DIGESTION, AND THE USE OF ARTIFICIAL DIGESTIVE AGENTS.

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As there are a great many artificial digestive agents now in extensive use it seems desirable that the general acquaintance with the digestive act should be enlarged. This is very desirable for pharmaceutical chemists and their assistants, as these digestive agents are not always purchased under medical orders; nor, indeed, is it necessary that they should only be dispensed under medical instructions: their use is too extensive for that. But as the labels affixed to these digestive agents are not themselves always accurate, indeed are in some instances actually misleading, it is very desirable that dispensing chemists should possess a sufficient knowledge of the digestive act to direct their customers as to the proper use of the artificial digestive agents they purchase, in order to secure the greatest possible benefit therefrom.

Such being the case, on the one hand, and, on the other hand, most works coming within their reach being obsolete as regards their acquaintance with digestion in its various sections, it is essential that dispensing chemists be made acquainted with more recent advanced views as to the digestive process. It will be well, then, to follow the digestive act as described by Professor Michael Foster, F.R.S., in his well-known "Text book of Physiology," it being clearly understood that the general outline is followed *here*, and no attempt essayed to discuss minutiae or dispute points. This being clearly recognized, those who wish to go deeper into the subject can easily do so, their studies being in no way impeded by a certain familiarity with the matter.

To make a broad distinction, then, it may be said that there are three divisions of the digestive act, according to the staple elements of our food: (1) Starch; (2) albuminoids; and (3) fats.

(1.) *Starch*.—This is a purely hydrocarbonaceous substance found in numerous vegetable products, markedly in the seeds of the cerealia. It has the formula $C_6H_{10}O_5$, which differs slightly from that of sugar ($C_6H_{12}O_6$). The

this is the first portion of the digestive act, marked "1. Alkaline."

A large quantity of the starch of our food is thus removed first, and so does not impede the action of the gastric juice on the other constituents.

(2.) *Albuminoids*.—These are complex bodies whose characteristic is that they all contain nitrogen. Albumen, white of egg, is the type of this form of food. Hydrocarbonaceous matter may be termed "fuel-food;" albuminoids are "tissue food." The grand division of Liebig stands good yet as a broad law—as the cardinal fact to be grasped. Nitrogen interferes with oxidation, so nitrogenized matters are the constituents of tissues. If tissues were not nitrogenized they would burn equally readily with "fuel-food." This would be as inconvenient with the body as it would be in a locomotive if the ironwork burned as readily as did the coals carried in the tender. This ironwork rusts by oxidation; and the tissues wear out by oxidation; but in each case it is a slow process, which contrasts with the quick combustion to which we apply the term "burning."

Nitrogenized foods are tissue foods, spoken of generically as "albuminoids." These are egg-albumen; the tissues of animals of all kinds, especially the red flesh or muscles; and caseine, animal as in milk, or as the caseine of the legumes, or pea tribe. Egg-albumen furnishes the tissues of the embryo fish, reptile, or chick, as the case may be; while from milk caseine the suckling mammal feeds its growing tissues. From the albumen of seeds the tissues of the embryo plant are formed.

Albuminoids are digested in the stomach by the action of the acid gastric juice. The gastric ferment, named "pepsin," is only active in an acid medium.

Gastric digestion exercises no effect upon either starch or fat: it only digests albuminoids.

If the reader will refer to the diagram he will see that just below the intestinal outlet of the stomach the common duct of the bile and the pancreatic secretion enter the bowel. When the contents of the stomach have been reduced to a pulp, known as "chyme," they pass through the ring (the

that sugar and albuminoids are taken up by the portal vein, and carried to the liver; the fat is taken up by the lacteals, and passing through several glands, reaches the blood by the thoracic duct (not shown), which opens into the venous system at the root of the neck. The fat does not pass to the liver directly.

The indigestible and waste matters pass down the intestines to be cast out as the feces.

Such, then, is an outline of the digestive act. Having mastered it the reader will readily comprehend the rationale and utility of the several artificial digestive agents, and will recognize what is aimed at in resort to them; and, further, what precautions are to be taken, what cautions to be observed, what errors to be avoided.—*Chemist and Druggist*.

PILOCARPIN IN DIPHTHERIA.

DR. ALFRED MULLER, of New Ulm, Minn., has communicated to the committee on diphtheria of the Minnesota State Board of Health, the following observations and extracts from a foreign article on the use of pilocarpin in diphtheria.

Dr. Franklin Staples, chairman of the committee, in furnishing the paper for publication, observes: "While there is, seemingly, undue importance given here to the membranous exudation, or the local disease in diphtheria, the facts given by one who has had the wide experience with the disease which Dr. Muller has had, and corroborated by the foreign authorities which he gives us, are worthy of examination."

Dr. Muller writes in a note accompanying the article, which was translated for him by Dr. R. P. A. Nix, as follows: "Dr. Kuhlman, of this place, New Ulm, who has had a large number of cases, has been successful with the fluid extract of jaborandi. I have used the muriate of pilocarpin, and my success in many cases was surprising to me. I have given wine after each dose of the medicine, and a sufficient quantity of the latter to excite a profuse flow of saliva, and this was kept up until all the membranes were seemingly washed away. No unpleasant symptoms appeared in the use of the remedy."

It is a well known fact that the intensity of the febrile and other phenomena accompanying diphtheria, is, in most cases, directly proportional to the extent and amount of pseudomembranous coating of the pharynx, velum, and adjoining parts. On the other hand, the disappearance of the pseudomembranes indicates convalescence, except in those extraordinary cases in which a secondary disease or morbid condition is produced. It is evident that, in the therapeutic treatment of that disease, we must seek to remove the diphtheritic membrane in the shortest possible time, and attempt to mitigate the local inflammation and other characteristic phenomena. Among the corrodents and other remedial agents hitherto used, there is none that may be said to effect the complete destruction of the fungoid excrescence. Their application keeps the diseased mucous membrane in a state of constant irritation, which renders it almost impossible to check the production of new diphtheritic membrane.

Extracts from an article by Dr. George Guttman, a Silesian physician, published in the Berliner Klinische Wochenschrift.

Dr. Guttman, after studying the physiological effects of pilocarpin, employed this remedy in cases of bronchial catarrh. Its irritative influence upon the salivary glands, and the entire absence of inflammatory effects, led him to believe that the increased secretion of saliva following its use would tend to dissolve and remove the pseudomembranes in diphtheria. Accordingly, he tried pilocarpin as a remedy in this disease. The effects produced surpassed his most sanguine expectations.

In April, 1879, seven members of the same family were successively taken ill with diphtheria; three of these were afflicted with the worst form of the disease. With the second patient Dr. Guttman used a medium dose of pilocarpin (0.05 daily) twenty-four hours. On the second day he noticed a very copious flow of saliva contaminated with diphtheritic pseudomembranes. In addition to pilocarpin, quinine had been taken internally; tannin had been applied to the diseased parts; the patient had gargled with lime water and pepsin. The other patients were treated in the same manner. All recovered in from two to four days.

Attributing this unexpected result to the use of pilocarpin, Dr. Guttman resolved to continue studying its effects in cases of diphtheritic and laryngeal croup. He communicated his experience to Dr. Geldner, who, together with Dr. Dylenky, applied pilocarpin with equally satisfactory results. In a letter to Dr. Guttman, dated August 2, 1880, Dylenky writes:

"Accept my heartfelt thanks for kind information concerning pilocarpin, which you were the first to use for croup and diphtheria. . . . I cannot dispense with a remedy which, in the few cases which I have treated, has produced the most excellent results. Let me mention but one case. A boy of four, already quite low by anæmia and suffering greatly from dyspnoea, was brought to my office at Pitschen. An examination showed highly swollen tonsils, and pharynx thickly covered with the characteristic diphtheritic "plaques." Local treatment with the usual corrodents was impossible, as the mouth could not be opened sufficiently on account of the swelling and pain. It was interesting to ascertain whether in this case, in which death by suffocation was to be expected every moment, pilocarpin would prove beneficial. I prescribed the usual dose, and requested that the patient, in case of surviving, be brought again two days later. On the third day, the dyspnoea and cyanosis had ceased, the swelling of the diseased parts (especially of the tonsils) had diminished, the diphtheritic pseudomembranes were scanty and small. On the seventh day the boy, though weak, was beyond danger."

From April 1879, to July, 1880, Dr. Guttman treated sixty-six cases of diphtheria. In fifteen of these cases the disease had reached such an aggravated stage that under the old mode of treatment at least two-thirds would have been considered fatal. Eighteen cases were of a mild nature, with but moderate fever. The remaining thirty-three showed a considerable development of diphtheritic pseudomembranes, and were of such a character that under the old treatment at least ten per cent. would have been fatal. Pilocarpin was used internally in each of these sixty-six cases. Gargling preparations and quinine were also used with a few of the earlier patients. Each of the sixty-six patients recovered in a very short time. Of the fifteen most critical cases, thirteen convalesced in from two to five days, one in nine, and one in eleven days. The remainder (fifty-one) recovered in from one to three days.

Those patients who were placed under Dr. Guttman's care in the earliest stage of the disease, when the pseudomembranes were as yet but loosely attached to the mucous membrane, recovered in twenty-four hours. The use of

DIAGRAM
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DIGESTIVE TRACT

difference consists in a molecule of water, which, however, makes a very important difference, viz., starch is insoluble, sugar is soluble. Insoluble starch is converted into soluble sugar in the digestive act by "hydration," that is, by the addition of water. Without such change starch could not pass through the walls of the alimentary canal and reach the blood. So if starch were not insoluble it could not be stored up for the needs of the young plant, but would be washed away, and so lost. The grain of corn digests its starch as it requires it. Startling as it may seem at first sight, such is the fact.

Insoluble starch is converted into soluble sugar; that is the first operation of digestion. By this means it passes into the portal vein, and is conveyed to the liver. But if it remained sugar it could no more be stored securely in the liver than in the seed; so it is there changed back into starch—insoluble starch, as "glycogen," or "animal starch." Solution was necessary to pass it through the wall of the alimentary canal. This glycogen, or animal starch, is given off from the liver as sugar, on which the body lives. As the seed digests its stored starch as it requires, so the system takes from its store of starch in the liver according to its needs. This is the broad outline of the digestion of starch. It has first to be made soluble to pass into the blood; then has to be turned back into an insoluble form for storage; finally, it is once more made soluble for its entrance into the general circulation.

Starch, then, is converted into sugar (or a soluble matter, "dextrine") in the digestive act.

This change is achieved by the action of the saliva. Saliva contains a ferment, "diastase," which is capable of converting insoluble starch into insoluble sugar by hydration. Diastase also exists in the seed of the cerealia, and digests the starch into sugar for the wants of the germinating grain.

This diastase is active in an alkaline medium; consequently when the stomach becomes acid it is killed. Salivary diastase is operative: (1) in the mouth; (2) in the oesophagus, or gullet; and (3) in the stomach, until it becomes acid. Referring to the diagram the reader will see

pyloric ring) of the stomach into the upper bowel, known as the duodenum. Here the chyme becomes mixed with the bile and the secretion of the pancreas. The acid of the stomach is neutralized by the bile, so that the contents of the duodenum become alkaline.

(3.) *Fat*.—Hitherto fat has remained untouched by the digestive act, now it is emulsionized by the action of the bile. Fat undergoes no change in the digestive act beyond being converted into a fine emulsion, which enables it to be taken up by the lacteals of the intestine.

Such, then, are the three divisions of the digestive act.

But the pancreatic section is a complex fluid, containing (1) diastase and (2) trypsin. Trypsin is an energetic digestive ferment, acting upon albuminoids in an alkaline medium. Consequently we see that in the duodenum the digestive act is seen in its greatest and completest perfection, known as "chylification."

(1.) Starch is once more converted into soluble dextrine and sugar by the pancreatic diastase; and the starch unchanged by the salivary diastase, having passed through the acid stomach unaffected, is now hydrated by the pancreatic secretion in an alkaline medium into sugar.

(2.) Albuminoids are digested by the trypsin in the alkaline medium.

Albuminoids are digested in the alimentary canal by being rendered soluble by a process of hydration, so as to pass from the alimentary canal, through the walls, into the blood. Albuminoids are called "proteids" until digested; digested soluble albuminoids are called "peptones."

The peptones are taken up by the radicles of the portal vein, and in the blood are changed back to "proteids."

In the liver the albuminoid parts of our food are further elaborated to fit them for the nutrition of the tissues.

In the liver waste and surplus albuminoids or proteid matters are converted into (A) bile-acids, uniting with soda, i. e., the bile which emulsionizes fat; and (B) urea and uric acid, the forms in which the nitrogenized waste is excreted by the kidneys. This destructive change is a process of oxidation. By referring to the diagram the reader will see