of great value to the student of this branch of social science.

A beginning in this line is being made in three large cities: in Hull House, Chicago, where a nearly complete New England Kitchen plant is being set up, and where, under the direction of Miss Addams, the question of reaching the very poor will be solved if it is possible to solve it in this country; in Philadelphia, where two of the workers in the College Settlement have been trained in the New England Kitchen, and are to use this training in work among the negroes of this section; and in Boston, where the head of the Settlement has also had the training of the New England Kitchen, and is in deepest sympathy with all its aims.

THE KITCHEN AS AN EDUCATOR.

Closely allied to this would be the work of the Kitchen as an educator. As it stands, it is meant to be a silent teacher of cleanliness, intelligent methods, and a uniform and good result in cookery. This it is hoped will slowly influence the cooking in the homes by raising the standard as to freshness, flavor, and nutriment of the food.

It would seem that this is the *only way* in which such a change can be effected. People seem to think that what they eat does not matter so long as it tastes good, and until it is clearly understood that it is worth the trouble to secure the best food, people will not take the trouble.

Hence it seems to be shown that the first work of the Kitchen must be based on hygienic grounds, and here, indeed, was the starting-point of the Pleasant-street Kitchen.

It still takes at least a month to introduce a new dish. It requires a great deal of persuasion, and many "tastes," and much learned discussion of food values to get a new kind of food tested. Strange names mean strange tastes, and it is only the true cosmopolitan who willingly takes new fare. We started with the idea that we must find the favorite dishes of the neighborhood, and then cook them better. This has been to a certain extent possible, though, as we have before said, it was not possible to add to our list national dishes for a limited number of foreigners. We began to ask, What are the national dishes of Americans? It is astonishing how few still partake of the simple fare known as New England. It seems to be a part of the restless and hurried life of this generation in large cities to have abandoned the cheap and simple foods that need long cooking and a little skill to make them palatable. This reduces the fare to chops and steaks, and tea with bread and cakes to be picked up at the bake-shop. Are these our national foods? It would almost seem so. Certain it is that home cookery is decreasing in amount and not improving in quality, more and more dependence being placed on the bake-shop and restaurant.

Now what is the result? The wage earner is illy nourished on money that is all-sufficient, if rightly expended, to buy him proper food. This is a serious question, because here there is the chance of more saving than in any other item of living; and what can so easily be saved here can be applied to better shelter, which is a more evident, if not more vital, need.

The studies which have been made within a few years of the food of working communities in Europe show that they have been forced down to a dietary which can hardly be bettered for the money. It is a survival of the fittest, indeed; and in a model paper by Carl Von Rechenberg on the food of the weavers of Zittau, science acknowledges that it can do little more for them while they have so little money to spend. The cooking of the staples is as a rule better done than with us, the better-class cooking is often not so well done, but the wage earners have been forced to learn the most effective and economical ways.

This has been recently brought home to us very forcibly in the comparative costs which we have been collecting for some carefully computed dietaries. It is found that the amount and quality of food which can be bought in America for from ten to twelve cents costs in Europe from eighteen to twenty-three or nearly twice as much; but a study of the statistics so carefully compiled by the United States Labor Bureau shows that our wage earners do not avail themselves of this opportunity of saving on food, but that they revel in the unwonted luxury. This applies equally to the citizen of foreign birth. "Where in the old country do you find a workman that can have meat on his table three times a day?" said one of our German neighbors. For this man American freedom and prosperity had a very limited meaning.

The $200 which a Lowell factory operative spends on food, out of his $360 total income, is largely spent on costly meat, sugar, butter, and fine flour, instead of on well-chosen cuts of meat, peas, beans, and corn meal. He could have secured better nutrition for $100, and have $100 to put into better shelter and a dress for his wife, who had had none since her marriage seven years before.

THE RUMFORD FOOD LABORATORY.

We have, then, three distinct kinds of work for public kitchens: the sale of foods, the gathering of facts regarding the food habits of a community, and the education that may effect a slow elevation of the common standard for healthful and nourishing food.

In addition to this, and calling indeed for a separate establishment and funds, is the work which has now reached such dimensions that we may claim for it the name of the Rumford Food Laboratory.

Beginning with the experiments concerning which report was made in August, 1890, to the trustees of the Elizabeth Thompson Fund, others have been added to the list, notably bread and sick-room cookery, in all cases undertaken only in response to demands that could be no longer ignored. As the food for the sick was our first success pecuniarily, so it was also educationally. The demand came from a training-school for nurses for lectures on the principles of cooking for the sick, and from a medical school for a practice class for students.

This involves a most careful study of the science of nutrition, and only a beginning has been made in this line; but enough has been done to rouse the interest of representative men in the medical profession, and the Kitchen was invited to give an exhibition of its products at a meeting of the Massachusetts Medical Association. It is through coöperation with the medical profession that we hope for wide application of what has been done in cookery for the sick. We should not appeal to them in vain to use the results of our investigations in their private practice and in the hospitals under their charge.

This is not the place to give in detail the plans for the work of a food laboratory. But we must say a word as to the need among all classes of people that such scientific principles as are now known to underlie the choice and preparation of food should take form, should be illustrated and brought to the final test in the cookery of all kinds of foods into dishes savory as well as nutritious, and whose amount and kind of nutrition shall be known.

No one will be more benefited by the results of such an experiment station than the individual housekeeper, she who is now held responsible for every failure in our national cookery. Considering how much else is expected of her in our social system, it is surely not fair to ask her to do anything more than learn to apply what some one else, with the necessary facilities and training, has discovered. She will then be doing as much as does the farmer or manufacturer.

And since it has been recognized that good food is not a matter of simple money, it has been more than surmised that the rich may be starving in the midst of their plenty, or contracting diseases due wholly to food improper in quantity or kind; and there would seem to be a need for a department of public hygiene that should concern itself with food alone,

In all these lines, even that of a public adviser, the New England Kitchen has been able to meet the wants of the people to some extent. To reach its ideal, a fuller equipment is necessary.

Let us consider the requirements for such a work:

First: The superintendence of trained scientists, who shall be able to draw on the stored knowledge of laboratory investigators and to direct original work on new lines.

Second: The assistance of those who are practised in the science of cookery as it is now understood, and who have the intelligence necessary for working out new problems.

Third: Business experience to take the results thus gained and bring them to the use of the general public.

Fourth: The assistance of those who have faith in this means of doing a great good to the public, and who are willing to endow it, or furnish sufficient money for its trial steps.

In conclusion, the managers of the New England Kitchen have no apologies to make for the fact that in three years they have expended a considerable sum of money, and yet great numbers of people in New York and Boston are badly nourished, or that waste and want still walk hand in hand. That a *lever has been planted in the right place* is what we claim, and more will not be expected of us by those who know the slowness with which the habits of any community change, or who see that experimentation must be as costly as it is necessary for the foundation of work that will be truly enduring. We are deeply thankful that we see light on the great problem of how to utilize known scientific facts for the nutrition of the people; and here we rest our cause with the many friends who have helped us and believed in us, certain that in some way the work will go on.

NOTE. — In order that the historical statement may be complete it is necessary to state that the fund for the strictly scientific part of the investigation, "On the Right Application of Heat to Food Materials," was supplied through Mr. Edward Atkinson by a grant from the Elizabeth Thompson Fund, and by contributions from Mr. Carnegie and Mr. Phipps.

For the printing of the reports, as well as for constant advice and suggestion, we are indebted to Miss Ellen F. Mason and Miss Ida Mason. Many other friends have been helpful in a variety of ways.

The New York Kitchen was for several years sustained by Mr. Theodore Havemeyer, under the direction of Dr. Thomas Egleston.

BOSTON, May 1, 1893.

THE RUMFORD KITCHEN LEAFLETS.

No. 18.

PUBLIC KITCHENS IN RELATION TO THE WORKING-MAN AND THE HOUSEWIFE.

By Mary Hinman Abel.

In all times of public calamity, such as war and pestilence, the poor of European cities have had resource to the soup kitchens supported by the state or by private philanthropy. These kitchens have, with few exceptions, been conducted with only ordinary intelligence, and have ceased to exist with the temporary need that called them into being.

But there is a class of permanent self-supporting public kitchens that claim our interest, because the cheaper foods are here prepared according to better knowledge than has yet reached the ordinary home.

The first kitchen of this class was built in 1790, under Count Rumford's direction, in Munich, Bavaria, as a part of the House of Industry. Instead of furnishing here the ordinary food of the country, he undertook to make a soup that should be as palatable and nutritious as possible for a small sum of money. He chose dried peas and barley as the basis, and studied with the exactness of the scientist the action upon them of water at different temperatures, and he gave the nicest attention to the flavor and consistency of the dish. Stoves were constructed with great ingenuity for the economical use of fuel, and as the result of these efforts 1,000 portions of soup in summer and 1,200 in winter were daily cooked and distributed with bread at a cost of one-third of a farthing, English money, per portion. This soup became very popular, and continued to form the main food of those who labored in the House of Industry. Each portion contained, as nearly as can now be estimated, about 19 grams proteid, 2.5 grams fat, 86 grams carbohydrate. Count Rumford's inventions and recipes were used in many later efforts to improve the food of the poor, but no real advance on the foundation that he laid seems to have been made until near our own time.

The *Volks Küche*, of Berlin, was started in 1866. Its original fund of 4,359 thalers (about $3,000) has grown by profits and gifts to 95,000 marks (about $24,000). With the exception that no interest is paid on this fund, nor on several other funds that are used to pay pensions to employees, etc., these kitchens are self-supporting, and can be patronized by the workingmen without loss of self-respect. It should be noted, however, that the superintendence is also unpaid. There are in Berlin fifteen kitchens of this kind, in which 2,724,419 portions were sold in 1890, one-sixth of which was carried away, and the rest eaten in the kitchens. This portion is sold for twenty-five pfennige (about six cents), and contains on the average, as estimated by Professor Voit in 1866, 47 grams of proteid, 23 grams of fat, and 193 grams of carbohydrate, or about one-third of a day's ration.

In many other cities of Germany successful kitchens have been established on this model.

The French form of the public kitchen is the *Fourneau Économique*, a branch of the work of the *Société Philanthropique*. In 1891, 3,031,000 portions were distributed from the thirty-one kitchens of Paris, at an average price of ten centimes; but we have no means of knowing what proportion was given away, nor is an analysis of the food furnished.

Successful public kitchens exist in various cities of Italy, Russia, Norway, and Sweden, but in many cases exact reports of their condition are not obtainable. The *Dampkjøkken*, of Christiania, Norway, sold, in 1888, 67,744 portions at twenty-eight ore (about seven cents) per portion, and six per cent. dividends were paid on the stock. No attempt seems to have been made to analyze the food.

A very interesting kitchen was opened in Amsterdam, Holland, in 1889. Its founders were in complete sympathy with the new philanthropy, and their ideal for the kitchen was perfect self-support, even to superintendence, and that the choice and preparation of the food should, as nearly as possible, conform from the first to the scientific knowledge of the day. These promises have so far been kept, and its future will be watched with great interest. In the year 1891 the first kitchen sold 196,000 portions, and in September of that year a second kitchen was opened, that sold in the first three months 70,000 portions. The price of each portion is fourteen cents (seven cents U.S.), and it contains on the average 40 grams proteid, 26.7 fats, and 214.07 carbohydrate.

THE NEW ENGLAND KITCHEN.

In January, 1890, the New England Kitchen was opened in Boston, Mass., for the sale of plain cooked food to those who would carry it to their homes, no food being eaten on the premises. In this it differed from all the foreign establishments, and also in the fact that the food was sold by the quart or pound, instead of by the too variable "portion."

A study was also made of the inevitable waste of raw material, and of the proportion of edible food-stuff which is actually used; therefore the food values which will be found on the menu of the "Rumford Kitchen" are a somewhat nearer approximation to the facts than is usually the case.

At the same time the managers of the kitchen, assisted by special funds, were carrying on experiments in the art of cookery, making careful analyses of cooked foods and collecting facts that would throw light on the domestic life of the city dweller of small means. In this part of the work many advances have been made in new fields, and much has been done in applying to the better nutrition of the people facts long familiar to the world of science.

A detailed statement of the aims and methods of the New England Kitchen is given in the preceding Leaflet, No. 17, as also its success in various lines up to May 1, 1893. It remains to note results obtained in the six years that have since elapsed.

The original establishment in Pleasant street has been removed to more commodious quarters at 485 Tremont street, and here, at a few tables placed in a corner of the kitchen, a luncheon is served of such food as is cooked for the day. In the basement a bakery has been started, with modern ovens and other appliances. The most important connection made by the kitchen in that time has been with the public schools, in the furnishing of luncheons to the High Schools.

The kitchen has been self-supporting during this time, although contributions were made toward the large expense necessary in fitting out 485 Tremont street.

The branches started on this model in other cities have, however, been discontinued, or have changed their character. None have reached self-support while holding to the standard. In some cases pity for the poor has led to the serving of larger portions than prices justified; some have yielded to the demand for a great variety of dishes without regard to their wholesomeness or the cost of handling. Lack of business knowledge has also been a bar to success. The perishable nature of the materials used, and the losses because of variations in demand, have proved a more important factor than was at first imagined.

But there are difficulties not easily met even when right ideals are adhered to and business experience and skill are at command. These difficulties mostly arise from one cause: the extreme slowness with which the mass of people change their habits with regard to food. In general, people like only the food to which they are accustomed, and any change in their habits is brought about by fashion and example rather than by common sense. The cosmopolitan traveller and the fashionable diner-out will taste of a new dish with readiness, while the factory worker or the average school girl cannot be brought to try it. The person who said, "I don't want to eat what's good for me, I'd rather eat what I'd rather," represents a large class.

It would seem, then, that in America the function of public kitchens will vary widely from that of such institutions in Europe.

The restaurants in connection with them will not be frequented by the families of workingmen, and the purchase of cooked food for home consumption in such families may not be sufficient in any given area to support a complete plant. Local centres may therefore prove too expensive to make them available for perishable food, only bakers' products and canned goods being handled without serious loss. Even were the wage earner and the housekeeper fully alive to the importance of wholesome food, and the saving of time in buying what is ready for use, they cannot be expected to walk miles to get it.

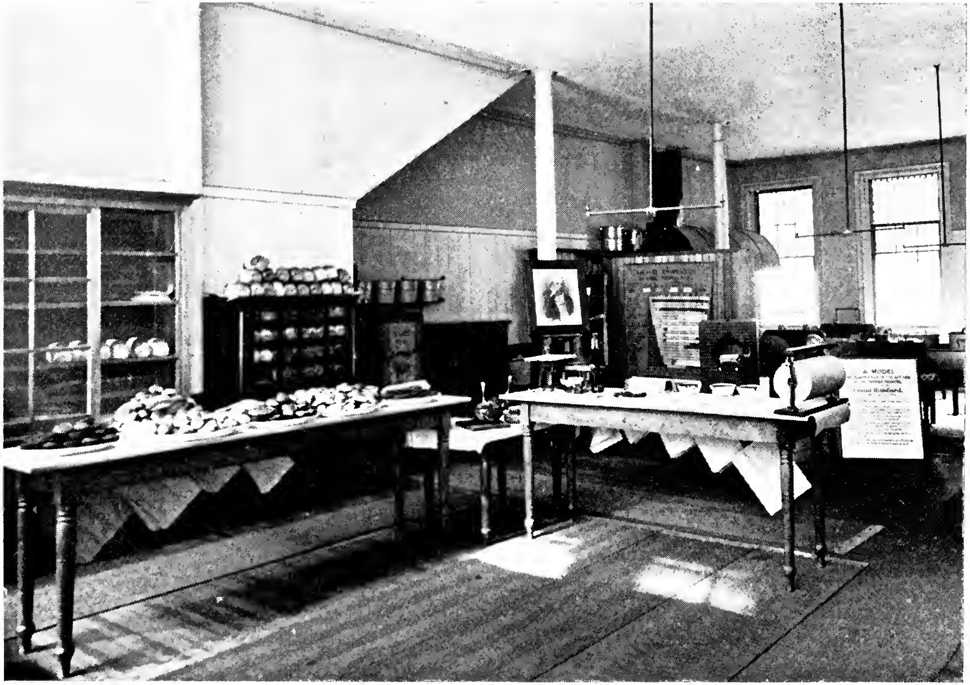
Certain conclusions that seem justified by our present knowledge may be thus stated:

1. Extreme care and cleanliness given to the preparation of food in a public kitchen are not appreciated by the poor and ignorant.

2. The constituency of any hygienic food depot must be sought in the better educated part of the community, a constituency slowly but surely increasing with the growing knowledge of food values and the economy of human force.

3. At the rate of present progress the next ten years will show great advances in popular appreciation of what is wholesome food. Much more help is to be expected from schools and colleges when they realize the importance to students of all ages, of food that will best furnish energy for work and growth. Meanwhile, the need of establishments that will keep to a high standard as to food and its preparation is very great. They cannot lay claim to "scientific

cooking," for in the present state of science there is no such thing, but they can apply a few simple principles to the cookery of the cheaper food materials and that with accuracy and persistence, and they can keep well in the lead in illustrating what is the best thought of the time as to human nutrition.



THE NEW ENGLAND KITCHEN, 485 TREMONT STREET, BOSTON.

THE RUMFORD KITCHEN LEAFLETS.

No. 19.

PUBLIC KITCHENS IN RELATION TO SCHOOL LUNCHES AND RESTAURANTS.

By Ellen H. Richards.

It has become generally conceded that some kind of luncheon for children who remain in school until one or two o'clock is absolutely necessary if the health of the pupils is to be maintained. It is beginning to be recognized that many of the complaints of overwork in the schools are due to under-nutrition, causing a lack of the force and brain power which might be reasonably expected of children of the given age.

The responsibility of the parent and the home for the physical condition of the child is held by many to be absolute and final. To such it seems quite beyond the province of the school to provide domestic training for girls, or luncheons for the pupils generally. The answer to this is that in the general ignorance about foods and food values it must be just as legitimate for the school to see to it that the children's bodies are in a condition to study the lessons given as to attempt to dispel the ignorance of the public by teaching arithmetic or Latin.

Once the pupil is sent outside the home to learn anything, the precedent is established, and the most essential points in habits, in character, and in information, must certainly come within the province of the school.

Let any one watch the eating habits of school children in any school in any city, and he will soon come to the conclusion that there is here a field for effort, wide enough for the most ambitious philanthropist.

The boxes carefully put up by the anxious mother with whatever the child most desires or whatever the family is in the habit of eating, or the lunch counter supplied from the bake-shop with sweets supposed to be attractive to the eye and palate of children, are anything but what they should be.

It is most distressing to watch growing children pay their money for that which is not wholesome food — eclairs, cream puffs, fried apple turnovers, and the many so-called confections.

Of course it is the parents' fault that the children do not know what is best for them, but shall the school authorities stand idly by and see their efforts at education paralyzed by the lack of proper food, or rather by the abundance of that which is not suitable?

But how to combat the evil is not so easily determined as is the fact that it must be met.

One city dismisses its high schools at half-past twelve, leaving the study hours to be taken at home. The blind public of this city raised strenuous objections because they pretended to believe that it was a scheme of the teachers to get a half holiday for themselves every day.

Another city engages a person to cater for the children under the direction of its teacher of domestic science.

One city has provided a kitchen and lunch room in its new high school building; but in most schools, where lunch is served at all, a basement corner is allotted to some outside person responsible to no one — a poor woman, who ekes out a living, or a friend of the politician of the ward, or the janitor, or his wife. These latter are usually the best providers, for they have an interest in the pupils and aim to satisfy them. It is ignorance rather than cupidity on their part that we have to deplore.

But in all such cases there is the pressure of the demands of the untaught pupil for the most unwholesome material — a pressure which it is impossible to withstand without a definite principle behind all the plan; and to have this principle there must be a certain amount of scientific knowledge reinforced by practical experience. In the present stage of public education as to food values there must be sought out, here and there, those who have fitted themselves to be leaders in this direction, and under their control must be placed the preparation and supply of food which shall serve as nutritive material for brain workers.

Only such persons can gain the confidence of the community and can win the regard of the youthful and capricious mind.

For it is the mind rather than the stomach which is to be educated in the case of food. It is nearly a parallel case to that of good taste in pictures. The crudest daubs, the worst combinations of colors, the most distorted figures, are held to be beautiful by those who have never known what is good art. In the same way the worst food in the most unwholesome combinations is considered good by those who have never known any other; for human animals have lost the animal instincts which preserve from mistakes, and the *habits* of civilized man have become far stronger than his instincts.

It needs the restraint of poverty, or of high principle, to secure the use of the best food by the majority of persons, and especially of school children.

One of the natural outcomes of the work of the New England Kitchen was an endeavor to furnish the one-session schools of Boston, namely, the nine high schools, with a luncheon which should be wholesome, inexpensive, and sufficiently attractive. Without precedent to work from, the experimental work of introduction required certain funds, like any other research work. These were furnished by Mrs. W. V. Kellen, whose personal sympathy and fruitful suggestions were even more valuable in the initial stages of the venture. An account of the work may be found in a paper presented to the Association of Collegiate Alumnæ in 1898, by Miss S. E. Wentworth, the manager of the New England Kitchen. It is sufficient here to give in condensed form certain conclusions which may serve as guides to those who are interested in similar work.

Wherever a public kitchen of established reputation exists, 5-cent luncheons may be served without loss to schools where three hundred patrons are assured. In schools with a smaller number the expense of transportation, special service at certain hours of the day, added to the cost of food, prevents the financial success of the plant at charges which seem wise for the public schools. Food can be served at less expense, but not that of the best quality, prepared in the most cleanly manner, and served in an attractive form. The kitchen can make both ends meet only by taking the surplus from the very large schools to make up the deficit in the smaller schools. The small surplus is usually obtained from the sale of so-called luxuries, such as ice cream and certain simple cakes, to those who have money to spend; because the kitchen idea is to keep the staple articles at a price barely enough to cover the cost of material and preparation. Student help and voluntary supervision by teachers or officials of the school may keep the expenses down, but in cases where much service is demanded — where tables are used and the variety is larger — an average expense of 10 to 15 cents per person is common.

In such schools where four or five hundred students are fed, it is preferable to plan for a kitchen properly ventilated and so situated as not to vitiate the air, for kitchen odors cannot be tolerated in a school building. An excellent example may be found at the Lewis Institute, Madison and Robey streets, Chicago, Ill. In this case the lunch room should be under the supervision of the head of the Science or Home Department, whatever it may be called, and not be let out to a caterer or to any one outside the school force. Only the best knowledge and the firmest principle can deal successfully with such whimsical and irrational habits as those in food, and none of these experiments will be wholly successful until the masses are convinced that it does make a difference whether the food is such as will give best blood and muscle and brain, or such as pleases the palate for the moment.

As has been indicated in several places in these leaflets the cost of the raw food material is slight in comparison with the cost of handling and serving in attractive form, and that brings us to consider the function of the kitchen toward other lunch places.

It is an undoubted fact that the one class of substances ready to serve on the instant to a teamster or expressman is liquor, that nowhere is a bowl of hot soup or chocolate served as quickly or as cheaply. This kind of quick luncheon counter is a great need and might be served from a public kitchen. It would be worth more than temperance lectures, but where the question is one of catering to the demands of the average public, rather than of educating the public to demand better things, the kitchen idea must wait until food values and the office of food in the body have been more efficiently taught.

The attempts to furnish restaurants for wage earners and for students with food of a strictly wholesome and nutritious character have everywhere resulted in the conviction that a belief in the importance of suitable food has yet to be disseminated. A select group of persons may be gathered in any city who do fully appreciate the work done; but the number of patrons is not large enough in any section to sustain an establishment. Reluctantly the plans have one after another been given up, and attention has been more and more concentrated upon the education of public sentiment.

THE RUMFORD KITCHEN LEAFLETS.

No. 20.

THE FOOD OF INSTITUTIONS.

By Ellen H. Richards.

In cases where large numbers of persons are fed from one kitchen, and are obliged to take the food provided or to have none, we have at once our easiest and our most difficult task: easiest in control of materials used, of processes of preparation, of quantities prepared, and of visible waste; most difficult in satisfying those who are not in normal condition, who have not the distraction of outside interests, and who for the most part lack the best sauce for food — sufficient out-door exercise. Such persons, having no choice in the food, consider it a duty to complain, no matter what is set before them.

With the knowledge of food gained in the past twenty-five years it is a comparatively simple matter to sit at one's desk and make out a good and sufficient menu covering the physiological requirements of any given class of people. A complication arises when this menu must be furnished for a definite and limited sum; but the crucial test, and the one which proves fatal to nearly all attempts to put well-thought-out theories into practice, is the refusal of the people to eat the good things thus carefully provided for them. Who has not seen a dog refuse a dainty morsel from his mistress's hands and go straightway to a neighboring garbage-pail and ferret out some scrap which satisfied his craving?

We sometimes forget that the habit of eating civilized food is as truly a matter of education as is the wearing of well-fitting and becoming clothes or the suitable furnishing of one's house. We are apt to think that our food ought to be a luxury to those in the so-called lower classes or to people poorer than ourselves. This is not the case, as one finds when one begins to cater to the inmates of an institution, school, or boarding-house. *People like best that to which they are accustomed.* Novelty in food does not commend itself to those who have had little variety in their lives.

It is true that the attitude of mind has much to do with the food habit, and, if one will, one can learn to like almost anything. Therefore, the strongest hope of the provider for a mass of persons lies in persuading them that the prescribed food is very good in itself, and not merely good for them. To this end the "pills" must be not only sugar-coated, they must look like candy. In these facts may be found the reason why food reformers have hitherto failed and why most of us reasonable "food cranks" may be worsted any day by a really good cook who will give the people what they like.

It is not enough, therefore, to calculate the food value; not enough to select the best receipts; not enough to have the food served in a manner that is attractive to us: The food must have a familiar look and taste, so that the question will not be raised as to whether it is a new dish.

A study, therefore, of existing habits and customs is essential to success in catering to any large body of persons, especially to those who have not been accustomed to variety. If they could be fed with their eyes bandaged it would be easier.

Hospitals for the sick and the insane present more difficulties in the variety demanded; but in catering for these unfortunates an element of pity comes in which is lacking in the case of persons who ought to know enough to coöperate with those who are striving to do the best thing for them.

Besides the acutely sick, who are fed solely by the physician's orders, there may be said to be, in general, three classes of persons to be provided for, either in separate institutions or separately in one institution, and certain principles are applicable to each class in whichever condition it may be found:

First. — Brain-workers with more or less exercise — professors, teachers, doctors, superintendents and students, convalescents in hospitals. For these the diet should be liberal, varied, well cooked, and, especially, well flavored. It is of the utmost importance that the food should be delicately served with all the attractiveness of napery and china; all the neatness possible as well as the utmost exactness as to suitable temperature. Two-thirds of the food served in most colleges and hospitals is spoiled, for those whose mind influences so profoundly the digestion, by neglect of this cardinal principle. It may be difficult to secure the serving of a thousand persons with hot plates, but let the *necessity* be once recognized and means will be found. The milk, cream, butter, and eggs should be of the best. It is not economy to pinch in this direction.

Second. — Manual workers — house-keepers, nurses, janitors, cooks, maids, etc. For those who have, as in many institutions, out-door work and work under favorable circumstances, hearty food of a kind with which they are familiar should be served neatly and abundantly, but in fewer courses. Soups and salads are, for the most part, unacceptable dishes. What we would call heavy food will not harm these vigorous hard workers. A lighter diet should be provided for those whose occupation confines them indoors, but the same principle holds: the refinements of diet are not as much appreciated as is the accustomed flavor of a favorite dish. Even when in the hospital ward the laborer who has been used to hearty, solid food — boiled beef and cabbage — feels himself much abused if he is given the best of broth and the most delicate dessert.

In general, made-over dishes and minced meat seem a very poor sort of food to many of this class. Even the college student who has been brought up on the heavy breakfast of steak, eggs, and griddle cakes, looks upon a simple breakfast of fruit, cereal, and a smaller portion of meat, with bread and butter and milk, as little better than starvation.

Third.—Pupils in schools where expenses must be kept down, patients in the average hospital ward, inmates of almshouses, and the chronic insane who are supported at public expense, as well as the inmates of institutions of all kinds. For all these, nutritious food must be served at the least possible cost. And in this there is the most urgent need of reform. It is here that scientific knowledge could accomplish the best results if coupled with sound common sense and some inventive genius. I have seen plates of food loaded as if for a day-laborer set before querulous old women who spent the day in their rocking-chairs. I have seen common, hearty food in like abundance sent cold to the bedside of a delicate girl recovering from a surgical operation; and I have seen dainty croquettes and thin sandwiches set before those who would have preferred a thick slice of tough meat with potato.

On the other hand, the inmates of schools and colleges too often lack the proper appetite for wholesome dishes; teachers are often placed in unnatural conditions and become morbid and difficult to please. The pupils often live under unhygienic conditions, although the school should, of all places, be placed in the front rank of improved dwellings. They are pressed with work and, worst of all, bring from their homes the tastes and whims so indicative of undisciplined persons.

In catering for institutions the greatest need to-day is for a combination of scientific knowledge and practical experience. This it is almost impossible to obtain because the public has not yet taken the food question seriously, and because neither college trustees nor hospital boards are, as yet, willing to pay a salary which will command the services of a superintendent already trained or induce a competent person to complete a defective training. The highest talent is sought for the medical or the teaching staff, and yet the most important position of all, the one which affects seriously the efficiency of all the rest, is filled in a hap-hazard way by any one claiming to be a cook or a caterer.

To even begin practical work in any institution, certain standards must be tested in order to see wherein changes in individual instances may be advantageously made. These standards may well begin with the lowest cost and least variety consistent with the maintenance of health; namely, that used in prisons, almshouses, and houses of correction; for, while the food should be well cooked so that it may be palatable and readily digested, it is not wise to make the menu so attractive as to encourage the hungry to commit petty crimes for the sake of the good prison fare; for we must remember that the old disciplinary diet of bread and water is no longer in vogue. The diet should not be stimulating, that is, it should contain a limited amount of meat, and only such proportion of spices and condiments as is absolutely necessary for the assimilation of the other and staple ingredients of the food. Vegetables should play a larger part than they appear to do in this class of food. Standard No. 1, costing for 500 to 1,000 inmates from 7 to 10 cents a day, and for 100 to 500 from 9 to 11 cents, offers a working basis for this class. These amounts have been proved to be sufficient, with suitable cooking, serving, and oversight, to prevent undue waste. While there are institutions of the kind in the country where the expense is given as less, it is not to be recommended that the cost go below 7 cents.

For children and youth in reformatories the food should furnish material for growth and development, and, since the inmates of these institutions are found there largely because their parents or they in childhood were under-nourished, their food should be somewhat abundant, although of the plainest and most substantial kind. Standards Nos. 2 and 3 give a working basis for this class. The cost of these two standards should not be below 8 nor over 11 cents for a minimum, nor below 10 or over 13 cents for a maximum.

For old persons and inmates of charity hospitals, a standard closely approximating No. 3, with less milk and eggs and with tea, may be used at the same cost.

The diet of the insane adult in public institutions approaches nearly that of the student in school where the expense must be kept low, and where refinements of serving are not attempted. Standard No. 4 shows the amounts found to be sufficient under the rigid conditions specified; namely, close inspection of raw material, careful cooking, and, when a general spirit of intelligence and contentment pervades the institution, with confidence in the management.

Wherever this rigid economy exists the medical inspector must be on guard in order to see that cases of starvation in the midst of general sufficiency do not occur, owing to personal idiosyncrasies, especially among children and students.

For officers of institutions, students, and convalescent patients, Standard No. 5 furnishes a guide for the staple articles to which may be added, for officers, as many luxuries as the purse will allow from market and store to tempt the jaded appetite of those who consider the pleasure of eating above the pleasure of good health. The officers rarely set a good example, but it is not usually held to be the superintendent's duty to provide *hygienic* food for them, but to satisfy them as far as is possible with the means at hand.

The chief reason of the great difficulty in satisfying the cravings of people of studious or sedentary habits is that they have not a healthy appetite for *food* as a means of nourishment, as a force producer, but a sort of sentimental craving for stimulant, something which tastes good for the moment or something which looks as if it would taste good. A mental treatment must in such cases precede the administration of simple, wholesome food. Nurses, students, and semi-invalids who have access to supplies of dainties, by frequent eating destroy the appetite for the regular meals and therefore become finical and difficult to please. In this age, when prevention is regarded as the highest application of science, to go on eating food which hinders the full accomplishment of the work or pleasure of the individual is a survival of by-gone days.

The cost of this general dietary ranges from 22 to 50 cents for groups of 50 to 500 persons; 27 cents should furnish all that is necessary, except when the group consists of only 10 to 50 persons, and when the demand for fruit and vegetables out of season is fully met.

From 5 to 50 cents seems a wide range for the same actual weight of dry food substances which may support human life, and illustrates the hap-hazard way in which all American customs as to food are allowed to become traditions. That the wider range is not necessarily more healthful is proved by the prevalence of diseases due to digestive disturbance and to the fact that cases of mal-nutrition are met with more frequently among the good-livers than among the more abstemious.

The whole question of food needs to be approached in a different spirit and with a greater confidence in its importance. No better school of diet could be found than an intelligently managed school or hospital. In any case the inmates should have confidence that the very best that science can teach is being done for them, and they should take the food with that faith and cheerfulness which go a long way toward making it palatable and digestible.

In the hospital more help should be provided in the wards to see that the food, when well cooked, is properly presented to the patient. The very lax way in which, in most places, the serving is now done, the coarse crockery, the lack of napkins and suitable trays for those to whom such things mean relish or disgust, militates against good work in the kitchen. While training schools for nurses have accomplished much there is a great gap as yet in the nurses' knowledge of food which will not be bridged until physicians and trustees have come to see the essential importance of unity of administration in the food department.

In the school nothing can take the place of well-assimilated food as a producer of brain power. In the hospital no medicine or disinfectant can rival nutritious food as a factor in recovery. It is the duty of those in charge to provide such food just as much as the other appliances usually found and universally conceded to be necessary.

There is a difficulty in dealing with so heterogeneous a mass of persons as those found in any American institution, persons of different nationalities, different habits, from childhood up, which only education can overcome.

In closing I can only reiterate the statement with which I began: The food will not be satisfactory in either college or hospital until trained persons are employed and well paid to superintend the whole business of food supply, — the buying, the cooking, and the serving, — for the three hold together, and a fault in any one may ruin the result.

In preparing this *résumé* free use has been made of previous articles by the author: "Notes on Hospital Dietaries," "Journal of Insanity," October, 1895; "Food as a Factor in Student Life," Chicago University, 1894; "Hospital Diet," "American Kitchen Magazine," April, 1896; "Report on the Dietaries of the Nine Institutions of City of Boston," to the Institutions Commission, 1897.

PROVISIONAL STANDARDS.

STAPLE ARTICLES PER PERSON DAILY.	I.	II.	III.	IV.	V.
	Ounces.	Ounces.	Ounces.	Ounces.	Ounces.
Meat and fish	10	12	7	12	16
Salt pork, lard, suet, etc.	1	1	½	½	½
Flour and rice	14	14	11	12	10
Oatmeal, cornmeal, hominy, barley, etc.	2	2	2	1½	1
Peas, beans, lentils, and cheese	2	2	2	1	1
Potatoes	12	12	6	12	12
Vegetables	6	6	4	6	3
Sugar	2	2	3	3	3
Dried fruits		¾	¾	1	½
Milk	4	4	16	16	16
Oleomargarine or butter		½	7/10	1	1½
Eggs			¾	¾	2
THESE MATERIALS SHOULD YIELD IN AVAILABLE FORM:	Grams.	Grams.	Grams.	Grams.	Grams.
Proteid	103	111	93	110	130
Fat	73	91	77	100	128
Carbohydrates	426	436	389	421	404
Calories	2,848	3,088	2,692	3,107	3,377
COST, EXCLUSIVE OF TEA, COFFEE, AND FRESH FRUITS.	Cents.	Cents.	Cents.	Cents.	Cents.
Minimum	7.2	8.3	9.0	11.0	15.0
Maximum	9.0	10.0	12.0	20.0	25.0
Tea, coffee, condiments, game, luxuries of any kind, which add little to the nutriment	1.0	2.0	2.0	5 to 10	5 to 25

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