Boston Mellk St Nov 10 1841

Digestion.

Yesterday we gave you Boerhaave's theory of Digestion and endeavoured to point out its deficiency. No man was better versed in all the preliminary studies of medicine, especially chemistry than Boerh. But he seems to have overlooked the vis vitæ; & to have framed a system or theory of Digestion on certain chemical principles, misunderstood. A closer examination of this process has helped us to correct the errors of the great Boerhaave. We now know that fermentation never takes place in an healthy stomach. much more can we allow of a putrefactive process. When fermentation takes place in the stomach it is not an healthy process but a disordered one.

By applying thermometers of a particular construction John Hunter found that the stomachs of Quadrupeds were not hotter than their large intestines. There is a pretty strong action in the stomachs of some birds, but it is not found to be the case in the human, or in animals whose stomachs are formed like the human. It is not found that air is necessary to the dissolution of our food. Air in the stomach is the consequence of disorder, & never occurs in perfect health.

It is remarkable that some of the most important facts & theories that have been established in medicine, have been given to us, not by Physicians, but by Divines. The Revd

Dr Stephen Hales, Dr Priestley, & the Abbe Spallanzani, are bright examples of this assertion.

The Abbe Spallanzani Prof.r of Natural History in the University of Pavia in Italy, has thrown more light on the process of Digestion than all the physicians that ever wrote. Spallanzani was the man to whom the dying hand of Haller consigned the defence of Truth and Nature.

As Birds have no teeth to break & grind up their food, this defect is compensated by strong muscular stomacks, and by the operation of a strong digastric muscle called a gizzard. The strong muscular apparatus in the gallinaceous fowls, break down & twist metallic tubes & wires; and pieces of glass down to an impalpable powder. Even an unpolished twelve sided garnet, w.c remained in a wood pigeon's stomach a month had its angles blunted in several places: and yet there was no laceration, abrasion, or division, nor the smallest appearance of injury to be observed in the stomach on dissection, excepted indeed, the pigeon's stomach w.c had retained the garnet for a month, was about three times as thick as it commonly is.

Spallanzani fixed 12 strong needles of tin in a leaden bullet, the points projecting about 1/4 of an inch. This was forced down the stomach of a Turkey, & remained there a day & an half without shewing the least symptoms of uneasiness. How the stomach should receive no injury from this horrid instrument is difficult to explain. Fowls which resist injury from such sharp instruments generally have a number of pebbles

or gravel stones in their stomachs. The size of these stones are generally proportional to the size of the bird. They are commonly bits of quartz, sometimes mixed with calcareous fragments. A 1000 have been found in the stomach of a goose. While the internal coat of the human stomach is soft like velvet, it is hard & gristly in the Gallinaceous fowls.

The gizzard of the Goose is about the size of one's fist, & of an elliptical figure. It is divided into two large muscles, each above an inch in thickness, & composed of very compact fibres. The whole action of these strong desgastric muscles consists in squeezing with violence, like the sides of an iron vice, & crushing & grinding all interposing sub-stances. Nature has providently covered this muscular apparatus with a cartilaginous coat. Beside a liquor re-sembling the gastric juice, there is found in the gizzard of fowl a portion of bile. All the liquor found in the gizzard is very bitter. The Abbe Spallanzani says, that the collection of divers liquors in the gizzard of our fowls, serves as a menstruum for the food, & for disposing it to be transmutted into chyle. But the first step to-wards this event is taken in the crop. It is here that the food or aliment is penetrated by the liquor of the oesophagus; & here it begins to change its smell & taste; and it is in the crop, or hopper of the mill that the hardest texture is prepared to be broken down by the gizzard, w.c in these birds supplies the place of teeth. But the meat does not immediately pass from the crop into the giz-zard, where it does not arrive till after it has been ma-cerated in the crop

Spallanzani passes from such birds as have mus-
-cular stomachs, as the common barndoor fowls, tur-
-keys - Ducks - Geese & Pigeons, to such as are provided
with intermediate stomachs, as the Crows & Herons.

By the term intermediate stomach is meant not such
a strong thick muscular stomach as have the galli-
-naceous family of birds, on the one hand, and on the
the other, not that of membranous one, as in
birds of prey, & in Man, but a stomach of an inter-
-mediate degree of thickness & strength - Of this kind
is the stomach of the Raven & Grey-crow; they however
approach nearer the muscular than the mem-bra-
-nous stomach

These birds possess an intermediate power w.c
contributes to characterize them; it is far from being
equal to the force of muscular, but greatly exceeds that
of membranous stomachs. Such tubes of tin as doves
& pigeons would flatten & disfigure with the greatest
ease, remain unaltered in the stomach of crows;
and grain is triturated by the former, but continues
whole in the latter. Their gastric muscles :: are not
inert. Thus, though they cannot compress tin tubes, they
are capable of producing this effect upon tubes of
lead, provided they are very thin.

These birds, crows & ravens have stomachs very
much resembling the human; and they, like men,
eat a variety of articles, as herbs, grass, seeds, and
flesh

flesh of every kind alive or dead.

//. 2 Now whenever you wish to make experiments on birds, with a view to illustrate the process of digestion in man, you sh.d make use of the Crow & the Raven, & not of the gallinaceous fowls that have gizzards, & because these birds in common with all birds of prey vomit up every 24 hours all hard, indigestible substances, & among them the metallic tubes used in our experiments.

Spallanzani found that in the birds with membranous stomachs, as well as in those with muscular stomachs, the pebbles found in both were not needful to their digestion. He says that in all his exp.s he never found, even in birds of prey any smell like putrefaction.

In the experiments with Crows ~~effected~~ the gastric juice the dissolution of the flesh was effected in the metallic tubes merely by the solvent power of the gastric juice, without the least aid from trituration. It appears that this fluid does not penetrate deeply into the flesh, but acts on the surface only, dissolving & removing one layer at a time, till it comes to the innermost part, w.h it also softens & melts down

The gastric juice collected from the stomach of crows has remained with meat in it, several days, in the hottest weather, without any bad smell, or signs of putrefaction; while a similar piece of meat in common water was very offensive.

Spallanzani proves in a very satisfactory manner that the gastric juice in the stomach of a Heron is the immediate agent of digestion, independently of trituration; and that it flows from certain follicular glands. He proves also that the oesophagus of the heron is not entirely destitute of the power of digestion.

Such is the strength of the gastric juice of a Heron, that it will dissolve a whole frog, bones & all in 3 or 4 hours; and yet there is no such trituration & force in its stomach as there is in the stomach of those gallinaceous birds w.^c have gizzards.

Spallanzani next institutes a train of interesting experiments in certain animals with membranous stomachs, as the Frog. Water-Newts - Land, & Water snakes & Vipers; and also Fishes. Then he experimented on certain herbacious animals as the sheep - Ox & the horse; and he found in all of them that digestion was performed by the solvent power of the gastric juice, without any assistance from trituration. He however discovered two species of worms in the stomach of the water Newt, which seems to be their natural residence. He found similar worms in the stomach of Crows, between the internal & the nervous coat.

Then he tried a variety of experiments on the rapacious tribe of birds, as the Owl - the Falcon, & the Eagle, which have membranous stomach resembling the human. He found that the gastric juice, was alone the agent of digestion in these voracious devourers of living animals. But powerful as is the succus gastricus in these birds it was incapable of dissolving a vegetable substance: so that the gastric juice is adapted by nature to the food of some animals, by which one can digest only flesh, and another only vegetables. Among other singular properties the gastric juice of animals will not freeze so soon as water, and when frozen will thaw sooner.

In a sick man flesh was not operated upon by the gastric juice.

There are many exp.ts to prove that the gastric fluid is capable of decomposing the hardest animal substances, such as the Tendo Achilles of an Ox, and even bones, but will not effect the softest vegetable bodies. This is also true of chemical menstrua's, for the nitrous acid dissolves the hardest calcareous stones, but leaves the more friable gypsum, & clay untouched.

It is difficult to determine from what pores the gastric juice flows. If you take the stomach of a cat, invert it, and inflate it like a bladder, it will be found covered with humidity as often as you wipe it. But we have not been able to discover the pores from which this fluid issues, by the aid of a microscope; nor can any glandular bodies be perceived in the coats, or the intervals between them; but when the stomach is held against the light, & examined with a glass of great magnifying powers, a number of bright specks or eyes appear through the coats. Spallanzani sometimes thought that this fluid did not issue from glands, but from arteries too small to be conspicuous: he however thinks that the pores whence this fluid issues are conspicuous in parts contiguous to the pylorus: He says that the gastric liquor in most animals consists of several different parts, or principles, viz of the saliva - of the juice of the œsophagus, and that w.c is peculiar to the stomach, as well as of the pancreatic juice

After shewing how digestion is performed in granivorous animals, & in herbivorous, & in carnivorous, the Abbe Spallanzani then undertakes to shew how digestion is performed in Man, who may be said to be omnivorous, for he eats every thing; and these too infinitely diversified by the art of cookery.

No topic has been more frequently discussed yr. Digestion, both among the antients & by the moders, yet it has been very little else than supposition, or guesswork.

It is remarkable that Hippocrates asserted that Digestion was performed by a solvent fluid in the stomach; but it seemed that few, or none believed him. And from his time down to the present century there was wanting direct experiments upon Man himself. There seemed to be wanting experiments of two kinds: The 1st to procure human gastric juice, in order to examine it as had been done with the gastric fluid of beasts & birds, and 2dly to swallow tubes full of various vegetable & animal substances, in order to see what changes they undergo in the Stomach. Reamur of France commence the Experiments; but it was left to the Abbe Spallanzani of Italy to complete them. The result of his Experiments we shall give in our next Lecture

The Abbe S. with the courage of a true discoverer, with the intrepidity of any circumnavigator of the globe, swallowed wooden tubes five inches in length & three in diameter, perforated with holes and enclosed in a linen bag, & containing from 36 to 45 grains of masticated boiled veal, and wc was voided in 17 hours, when there was found only 21 grains, its surface being soft & gelatinous; whence the Abbe concluded that in Man as in numberless other animals, the gastric fluid digests the food without the concurrence of trituration. After swallowing grapes & plums he found their delicate coats entire, another proof that no triturating force is exerted by the human stomach —
He found that masticated flesh was sooner dissolved & more perfectly than meat not masticated. Cartilage was more speedily dissolved than tendon. Membranes with difficulty, bones not at all. [The gastric juice was kept a month in the hottest season of the year without any change of colour, taste or smell]. Digestion is found to go on a few hours after death provided the stomach be kept blood warm, or not cold.

S. shews that the gastric juice is not only a solvent, but an antiseptic. The Stomach has the power of correcting putrid food, as in carrion-crows.

Spalanzani, upon the whole proves 1st. of the three species of fermentation the sweet, — the acetous — & the putrid neither takes place in digestion.
2dly. Though this function is sometimes accompanied with an acid, yet this principle disappears entirely towards the conclusion of it.
3dly. Putrefaction never, in health, attends digestion.

The experiments of Dr Stevens published at Edinburgh 1777 confirms those of Spallanzani. (See Woman with hole in her stomach in Lecture on Tobacco.

see p. 197 + 199. for origin of the inc: quest.