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ON

Digestion

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BY

Sam. C. Rice

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To Dr A. H. Buchanan as a mark of the high respect which I have for him and for the many attainments which his shrewd mind and great skill has placed him in the science of medicine. This feble effort on the subject of Dégestion is respectfully inscribed by his most humble Servent

Sam'l V. Péce

Digestion

Digestion is a function peculiar to animals; and the existence of a seperate set of organs devoted to digestion, has been regarded as one of the characterestics by which animals are distinguished from plants. Vegetables, it is true, are nourished and grow; but they do not, properly speaking, digest. Their nutrition and growth are the result of an external absorption from the atmosphere, and the soil effected at their surface, and by means of roots; while animals first receive the materials of their nutrition into a central cavity, where they are subjected to a series of remarkable changes, and their nutritive elements are afterwards carefully selected and imbibed by a set of internal roots. Nutritive matter, therefore, is absorbed in a crude state by plants; but in a digested state by animals. In vegetables, and the lowest orders of the animal kingdom, the absorbing vessels themselves exercise an assimilating power over the matters absorbed as nourishment, and this preparation is the only digestion which the food of these kinds of organized beings undergoes; but in all the animal kingdom, with the exception of the very lowest orders in the Zoological

scale, digestion is centralized in a particular apparatus, more or less complicated, according to the position of the species in the scale of animal life.

In its simplest or rudimental state, the digestive apparatus consists of a membranous tube, provided with two openings, which serves for mouth and anus. In its first stage of complication, it assumes the form of a straight canal, the length of which is less than that of the animal to which it belongs, and is provided with two orifices, one destined for the reception of the food, the other to the expulsion of the refuse matter of nutrition. In its higher state of complication, it progressively acquires a greater relative length, in some of the higher orders of animals exceeding, by nearly thirty times, the length of the body, and presenting numerous convolutions. Its two orifices are guarded by circular muscles, which act under the control of the will; and several auxiliary organs are connected with it, which contribute to give greater variety and complications to its functions

In the mammalia, the digestive canal presents its greatest or

last degree of complication. In the human species it consists of a tube about six times the length of the body, extending from the mouth, through the chest and abdomen, to its inferior orifice, the anus; unequal in its diameter, being much larger in some places than in others, and in one place swelling out into a capacious sac; presenting, in a great part of its course, irregular convolutions, and terminating at each extremity by one orifice, closed by a circular muscle, which acts under the control of the will

The digestive canal is found partly in the head, where it forms the cavity of the mouth; partly in the neck and thorax, where it takes the name of the pharynx and Oesophagus; but principally in the abdomen, where it forms the stomach and intestines, which, with the associated viscera, the Liver, the Pancreas, the Spleen and the mesentery, occupy nearly the whole of this great cavity

The mouth is formed by the two lips. Its cavity is bounded above by the palate, below by the tongue, before by the teeth, laterally by the cheeks, and posteriorly by the curtain of the

palate, which seperates the cavity of the mouth from the Pharynx. The Pharynx is a funnel shaped cavity, which terminates in the Oesophagus. It has opening into it. the posterior nares, from the nasal cavity; the Eustachian tubes from the ears, also the mouth, Larynx and oesophagus. The Oesophagus is a continuation of the Pharynx. It is a long, straight, fleshy tube, which gapes down the chest, behind the Trachea, lying upon the vertebral column, and opens into the stomach by an orifice which is called the Cardiac The Pharynx and Oesophagus or the Pharyngo-Oesophageal cavity is the organ of deglutition

The stomach is a large pouch, situated below the diaphragm and lying obliquely across the epigastric region, and a part of the left hypochondriac. Above it is bounded by the liver, and the diaphragm; below by the transverse colon; behind by a part of the vertebral column; before by the false ribs of the left side, with their cartilages; on the left by the Spleen. The stomach has two orifices, a superior, or cardiac orifice, which communicates with the Oesophagus; and an inferior

or pylorick orifice, which opens into the duodenum. It also has two borders, a superior or concave border, and an inferior or convex border, the arch in the latter is much greater than in the former. The situation of the organ, as well as its volume varies much according to its state of emptiness or repletion. When empty it is flaccid and pending, and its greater curvature inclines downward. But when distended its greater curvature is raised forward. The stomach is the organ of Chymification or gastric digestion.

The intestines extend from the pylorus to the anus, forming a mass of convolutions, which fill most of the abdominal cavity. They are divided into two portions, viz, the large and the small intestines, a distinction founded on their relative diameters. The small intestines are subdivided into three parts, viz, the Duodenum, Jejunum, and Ileum. The first receives its name from its length, which is equal to the breadth of twelve fingers. It is the seat of chylification. The Jejunum, or hungry gut, is so called from its generally being found empty, and the Ileum, ie, the twisted gut, derives its name from the

numerous convolutions which it exhibits. The small intestines have a less diameter and thinner coats than the other portions of the intestinal canal; but their length is much greater, amounting in an adult to four or five times the length of the whole body. They are attached to the superior lumber vertebra by a duplicature of the peritoneum, called the mesentery. The large intestines commence where the small terminate. A circular fold of the mucous membrane of the Ileum, penetrating by its free border into the large intestines, and called the Ileo Cæcal Valve, seperates the two great divisions of the intestinal canal from each other. The large intestines are divided into three portions, viz, the Cecum, Colon, and Rectum, which last terminates in the anus

In the greater part of its extent, the digestive canal, consists of three membranes, viz, a mucous, muscular, and serous. Only the two first however, are essential to it; the mucous, or internal tunic, constituting a secreting and absorbing surface; and the muscular, or middle, executing the various motions to which the food is subjected after

its reception into the stomach; the external or serous tunic, is merely accessary, as it is wanting in many parts of the digestive tube, and no where completely envelopes it.

The soft parts of the mouth are composed almost wholly of muscles, lined internally by a mucous membrane. These muscles execute the different motions of the mouth, by which this cavity is enlarged or diminished, and variously modified in its shape in the processes of mastication and insalivation, and the food is afterwards forced from the mouth into the Pharynx. The membrane which lines the mouth secretes a mucus which lubricates this cavity, and is blended with the food in mastication. The Pharynx also is composed of a mucous membrane of a deep red color, and a muscular layer, which contracts this cavity and compresses its contents, forcing them into the Oesophagus in the act of deglutition. The Oesophagus, in like manner, is composed of a muscular coat and a mucous membrane. The former consists of two strata of muscles, one external which is composed of longitudinal fibres of considerable thickness and strength

near the stomach they diverge, and may be traced extending over the cardiac orifice of the stomach; and an internal layer consisting of circular fibres considerably thinner than the former, and disappearing at the termination of the Oesophagus. The mucous membrane is continuous with that which lines the Pharynx. It presents numerous longitudinal folds, which are owing to the contraction of the muscular coat

According to Magendie, the inferior third of the Oesophagus, is subject to an uninterrupted alternate motion of contraction and relaxation. The contraction commences at the upper part of the inferior third, and proceeds with a certain degree of rapidity, to the insertion of the Oesophagus into the stomach. Its duration is variable, but on an average amounts to about thirty seconds. The part thus contracted is hard and elastic, like a tense cord. The relaxation which succeeds, takes place suddenly and simultaneously in the contracted fibres

The Oesophagus is furnished with mucous follicles, which,

are sparingly distributed over it

The stomach, also, is composed of two principal coats. The internal is a soft, spongy, mucous membrane which is extremely vascular, or plentifully supplied with blood vessels. It is smeared with mucus, secreted by numerous follicles, seated in it. The second coat of the stomach is muscular and is composed of fibres, disposed in three different directions, viz, longitudinally, circularly and obliquely. The longitudinal fibres form the exterior muscular plane, which is a mere continuation of the longitudinal fibres of the Oesophagus. Immediately beneath this are the circular fibres, and subjacent to the latter are the oblique. Besides these two principal coats, the stomach receives an external tunic, formed by a duplicature of Peritoneum. This coat is united to the muscular by cellular tissue

The stomach is plentifully supplied with blood vessels and nerves. The blood is chiefly designed to furnish materials for the secretion of the gastric juice, which

is supposed to be the principal agent in Chymification
The arteries of the stomach are very large and numerous,
and they all spring directly, or indirectly, from a
large trunk called the Celiac artery. The nerves of the stoma
-ch originate from both nervous systems, the Cerebro
-Spinal, and the ganglionic. From the former it receives
branches by means of the Pneumogastric; and from the
latter by the Celiac Plexus
The structure of the Intestines resembles, very nearly, that of
the stomach. They are composed essentially of a mucous
membrane and a muscular coat; the former constitutin
-g a secreting a secreting and absorbing surface; the
latter executing the various motions, which are necessary
in propelling the contents of the intestines regularly
through the canal. There is a third tunic, which is
external, derived from the Peritoneum, hence its na
-me, Peritoneal covering. The internal surface is always
kept lubricated with mucus secreted by the follicles of
the intestines. Into the first of the small intestines

opens the excretory ducts of two important glands, the liver and the pancreas

The necessity of taking food arises from the loses which the body is constantly undergoing, by the different secretions and excretions, which amounts to several pounds in the space of twenty four hours. These loses immediately affect the blood, which becomes impoverished by the demands upon its principles, which nutrition, and the various secretions and excretions are constantly making. But indirectly, the solids feel the effects of this incipiant drainage, because they are undergoing, without intermission, the process of organic decomposition, and the molecules detached from them, are paping into the venous blood, and are afterwards eliminated from the system by the urinary and other excretions

We are incited to take food by certain internal sensations, which are termed hunger and thirst. Neither the seat, nor the efficient causes of these sensations

are well known. Hunger has been referred to a pecu-
liar affection of the nerves of the stomach; an opinion
which in itself seems sufficiently probable, as sensation
is a phoenomenon of the nervous system, and as
the sensations of hunger is referred directly to the stom-
ach. Thirst has been referred to a certain impression
upon the nerves of the fauces and pharynx
The process of digestion may be divided for consider-
ation into the following Process 1st Prehension, 2nd
Mastication and Insalivation - 3rd Deglutition, 4th
Chymification, 5th Chylification and 6th Defecation
The Arms and Hands are the chief instruments of
Prehension. It is scarcely necessary to say, that the ha-
nds seize the food and convey it to the mouth, when
it is conveyed to the mouth it must open to receive
it; as soon as introduced, the jaws are closed to retain
it, and subject it to mastication. Most animals
are compelled to use the mouth alone
The first changes which the food is subjected in

the alimentary canal, takes place in the cavity of the mouth; the solid articles of food are here submitted to the action of the teeth, whereby they are divided and crushed, and, by being at the same time mixed with the Saliva of the mouth, are reduced to a soft pulp, capable of being easily swallowed. The fluid with which the food is mixed in the mouth, consist of a secretion of the salivary glands, and a mucus secreted by the lining membrane of the whole buccal cavity. The glands concerned in the production of Saliva are very extensive and in Man and Mammalia generally, are presented in the forms of four pairs of large glands, Parotid, Submaxillary, Sublingual, and Intralingual, and numerous smaller bodies of similar structure, and with separate ducts, which are scattered thickly beneath the mucous membrane of the lips, cheeks, soft palate, and root of the tongue. These all have the structure common to what are termed Conglomerate glands. The rate at which saliva is secreted

is subject to considerable variation. When the tongue and muscles of mastication are at rest, and the nerves of the mouth are subject to no unusual stimulus, the quantity secreted is not more than sufficient, with the mucus to keep the mouth moist. But the flow is much accelerated when the movements of mastication takes place, and especially when they are combined with the presence of food in the mouth. It may be excited also even when the mouth is at rest, by the mental impresions produced by the sight or thought of food. The purposes served by saliva are of several kinds, acting mechanically, it keeps the mouth in a due condition of moisture, facilitating the movements of the tongue in speaking, and the mastication of food. Thus also it serves in dissolving sapid substances, and rendering them capable of exciting the nerves of taste. But the principal mechanical purpose of the saliva is that by mixing with the food during mastication, it makes it a soft pulpy mass, such as may be easily swallowed.

To this purpose saliva is adapted both by quantity and quality. For, speaking generally, the quantity secreted during feeding is in direct proportion to the dryness and hardness of the food.

The quality of saliva is equally adapted to this end. It is easy to see, how much more readily it mixes with most kinds of food, than water alone does. Beyond these its mechanical purposes there are reasons for believing that saliva performs some chemical part in the digestion of the food. The chief of these reasons are, the number and size of the glands engaged in the secretion; the variety of substances which enter into its composition, and which can scarcely be supposed to be of use so far as its mechanical properties are concerned; the quantity which is secreted, not only during mastication, but after the food has entered the stomach, especially in old persons, who from their loss of teeth, frequently swallow their food in an imperfectly masticated state. Starch appears to be the only

principle of food upon which saliva acts chemical
-ly

Deglutition, although executed with extreme rap-
-idity, and apparently simple, is the most complicated
of the digestive operations. It requires the action of
the mouth, pharynx, and oesophagus. To facilitate its
study Magendie divides it into three stages. In the
first the food passes from the mouth into the pharynx;
in the second it clears the apertures of the glottis and
nasal fossae and attains the oesophagus, and in the
third clears the oesophagus and enters the stomach.

1st When the food has been sufficiently masticated
and imbued with saliva, it is collected by the action
of the cheeks and tongue upon the upper surface of the
last organ; the mass being more or less rounded, and
hence usually termed the alimentary bolus, having no
other way of escaping, from the force preping it is dir
-ected towards the pharynx. By this combination of results
the food is impelled into the pharynx. In this first stage

of deglutition, the motions are voluntary. The process is not executed with rapidity, and is easily intelligible. 2nd The distance over which the bolus has to travel, in the second stage is trivial; the rapidity of its course is owing to the larynx or superior aperture of the wind-pipe which opens into the pharynx, having to be cleared instantaneously, otherwise respiration, would be arrested, and the most serious effects ensue. The mode in which this second stage is accomplished; is as follows. As soon as the alimentary bolus comes in contact with the pharynx, all is activity; the pharynx contracts, embraces and prepes the bolus, and by the aid of several muscles, (not necessary to mention) glides on over its surface; and forced on by the veil of the palate, and by the constrictors of the pharynx reaches the oesophagus

3rd In the third stage, the pharynx, by its contraction, forces the alimentary bolus into the oesophagus so as to somewhat dilate the upper part of the organ. The upper

circular fibres are thus excited to action, and force the food onward. In this way by the successive contraction of the circular fibres it reaches the stomach. In the upper part of the oesophagus, the relaxation of the circular fibres speedily follows their contraction, but this is not the case in the lower third, the circular fibres remaining contracted for some time after the entrance of the bolus into the stomach, probably to prevent its return into the oesophagus

As soon as the bolus has entered the stomach it is subjected to several agencies, all of which are more or less concerned in effecting its solution. It is exposed in the first place to the "movements" of the stomach, which have for their object to produce the thorough intermingling of the gastric juice with the alimentary mass. The fibres of the muscular coat of the stomach are so arranged, as to shorten its diameter in every direction; by the alternate contraction and relaxation of these bands, a great variety of motions are induced. This contraction is due to the

stimulus of the food, and when the aliment is difficult of digestion the muscular coat is proportionately stimulated. These movements are also increased by the action of the respiratory muscles. The contraction of the muscular fibres extends also to those of the two orifices of the stomach, so as to prevent the escape of food. This is particularly the case as regards the pyloric orifice in the first period of digestion.

The bolus in the next place, is exposed to the action of the gastric juice, a pure, colourless, and slightly viscid fluid, having a distinctly acid reaction, which has been observed to distil from the surface of the mucous membrane and mingle with the food. The exudation of this fluid is always excited by the contact of any foreign substance, but it is never present in the organ when empty the sole contents being then a little viscid mucus.

The gastric juice is secreted through cell agency by follicles of a tubular shape, resting upon the submucous tissue, having their open ends towards the cavity of the stomach. The quantity of gastric juice prepared

is regulated by the wants of the system and not by the amount of food taken, hence all that is taken over and above these wants, acts as a source of irritation.

All substances are not equally soluble in the juices of the stomach; in general terms it may be said, that animal matter is more soluble than vegetable, though there are exceptions to this rule

The fluids taken into the stomach are for the most part absorbed from it; and do not even pass the pylorus. The solids with the exception of the insoluble parts, are reduced to a substance called chyme, the consistence of which will of course vary with the amount of fluids taken. In general it is grayish, semifluid and homogeneous, with a slightly acid taste and smell. When the fluid has been of a rich character it resembles cream; when of a farinaceous order it resembles thin gruel.

The time occupied in the reduction varies according to the nature of the food, from three to five hours.

The chyme thus being formed passes out of the stomach

into the duodanum where it comes in contact with the pancreatic fluid, the bile from the liver, and the secretions of the several glands imbedded in and forming the intestinal mucous membrane. By the action of these various secretions the chyme undergoes further changes; after which, being more perfectly seperated from the innutritious parts of the food, it is converted into chyle which is absorbed by the blood vessels and lacteals, and conveyed into the thoracic duct, through this into the left subcla-vian vein, then into the vena cava decendens, then into the right auricle, then into the right ventricle, from the right ventricle through the pulmonary ar-tery into the lungs, then through the pulmonary veins to the left auricle, then into the left ventricle, from thence through the general system; the rest of the food, that is the innutritious portions of food is car-ried on by the peristaltic action of the intestines untill it is ejected in feces.