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PART II.

THE ACTIONS AND USES OF REMEDIAL AGENTS.

THOSE USED TO PROMOTE CONSTRUCTIVE METAMORPHOSIS.

ALIMENTS.

This extensive subject can, in this work, be considered briefly only, and from the point of view of therapeutics. The various aliments are of the first importance as remedial agents. No satisfactory repair of diseased or wasting tissues can take place without a suitable supply of healthy blood, and healthy blood is the product of proper food and normal digestion and assimilation.

The Physiological Relations of Food.—The food of man is derived from the three great kingdoms of nature: mineral, vegetable, animal. It may be conveniently classified into three principal groups: 1. Mineral constituents—incombustible or unoxidizable: water, phosphate of lime, chloride of sodium, etc.; 2. Oxidizable—heat-producing and force-forming—carbon compounds: fat, sugar, starch, gum, etc. Nitrogenous — flesh-forming: albumen, fibrin, casein, etc.; 3. Food adjuncts—alcohol, acids (citric, tartaric, etc.), alkaloids (caffeine, theine, etc.).

The members of the first group will be discussed hereafter, under the head of "agents promoting constructive metamorphosis"; the second group, the most important, will be considered in this relation, with the foods; and the third will have separate treatment under appropriate heads.

The classification of foods, originally formulated by Liebig, if not too strictly adhered to, is of much utility, as indicating the general purposes of these substances in the economy—viz.: carbonaceous or force-producers; nitrogenous or flesh-formers. Under the first division are comprehended fat, starch, sugar, etc.; under the second, substances containing nitrogen, as albumen, casein, etc. There is not, however, a rigid line of separation between these two classes, for both

are more or less concerned in the functions attributed to each, but their most important position and office are as assigned by the classification.

The ultimate uses of food are two : to construct tissues or repair them when destroyed by wear ; to supply force—muscular, nervous, secretory, etc. The reception, digestion, and absorption of food is known as the *primary assimilation ;* the utilization of the material for the growth and repair of the tissues, and by the organs, as force, constitutes the *secondary assimilation.*

The first step in the primary assimilation is the mechanical subdivision of the food by mastication. The admixture of the saliva with the food facilitates the process of mastication, and, as it contains a ferment, *ptyalin*, which has the property of converting starch into sugar, a portion of this constituent undergoes conversion ; but, probably, the chief use of the saliva is to give a slight alkaline reaction to the mass of food. According to the laws of osmosis, the entrance of an alkaline fluid into the stomach hastens the formation of the acid gastric juice. In the stomach, under the influence of the ferment, *pepsin*, and the acid (hydrochloric) of the gastric juice, the nitrogenous materials—the albuminous constituents of the food, the proteids—are transformed into *peptones.* Although fat is necessary to the stomach digestion, it does not undergo conversion in the stomach, and escapes in a coarse emulsion, with the chyme, into the duodenum. Starch, sugar, and gum, also pass into the chyme unchanged, although separated from their proteid envelopes, by the action of the gastric juice, except such portions as may diffuse directly into the stomach-veins. The peptones, to a large extent, diffuse into the blood from the stomach, and doubtless, also, such crystalloidal substances as sugar, to some extent. The chyme contains parapeptones, starch, fat, sugar, and refuse matter remaining undissolved. In the duodenum the acid chyme mixes with the alkaline intestinal and pancreatic juices and the bile, which are poured out freely as the materials from the stomach distend the canal. Here the conversion of starch into sugar takes place actively, and the fats are emulsionized and to some extent, also, saponified. The pancreatic juice not only emulsionizes the fats, but separates them into their component fat acids and glycerin, and the acids meeting alkaline bases form soaps, which are readily diffusible. The action of the bile is also very important. It renders the soaps formed soluble, and promotes the emulsionizing of the fats. Its agency in the digestion of the fats is well shown in the results of the experiment for forming a biliary fistula. When the bile is conveyed externally, the amount of fat entering the lacteals is much below normal, and instead, the fat appears in the stools. In the small intestine the proteids which escape conversion in the stomach are transformed, under the agency of the bile, pancreatic fluid, and intestinal juice, into peptones and other substances, the starch is converted into sugar, and the fats are emulsionized, and in part, also, saponified. These nutrition materials diffuse into the portal veins and into the lacteals, so that, by the time the intestinal contents reach the ileo-cæcal valve, they are composed, for the most part, of excrementitious matters and the refuse of the foods taken.

When the nutrition of the body goes on in the normal manner, there exists a certain ratio between the income and the outcome. The income consists of the proteids, fats, carbohydrates, salts and water of the food, together with the oxygen absorbed from the atmosphere. The outcome is made up of the excreta of the respiratory act, consisting of carbonic acid and water with a little hydrogen ; of the perspiration, composed of water and salts ; of the urine, which contains the nitrogen excreted from the body and a large quantity of saline matter ; and of the fæces, composed of excreta from the immense glandular apparatus of the ileum and colon, and from the liver. In a perfectly healthy condition of the body, after it has attained its full growth, there should be an exact ratio between the income and outcome ; the income should suffice to furnish the force necessary for the performance of the various functions and to repair the waste of the outcome. In an ideal dietary, the amount of the food should be sufficient to maintain this ratio at the normal standard.

As respects classification of foods, for the purposes of this work, they may be considered under the natural divisions of *Animal* and *Vegetable.*

Animal.—One of the most important articles of diet for the sick is *Beef*, and it should be of good quality : the bone should not exceed 20 per cent ; the fat should be firm, not yellow, and free from blood, and should not be in too great proportion relatively ; the muscle should be firm without being tough, not too pale, nor dark-colored, and should not present any marbling or lividity on cross-section. The most esteemed parts of the beef are the thigh and hip (round, sirloin, fillet), the loin and certain parts of the shoulder (rib-roast, porter-house steak, etc.). The composition of beef, according to Moleschott's mean of the Continental analyses, is as follows (Parkes) :

Water	73·4
Soluble albumen and hæmatin	2·25
Insoluble albuminous substances	15·2
Gelatinous substances	3·3
Fat	2·87
Extractive matters	1·38
Creatin	0·068
Ash	1·6

The ash contains chlorides of sodium and potassium, potash, soda, lime, magnesia, iron (oxide or phosphate), phosphoric acid, sulphuric, chlo-

rine, and silica. The composition of cooked meat, according to Moleschott (Parkes), is as follows :

Water	54·0
Albuminates	27·6
Fats	15·45
Salts	2·95

It will be perceived from the foregoing analyses that beef contains alimentary principles the most important for the nutrition of the body. When of good quality, neither too old nor too young, the fat and muscle suitably proportioned, and not altered by disease, and properly cooked, it is the best of the animal foods. The loss of lean beef in the process of cooking is about one third of the total weight ; of fat beef, about one half. The time required for the complete digestion of beef, as ascertained by Dr. Beaumont, is two and three fourths to three hours.

Veal is less digestible and less nutritious than beef, and has a laxative action, which may, however, be utilized in states of disease. It has the following composition :

	Parts.
Water	63·0
Nitrogenous	16·5
Fat	15·8
Salts	4·7

As compared with beef, it is rather slow of digestion, requiring five hours or more. It is more albuminous than fibrinous, and abounds in gelatin (Fonssagrives). The thymus gland of the veal (*sweetbread*) is, when "plainly cooked (by boiling) and moderately seasoned, a very agreeable and suitable dish for the convalescent."—(Pereira.)

Mutton, although possessing a lower degree of nutritive value than beef, is one of the most useful of the animal foods, as it is easily digested. Many patients, however, experience a marked degree of repugnance to mutton and can not be induced to make use of any article of diet containing it. An evident idiosyncrasy exists in some constitutions against it, so that taken disguised in any way it disagrees with the stomach. It does not continue long in favor as the exclusive article of the meat portion of the diet, even with those who relish it for occasional use. According to Church, the following is the composition of mutton :

	In 100 parts.
Water	44·1
Albumen	1·7
Fibrin (true muscle)	5·9
Ossein-like substances	1·2
Fat	42·0
Organic extractives	1·8
Mineral matters	1·0
Other substances	2·3

Pork contains more fatty matter and more often disagrees than the meats above described. Many dyspeptics can not make use of it in any form : on the other hand, breakfast bacon may be much relished and be easily borne. Pork is rarely prescribed as a diet for the sick, but, for convalescents, roasted sucking-pig, which is easily digested, may be ordered to vary the food and to stimulate a languid appetite. Pork differs from beef and mutton in the relatively greater quantity of fat. The loss on cooking pork is 50 per cent. Pork, also, yields up to water less solid matter, for, while the solids contained in broth of beef and mutton were 27 and 33 per cent respectively, that from pork contained only 19 per cent. Beaumont found that roasted pork required five and one fourth hours for its solution and digestion in the stomach.

Bacon has the following composition, according to Church :

	In 100 parts.	In 1 lb. oz.	In 1 lb. gr.
Water	22·3	3	248
Nitrogenous matter	8·1	1	130
Fat	65·2	10	189
Salt	3·8	0	256
Phosphates, etc.	0·6	0	42

Venison is more easily and quickly digested than beef, but does not possess the same nutritive value. It is useful as an occasional article of diet for the state of convalescence and during a course of special animal diet, but for habitual consumption is not equal to beef.

The domestic Chicken is a most important article of food for sick and convalescents. The taste is agreeable, the tissues soft and easy of mastication and digestion. "Spring chickens" are more tender and delicate than the fully-developed fowl of four or six months. Next to the chicken in point of digestibility is the domestic turkey, and after this the domestic goose and duck. Certain "game-birds," e. g., the prairie-chicken, wild-ducks, woodcock, snipe, are frequently prescribed for convalescents, and possess a high degree of nutritive value, but are not, of course, adapted for habitual use.

The viscera of certain animals are sometimes employed as food. Allusion has already been made to "sweetbreads," the thymus of the calf. The pancreas is very often substituted for the true sweetbread, and may, when in proper condition, be used instead of the thymus, but it is apt to be stringy and fibrous. The brain, tongue, heart, liver, kidneys, and alimentary canal, are occasionally eaten, but are not frequently prescribed for the sick. Brain is easily digested, and, as it contains fats in combination with phosphorus, may be usefully prescribed in conditions of disease in which these constituents are presumed to be deficient in amount. Liver, as ordinarily prepared by frying, is very trying to weak stomachs, but this food contains mat-

ters which may be utilized in certain diseased states. According to Braconnot (Pereira), the composition of liver is as follows :

Brown oil, containing phosphorus	3·89
Nitrogenous matter	6·07
Albumen	20·19
Salts	1·21
Water	68·64

Kidneys, especially as ordinarily prepared, are very difficult of digestion, and are unsuited for the sick. As they contain a notable quantity of urea and other excrementitious matters, they are for this reason objectionable articles of diet. Tripe, the stomach of ruminants, is very easily digested and very nutritious, when prepared in the simple way, only, which is advisable for invalids. It consists largely of albumen.

In order to test the relative value of the animal foods considered in the foregoing pages, Marchal de Calvi (Fonssagrives) made a series of elaborate examinations to determine the proportion of water and fat to the solid. The results were as follow :

ANIMAL FOODS.	First Analysis.		Second Analysis.	
	Solid matters.	Water.	Solid matters.	Water.
Pork	294·50	705·50	302·50	697·50
Beef	277·00	723·00	275·00	725·00
Mutton	265·50	734·50	263·50	736·50
Chicken	263·50	736·50	263·00	737·00
Veal	260·00	740·00	255·50	744·50

These analyses assign to pork the first position. In another series of experiments M. Marchal used ether to dissolve the fat contained in the fibers of these meats. His results are expressed in the following figures :

ANIMAL FOODS.	Matters soluble in ether.	Matters insoluble in ether.
Beef	25·437	249·563
Chicken	14·070	248·930
Pork	59·743	242·757
Mutton	29·643	233·857
Veal	28·743	226·757

The following is the most recent contribution to our knowledge of the composition of these animal foods (Church) :

The composition of 1 lb. of

	Beef.		Mutton.		Pork.		Veal.		Lamb.	
	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.	Oz.	Gr.
Water	8	0	7	16	6	69	10	0	8	44
Albuminoids	1	122	0	385	0	315	1	199	0	360
Ossein-like substances	1	62	1	52	0	385	1	82	0	400
Fat	4	340	6	176	8	0	2	281	5	263
Mineral matter	0	350	0	245	0	105	0	312	0	244

According to these experiments, from the chemical point of view, beef has the highest nutritive value ; chicken ranks second, and is but little inferior to beef ; while veal is the lowest.

There are certain substances of animal origin which possess great importance as dietetic agents, viz., eggs, and milk and its products.

Eggs.—The following observations refer to the eggs of the domestic chicken. The egg is composed of four distinct parts : the shell ; the membranous envelope of the albumen ; the white ; the *vitellus*, or the yellow. The envelope of the albumen contains nitrogen and sulphur, and phosphate of lime remains after incineration. The white or the albumen contains in 100 parts :

Albumen	12 to 15
Matter not coagulable	5
Water	80

The residue after incineration of the albumen is composed of phosphates and sulphates of lime and magnesia, and alkaline carbonates. The yellow is a phosphorated fatty matter suspended in water by means of an albuminous substance known as *vitellin*. The yellow contains 53·78 parts of water, 17·47 of albumen, and 28·75 of fatty matter. According to Gobley (Fonssagrives, from whom most of these details have been obtained), the yellow has the following chemical constitution :

Water	51·486
Vitellin	15·760
Margarin and olein	21·304
Cholesterin	0·438
Margaric and oleic acids	7·226
Phospho-glyceric acids	1·200
Sal-ammoniac	0·034
Salts	7·299
Extracts	0·400
Ammonia, nitrogenized matters, coloring matter, lactic acid	0·833

Eggs consumed by the sick should be fresh and sound. The average weight is about two ounces avoirdupois. According to Parkes, the following are tests of the freshness and soundness of eggs :

"Fresh eggs are more transparent in the center ; old ones at the top. Dissolve one ounce of salt in ten ounces of water : good eggs sink, indifferent swim. Bad eggs will float even in pure water." Fonssagrives recommends the same tests. Eggs coated with beeswax dissolved in warm olive-oil (one third beeswax, two thirds olive-oil) it is said may be preserved for two years.

Eggs raw, or better, whipped, are the most digestible of alimentary substances, and, as their composition indicates, possess a very high degree of nutritive value.

Milk is one of the most important articles of food for the sick, and