

AN
INAUGURAL DISSERTATION
ON
Digestion

SUBMITTED TO THE
President, Board of Trustees, and Medical Faculty
OF THE
UNIVERSITY OF NASHVILLE,
FOR THE DEGREE OF
DOCTOR OF MEDICINE.

BY
Wm. J. Coles

OF
Tennessee

1859

MEDICAL JOURNAL OFFICE,
NASHVILLE.

Digestion

Digestion is a function which prepares the food for building and sustaining the system, which undergoes a perpetual waste. It is a function that is not under the influence or control of the will. This function is composed of a series of organic actions, differing according to the particular organization of the animal. In man they are eight in number, Viz 1st Ingestion of food, 2^d Mastication, 3^d Insalivation, 4th Deglutition, 5th Chymification, 6th Chylification, 7th Actions of the intestines, & 8th Defecation. 1st Ingestion, or the taking of food into the mouth, is performed principally by the hand, assisted by the cheeks, lips, as well as the anterior teeth and the Tongue. The food is thus taken in, and is now ready to undergo mastication, which is the next and most important step in digestion. 2^d Mastication (and 3^d Insalivation) is the act of bruising food, to prepare it for the

2

digestion it has to undergo in the Stomach.
This is executed by the joint action of
The tongue, cheeks and lips, which push
The alimentary substance between the
Teeth, and by the movements of the lower
jaw it is comminuted into a substance
very readily acted upon by the solvent
juices. During mastication the alimentary
substance is mixed with the saliva and
other fluids of the mouth, which latter
Cavity is closed anteriorly and posteriorly
during the process. The disintegration of
The food, by mechanical reduction, is
manifestly aided by insalivation.

The admixture of the buccal fluids,
however, has mechanical and chemical
effects, the nature of the secretion being
different and answering different purposes.
The fluid that is secreted by the
Submaxillary and parotid glands is

thin and limpid, and assists in mastication, that of the sublingual is thick and glutinous and assists in deglutition. The saliva serves in dissolving sapid substances and rendering them capable of exciting the nerves of taste. But the principal mechanical purpose of saliva is that by mixing with the food during mastication, it makes it a soft pulpy mass such as may be easily swallowed. The agency of saliva however is not purely mechanical, it has a higher function to perform, that is a chemical action upon a large portion of the food used by man. After animal food, which is easily assimilated, amylaceous elements play the most conspicuous part in the support of life, but starch, as is well known, in the crude form is entirely insoluble, it is however converted by

Certain processes into a very soluble substance, dextrine. These processes consist in roasting the starch or boiling it with water slightly acidulated with sulphuric acid. As one of the constituents of saliva, Ptyaline plays the part of a chemical agent by converting the starch ^{food} ~~off~~ into dextrine. Its proportion as a constituent of saliva is indicated in the following analysis of this secretion.

| | | |
|-------------------|--------------|---------------|
| Water | = 988.1 | |
| Ptyaline | ... 1.8 | Mucus .. 2.6 |
| Fatty matter | .. .5 | Ashes ... 1.1 |
| Albumen with soda | .7 | Lip ... 1.2 |
| | | 1000.0 |

That Ptyaline has this power over starch has long since been proved by direct experiments, which are described in Physiology. After the dextrine has been formed it is converted into grape sugar.

The action of Ptyaline in this case is

5
probably similar to that of diastase
in mashing.

Saliva seems to act chemically, only
on starch and not on any other alim-
entary substance.

1st Deglutition. The food comminuted
and moistened in the mouth, by the means
above mentioned, is prepared for the ~~digestion~~
action of deglutition. In this there are three
stages, on the first, the particles of the food,
collected to a bolus or morsel, glide between
the surface of the tongue and the palatine
arch, till they have passed the anterior
arch of the fauces. This is a voluntary
movement, on the second, the bolus is
carried past the constrictors of the pharynx,
on the third, it reaches the stomach
through the oesophagus, these three acts
follow each other with extreme rapidity.
During the second stage of deglutition

the muscles of the anterior and posterior
half arches, the superior muscles of the
soft palate, the Tongue, and the constrictors
of the pharynx are all in action,
The epiglottis is pressed over the rima glottidis,
by the retraction of the Tongue, and the
elevation of the larynx, The communication
between the fauces and posterior nares is
cut off, by the posterior palatine arches,
which contract sufficient to cause
the sides of the arch to approach each
other like a pair of curtains, and the
cleft between the two sides, the uvula
is applied like a valve. Some of these
acts may be performed by the consent
of the will, but the combination of
the whole is automatic, and is presided
over by the reflex system of nerves, In
the third act, in which the food passes
through the Oesophagus, every part of that

4

Tube as it receives the morsel, and is dilated by it, is stimulated to contract. The movements of the Oesophagus are involuntary and rhythmical in their character.

At the Cardiac orifice of the Stomach there is a sort of sphincter, this is made to open by the pressure of food, and afterwards closes so as to retain the food in the Stomach.

5th Chymification. As soon as the morsel 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 produces a thorough intermixture of the gastric juice with the alimentary mass. The fibres of the muscular coat of the Stomach are so

constructed, as to shorten its diameter
 in every direction, by the contraction and
 relaxation of these fibres a variety of
 motions are induced, This contraction
 is due to the Stimulus of the food, and
 when aliment is not easily digested, ~~the~~
 the Stimulus of the muscular coat
 is in proportion. The movements are
 somewhat increased by the respiratory
 muscles. The bolus in the next place, is
 exposed to the action of the gastric juices,
 which is a pure, transparent, and slightly
 viscid fluid, having an acid reaction.
 The exudation of this fluid is excited by
 the application of any foreign substance,
 but it is never present in the empty
 organ, the contents are nothing more
 than a little viscid mucus.
 According to some of the best writers.
 gastric juice contains free hydrochloric

used acetic acids, phosphates, and hydrochlorate of potassa, soda, magnesia, and lime, others contend its acid reaction is due to the presence of super-phosphate of lime, and others attribute it to the presence of lactic acid.

This discrepancy as to the acid which imparts its acidity to the gastric juices, is due to the probability that in different animals one acid prevails and another acid prevails in others, or either acid prevails according to circumstances.

The majority of authorities attribute the acidity of the human gastric juice to hydrochloric acid.

Whichever it is, it probably matters but little, we know that the gastric juice must be acid in order to perform the function of chymification.

The gastric juice contains an animal

matter which has received the name of Pepsine, from the greek word for digestion. It is an agolized substance, the composition of which according to Bidder and others consists of Carbon 53 Hydrogen 6.7 Nitrogen 11.8 and Oxygen 22.5.

Pepsine acts probably as a ferment, all that we can say about it, as yet, is merely conjectural, but like a ferment, it undergoes decomposition or change, inducing other matter likewise to change.

This peculiar organic matter is considered to form the proper digestive solvent. By the combined actions of the stomach and the fluids secreted by it, the food is formed or changed into what is termed chyme.

6th Chylification. The chyme passes out of the stomach through the pyloric orifice into the duodenum, where

It is exposed to the influence of the bile pancreatic juice and the secretion of the several glands, imbedded in the mucous membrane. The principal agents in chylification are the pancreatic and biliary fluids. The pancreatic juice is alkaline like saliva, and like that fluid changes starch into dextrine. It is supposed that it forms with fats a species of emulsion or soap thus rendering them absorbable. The biliary secretion first formed in the liver, acts a most important part in the process of digestion, this is readily perceived when the organ which generates it, is out of order. The Composition of bile, according to Berzelius

| | |
|------------------|--------|
| Water | 904.4 |
| Bilinc | 80.8 |
| Mucus | 13.0 |
| Salts | 12.6 |
| | 1000.8 |

As to its action, we may infer it from the fact that bile forms with fats a species of soap very soluble in water, so that it serves when mixed with food to convert the indigestible fatty globules, into a digestible soapy matter. That this is its function, may be proved by the presence of fatty matter where the biliary duct had been closed.

Another office of the bile is doubtless to promote the expulsion of the indigestible food.

4th Action of the intestines. From the time that the alimentary substance enters the intestinal tube, it is propelled onwards by the peristaltic contractions of its muscular coat; which are excited, independently of all nervous influence, by the contact of the aliment, or

by that ^{of the} secretions mixed with it in
 its passage along the Canal. These last
 appear to have an important effect;
 for we find that, when the bile-duct
 is obliterated or tied, so as to prevent
 the bile from entering the intestine,
 Constipation always occurs; whilst an
 increase of the biliary and other secret
 ions, consequent upon the action of
 mercury or upon any other cause,
 produces an increased peristaltic
 movement, and a more rapid discharge
 of the excrementitious matter. During
 the passage of the alimentary substance
 along the small intestines, a large propo
 tion of it is taken up, by the absorbent
~~and~~ power of the villi; and the residue
 is again brought to a more solid
 consistence,

§th Defecation. The remaining

portion which is not capable
 of being dissolved or finely divided,
 so as to be taken up by the absorbents,
 and part of the secretions poured into
 the alimentary canal, by the various
 glands that empty their contents into
 it, for the purpose of being expelled,
 are ejected from the body.

The act of defecation is due to the
 pressure upon the contents of the
 rectum, which is occasioned by the
 combined contraction of the diaphragm
 and the abdominal muscles; whilst, on
 the other hand, the retention of the
 feces is due to the contractile power
 of the sphincter muscle, which surrounds
 the anus. The action of the sphincter
 ani, like that of the sphincter of the
 Cardia, is a reflex one; dependent upon
 the connection of the muscle, by

excitor and motor nerves, with the spinal cord. If the lower portion of the cord be destroyed, or if the nerves be divided, the sphincter loses its contractile power, and becomes flaccid. When in proper action, however, its power is sufficient to prevent the escape of the contents of the rectum; until the expulsive force becomes very strong, in consequence either of the quantity of feces which has accumulated, or the acidity of their character. In either case, the impression made upon the mucous membrane of the rectum is conveyed to the spinal cord; and by a reflex motor impulse, the muscles of defecation are thrown into combined action, the resistance of the sphincter is overcome, and the feces are expelled.