

CHAPTER XIII

VEGETABLE FOOD

180. Grain. — Food prepared from grain contains

Albumin	8 per cent	to	15 per cent.
Starch or sugar	50	“	to 75 “
Fat	1	“	to 10 “
Mineral matter	1	“	to 3 “

Some forms of its starch or sugar are digested with a considerable expense of time and energy, and there is always a considerable portion left over. From grain nearly all the starch and sugar of food is obtained.

181. Gluten. — The albumin of most grains is called *gluten*. It is easily dissolved in water and gives the sticky character to a mixture of flour and water. Its digestion requires an expenditure of more time and energy than the digestion of most forms of animal albumin, but its oxidation yields the same amount of energy. About one fifth is left undigested, whereas only one thirtieth of animal albumin is left.

The husks of the kernels of grain and the cellulose frameworks within are wholly indigestible. When milk is digested, there is little waste matter upon which the intestine can contract. A food like grain, which leaves much waste matter, furnishes something upon which the intestine can contract, and thus sweep the waste matters on and out of the body. For this reason vegetable food is of use aside from its nutritive value.

182. Fermentation of grain in the alimentary canal. — Owing to its large amount of starch and sugar, and to its comparatively slow digestion, grain foods are liable to ferment. Fermentation will be the least apt to occur with a mixture of about equal parts of animal and vegetable food.

183. Bread. — Bread is the most common form of food made from grain. Usually some means are employed to make the bread porous and soft. *Yeast* is commonly added. Its germs grow and change the sugar of the flour to carbonic acid gas and alcohol. The gas, bubbling through the wet and sticky flour, puffs it up and fills it with small cavities, whose form the stiff and sticky gluten preserves. Corn meal has but little gluten to make it sticky, and so it will not preserve enough porous character to form a loaf of bread.

Instead of yeast, *baking powder* is often used to make bread or biscuit *light*. The powder develops carbonic acid gas, which bubbles through the dough. Nearly all baking powders are minerals, and their use in large quantity is undesirable.

Bread made from wheat flour requires less energy in its digestion than any other kind of vegetable food. Since some starch must be eaten, bread, in combination with milk, eggs, and meat, forms the best diet for everyday use. Rye flour makes nearly as good bread as wheat flour.

184. Other forms of grain food. — *Biscuit* is bread with a little fat added and baked in small lumps.

Cake is a mixture of flour, eggs, fat, and sugar. A large amount of fat or *shortening* tends to make it indigestible.

Pancakes are made of flour, corn meal, or buckwheat flour. If they are light and well cooked, they are of as much value as bread.

Cracked wheat and other preparations of wheat are often boiled in water, forming a mush or pudding. This has the composition and digestibility of bread.

Corn meal boiled, or made into pancakes or *corn bread*, is almost as easily digested as wheat flour. It contains a larger amount of fat than any other grain.

Oatmeal when boiled to a mush is a very popular article of diet. It requires more time and energy in its digestion than any other common grain food. It leaves a large amount of undigested residue, which sweeps out other waste matters as it is forced down the intestine.

Rice is poorer in albumin and richer in starch than any other grain. But when animal food is used in connection with it, there is no better combination of food, for it is the equal of flour in digestibility.

Barley is but little used as food by man. It contains little albumin but a large amount of starch.

185. Ways of preparing grain. — The finest grades of flour make bread which is digested with less cost of energy and with less residue than flour from the whole grain, while there is but little difference in the amount of albumin and starch which they contain. *Hot bread* is injurious only when it is moist and sticky so that it cannot be chewed to fine morsels. *Old bread* is more easily digested than new because it is harder and drier, and so can be chewed fine.

186. Beans and peas. — Beans and peas contain

Albumin	about 25 per cent.
Starch	“ 60 “
Fat	“ 2 “

Their albumin has much the same composition as the casein of milk, and is called *legumin*. It requires a large expenditure of time and energy in its digestion. Both legumin and the starch are very liable to ferment in the intestine and produce gases. At least one fifth remains undigested. Beans and peas are good foods for an outdoor laborer who has a great deal of spare energy.

187. Potatoes. — Potatoes contain

Albumin	3 per cent.
Starch or sugar	22 “
Water	75 “

They are very poor in albumin, but rich in starch, so they go well with meat and eggs. Potatoes require a greater amount of time and energy in their digestion than bread and yield less heat and energy, and leave more undigested residue, and are more liable to ferment.

188. Difference between animal and vegetable food. —

Animal and vegetable foods differ in several particulars:

First. Animal food requires less energy in its digestion. Animal, rather than vegetable, food is *light* diet.

Second. Because of its longer time of digestion, and of the larger amount remaining undigested, vegetable food is more liable to ferment in the stomach and intestine, so that in severe sickness vegetable food is usually entirely withheld.

Third. Vegetable food alone contains too much starch and sugar for the needs of the body. Fermentation is thus promoted. When absorbed, sugar is more readily oxidized than fat or albumin, and an excess of sugar takes oxygen from other parts of the body.

189. Special use of vegetable food. — While animal albumins and fats are more easily digested, and furnish a greater supply of heat and energy than the same kind of food of vegetable origin, it by no means follows that man should use them to the exclusion of vegetables. Their very ease and completeness of digestion may lead one to eat too much. Man's mouth and stomach combine the characteristics of herbivorous and carnivorous animals, and he will enjoy the best health when both classes of food are used. He must use some vegetable food for the sake of its starch or sugar.

190. Effect of cooking. — The distinctions between food just given were based upon experiments made upon healthy men, who ate slowly, and masticated food properly cooked. All vegetable food should be cooked so that it is a dry and crumbly mass which the digestive juices can easily pene-

trate. Thorough cooking renders all kinds of food more digestible. Raw starch is indigestible.

191. Green vegetables. — There are many kinds of vegetable food which supply little weight, heat, or energy to the body, yet are often eaten because of their agreeable taste. Beets, turnips, carrots, parsnips, pumpkins, and melons are poor in albumin. They contain some starch and sugar and much fibrous substance wholly indigestible. Their agreeable taste may increase the flow of the digestive fluids, and their bulk may excite the peristalsis of the intestine.

Tomatoes, cabbage, cauliflower, onions, asparagus, and all other green vegetables are still poorer in food material, and are especially liable to ferment in the intestine.

Green vegetables, such as cucumbers, which are eaten in an unripe state, are wholly indigestible. Thus they may pass through the intestine almost unchanged, or they may ferment and produce pain.

192. Iron in vegetables. — Green vegetables contain a considerable quantity of *iron-bearing* albumin or *nucleo-albumin*, while grain and animal food contain only a small quantity. This form of albumin is easily destroyed in the intestine if fermentation of food takes place. Under these circumstances green vegetables, by furnishing an abundance of this material, are a real food. Those should be chosen which do not readily ferment. Of them all, probably celery and spinach are best.

193. Fruit. — Fruits, such as apples, pears, plums, peaches, and berries, have little albumin which man can digest, but often have a large amount of sugar. Their chief use is to fill the intestine when a food is eaten which, like milk, leaves but little undigested matter to sweep along with the bile and other waste matters. But all fruits

are liable to ferment in the intestine. Grapes contain more albumin than almost any other fruit, while their sugar is the form produced by digestion. For these reasons they are easily digested, and are a real food. Bananas also contain much albumin and sugar. Green fruit is digested with difficulty and is very liable to injure the stomach. Over-ripe and decayed fruits often contain poisons which produce violent sickness. Only a small quantity of any fruit should be eaten at once.

194. Tart fruits. — Oranges, lemons, rhubarb, and such tart or sour articles of food are often said to be "cooling" to the blood. When the appetite fails, and the mouth is dry with a false thirst, their sourness excites the flow of the alkaline saliva, and so the mouth and tongue become moist, and the false thirst is relieved. In long voyages and expeditions, when fresh food cannot be obtained, they are of value in warding off scurvy. When eaten at meal times, the acid of sour fruits hinders the production of the gastric juice, and thus retards rather than aids digestion. In the stomach the acids unite with the mineral matters of the food, and then are absorbed into the blood. Their presence in the blood seems to have some effect on the nutrition and action of the cells, and on this account they are sometimes given as medicine. They seldom take part in building up the body, but are quickly thrown off by the kidneys. The popular idea of their cooling effect is derived mainly from the fact that they excite the flow of saliva, and thus render the mouth moist.

195. Nuts. — Nuts contain oil, but it is doubtful if much of it is emulsified and absorbed. They contain an abundance of albumin and starch, but their digestion usually requires more time and energy than the stomach of man is designed to furnish.

196. Canned food. — When food is heated so as to destroy its living germs, and then is at once sealed air-tight, it will neither decay nor sour, and when opened a long time afterwards it will be found to be as fresh and wholesome as when it was put into the can. Thus it is possible to carry fresh meat and vegetables on long voyages or to remote

and cold countries. When carefully prepared, canned food is as wholesome as food recently cooked. When opened it soon spoils.

197. Scurvy. — When men have been living for months upon bread and salt meat, without fresh food, there sometimes comes a disease called *scurvy*. The gums become sore, and the legs ache and turn "*black and blue*" as though they were bruised. Then fruit or green vegetables are of the highest value, probably because they furnish a good supply of *nucleo-albumin*, in which old bread and salt meat are apt to be deficient.

198. Seasonings. — Pepper, mustard, nutmegs, cloves, and all such sharp-tasting things are added to food simply for their taste. They are probably neither digested nor oxidized, and yield neither weight, nor heat, nor energy. They irritate and burn the stomach just as they do the mouth. Yet their pleasant taste may be of value in promoting the flow of the digestive juices.

199. Tea and coffee. — Tea and coffee are often supposed to supply food to the body. They belong to the class of substances which, acting through the nervous system, spur on the work of the cells of the body, especially of the brain. They supply no heat or energy for the extra exertion. Substances which excite the cells to action, without giving them material out of which to develop heat and energy, are *stimulants*. The active principle of tea and coffee is a stimulating substance called *caffeine* which spurs the cells of the body to do more work. They enable a person to do a larger amount of work *in an emergency*, and when the body is tired they rouse the digestive and assimilative organs to renewed activity, so that these quickly prepare a new supply of food. When they are used continually the body learns to rely upon their stimulation. Thus a habit of drinking them is formed which is not easily broken.

200. Tannin. — Coffee and tea also contain some *tannin*, which is a substance used in the manufacture of leather. It puckers and contracts albumin with which it comes in contact, and is liable to hinder digestion. Much of the bad effect of strong tea is due to its tannin.

201. Volatile oils. — Both tea and coffee also contain a considerable quantity of an oil, which gives the drinks their peculiar odors and flavors, but which evaporates quickly. It is mainly this oil which produces headache and sleeplessness and other troubles, when large quantities of tea or coffee are taken. Yet both drinks agree with the stomach better when the oil is retained in the drink.

202. Preparation of tea and coffee. — Both the caffeine and the oil of tea and coffee are easily dissolved by boiling water, but by long boiling the volatile oil is driven off in the vapor, and a large amount of tannin is extracted. Both these results are undesirable, and can be avoided by pouring boiling water over the tea and coffee, and then steeping it slowly for only a few minutes.

Coffee will be digested more easily if the milk which is added is boiled with the coffee. Better still would be to add no milk at all.

203. Adulteration of tea and coffee. — It is easy to add the leaves of other plants to tea leaves. Green teas are often colored with copper.

Coffee is adulterated with all kinds of roasted roots. A root called *chicory* is cultivated especially for this purpose.

204. Cocoa. — Cocoa contains a small quantity of a substance which stimulates like caffeine. It also contains a considerable quantity of albumin and fat, both of which will dissolve in water. Thus it is more of a food than tea or coffee, and its use is less likely to cause indigestion. Chocolate is a preparation of cocoa.

205. Use of tea and coffee. — Tea and coffee are not necessities, and men would be just as healthy without their use. They have a reputation of retarding waste

of the body, but this view is not founded upon definite experiments. The nervous system of children is easily impressed by tea and coffee, and their bodies cannot stand the stimulation and extra work which these substances induce. When long and fatiguing work *must* be done or great exposure endured, then tea and coffee are valuable stimulants.

206. Adaptation of man's stomach to certain foods. — Green vegetables, fruit, and grass contain the proper quantities of food elements to support man's life, but man cannot digest them readily. Lower animals eat the food and expend their digestive energies on it; finally, when man eats it in the form of milk, eggs, or meat, it needs but little further digestion.

SUMMARY

1. Grain is the main source of vegetable food.
2. Grain albumin, or gluten, is digested at more expense of time and energy than the albumin of animal food.
3. Grain food contains much starch, and must be eaten to supply this element.
4. Grain food is more liable to ferment than animal food.
5. Bread is the form of grain most available for digestion.
6. Boiled preparations of grain contain the same food elements as bread.
7. The most valuable of the grains which are usually eaten boiled are rice, cracked wheat, corn meal, and oatmeal.
8. Cake and biscuit may be considered as forms of bread.
9. Beans and peas are rich in albumin and starch, but require a great deal of energy in their digestion.
10. Potatoes are poor in albumin but rich in starch. Their digestion requires much energy.

11. Animal food in general fulfills the points of digestibility better than vegetable food.
12. Green vegetables and fruit are of value because their taste may excite the flow of digestive fluids; the large residue left after their digestion may sweep waste matters down the intestine; and they may form a supply of nucleo-albumin when the supply in ordinary food is deficient.
13. Green vegetables and fruit should be eaten a little at a time, because of their great liability to undergo fermentation.
14. Tea, coffee, and cocoa spur the cells on to renewed activity when the body is tired or weakened.

DEMONSTRATIONS

56. Grain albumin, or gluten, can be separated by mixing a small mass of dough of wheat flour and gently washing out the starch by kneading it under water. The gluten will be left as a stringy, sticky mass. The starch in grain can be shown by the iodine test (page 31).

57. Show samples of bread, both light and heavy, sweet and sour, well-baked and under-done, new and stale, and hot and cold. Show that the difference between the last three pairs depends upon the one kind forming a pasty mass when wet or chewed, while the other kind may be broken into fine particles.

58. Show samples of properly cooked and of improperly cooked rice, oatmeal, etc.

REVIEW TOPICS

1. Give the composition of *grain*.
2. Describe the albumin of grain.
3. Describe *bread* and the process of its manufacture.
4. Describe foods which are like bread.
5. Describe the various kinds of grain which are eaten when boiled to a mush.

6. Give the difference of digestibility between bread made from unbolted and fine flour; between hot and cold bread; between new and old bread.
7. Give a reason why grain food should not be sweetened.
8. Describe *beans* and *peas*.
9. Describe *potatoes*.
10. State why the method of cooking and the manner of eating make a great difference in the value of vegetable foods.
11. Give the main points of difference between animal and vegetable foods.
12. Name the food elements in green vegetables and in fruits.
13. Give the important uses of green vegetables and fruits.
14. Tell how green vegetables and fruits should be eaten.
15. Show that man's stomach is adapted to certain kinds of food only, and tell how all kinds of food may ultimately become adapted to his use.
16. Give the active principles of tea, coffee, and cocoa, and the effects of each upon the body.
17. Name the food elements in milk; in eggs; in meat; in grain; in potatoes; in beans.
18. Give the organ in which each of the following foods are acted upon, the digestive fluids which act upon it, and the chemical change produced by each fluid: milk, eggs, meat, bread, butter, grain food, potatoes, beans.

CHAPTER XIV

QUANTITY OF FOOD REQUIRED

207. Amount of food elements required. — Although oxidation is continually going on in each cell of the body, only a small part of the albumin eaten is required in their reconstruction; the remainder and all the sugar and fat are oxidized without ever becoming a part of the living cells of the body.

In order to repair the waste caused by the oxidation of the cells, and to supply the requisite amount of heat and energy, the average man must assimilate daily —

Albumin	4 $\frac{1}{5}$ ounces
Fat	4 “
Sugar or starch	5 “

208. Amount of oxygen required. — The amount of oxygen needed to oxidize the —

Albumin	is	1 $\frac{1}{2}$	times	its	own	weight,	or	6.3	ounces
Fat		3	“	“	“			12	“
Sugar		1 $\frac{1}{5}$	“	“	“			6	“

Total amount of oxygen required daily, 24.3 ounces

The average amount of oxygen taken in daily by the lungs is twenty-four ounces. When more food is eaten than this amount of oxygen can oxidize, some of the albumin is changed to fat, which increases the weight of the body.

Anything which causes the lungs to take in more oxygen

will enable the body to oxidize more food. So the laborer breathing deeply of fresh air is less troubled with the bad effects of over-eating than a clerk in an office.

209. Oxidation of an excess of sugar. — Sugar is more rapidly oxidized than other food, and when too large a proportion of starch or sugar is eaten the other food is incompletely oxidized, and sickness is the result. A greater proportion of starch is required when more heat and energy are needed, as in physical labor.

210. Selection of diet. — To supply the proper elements, a variety of food may be selected, of which the following diet for twenty-four hours is a typical example.

	OZ. OF ALBUMIN.	OZ. OF FAT.	OZ. OF SUGAR.
7 ounces of bread contains . . .	0.7	0	4.2
3.5 " eggs (2) " . . .	0.5	0.5	0
14 " meat " . . .	2.5	2	0
24 " milk (1½ pt.) " . . .	0.9	1	1.2
1.5 " butter " . . .	0	1.5	0
Total	4.6	5	5.4

Allowing for the amount usually left undigested, there would remain about the proper amount of each kind of food element. This food contains more than enough mineral matter to supply all the needs of the body.

211. Choice of food. — The price of food has little to do with its nourishing qualities. Fine taste, good appearance, and rarity are usually what make foods costly. The cheaper kinds are quite as nourishing as the more fashionable, and will taste as good if they are well cooked. About three fourths of a laborer's wages are spent for food. Cheaper meats and fish, with less sugar and desserts, will

furnish him a better diet, and at less cost. It is as bad economy for a poor man to buy the *best* of food as it is for him to buy silk and broadcloth clothing. Scraps and food left over from the table are as good quality as ever, and should be saved for the next meal.

212. Amount at a meal. — Rules prescribing the amount of food to be eaten at once cannot be given, any more than fixed rules regulating the amount of wood to be added to the fire in a cooking stove. Hunger and taste are reliable guides when plain food is eaten slowly.

213. Too much food. — In some persons the stomach cannot digest and absorb food so fast as the lungs can furnish oxygen for its oxidation. While these persons eat heartily they generally remain thin, for, instead of accumulating food, they use it up in developing energy for active work. They are apt to overwork their stomachs and to suffer from indigestion. They need nutritious and easily digested food. Other persons can digest food faster than the lungs can supply oxygen for its oxidation. These persons eat little, but, since the slow oxidation allows food to accumulate, they are apt to be fat and lazy and to suffer from lung troubles. By allowing their strong stomachs to act upon the less easily digested foods their appetites will probably be satisfied, and still not enough food will be digested and absorbed to overtax their lungs.

214. Starvation. — When man is deprived of all food, life is supported by the oxidation of his own flesh as long as it lasts. In from six to ten days a man will lose two fifths of his original weight, and then death occurs. When water is given, life will last for a much longer time.

215. Brain food. — Brain workers require the same kind of food as the laborer. In its action the brain uses heat and energy, the same as any other part of the body. Fish is no more a brain food than beef-steak. Phosphates, which are popularly supposed to nourish the brain, are arrested at the liver; but they stimulate the liver to greater activity, so that food is more perfectly assimilated, and thus greater strength is given to the brain cells, as well as to the rest of the body. Phosphorus is found in most foods in greater quantities than the body needs.

SUMMARY

1. About four ounces of each of the food elements — albumin, fat, and sugar — must be eaten daily.
2. To oxidize this amount of food requires about twenty-four ounces of oxygen, which is about the amount breathed in.
3. A diet of bread, eggs, meat, milk, and butter will furnish the best food elements.
4. If too much sugar or starch is eaten, the albumin and fat are not fully oxidized.
5. If too much food is eaten, all the oxygen is used up, and there is none left for an extra exertion.
6. If little or no food is eaten, not enough heat and energy are produced to keep the body alive.

DEMONSTRATIONS

59. Weigh out the different amounts of bread, eggs, meat, milk, and butter which are required daily. Also measure out a quart of water. This will show the class the amounts of food required daily.

60. Weigh out the required quantities of albumin, fat, and sugar. Albumin may be represented by gelatine or glue.

REVIEW TOPICS

1. Give the amount of albumin, fat, and sugar required daily.
2. Give the amount of oxygen required to oxidize the food.
3. Give the results of oxidizing an excess of sugar.
4. Give the amounts of bread, meat, etc., required daily to furnish the body with the proper amount of albumin, fat, and sugar.
5. Give the best times for eating.
6. Give the effects of eating too much food; of too little.

CHAPTER XV

DRINKING WATER

216. Pure water. — Water is the only food which man habitually takes without its previous preparation. Water is the same from whatever source, but substances dissolved in the water change its appearance. Carbonic acid gas, oxygen, and air are dissolved in all ordinary water, and in it float particles of dust and harmless living germs. Such water is clear and colorless. It has a slight taste, due to the dissolved air. When the air is expelled by boiling, the water is insipid and almost tasteless.

217. Hard and soft water. — Water also contains a variable amount of mineral matter, especially lime, soda, and potash. Water containing lime makes the fingers feel slightly rough and puckered. The lime combines with soap, forming a scum which will not dissolve. Water containing lime is said to be *hard*, while water with little or no lime is *soft*. Although some gases and minerals are dissolved in all water, they are harmless and do not make it impure, but rather they give it a more pleasant taste. When very hard water is boiled, some of the lime is deposited on the sides of the kettle, and the water is improved but not made soft.

218. Mineral waters. — When much mineral matter is present the water is called *mineral water*. The principal minerals thus found in water are salt, lime, soda, potash, iron, and sulphur. These waters form springs in various parts of the country, and have borne a great