Gastric Digestion
and
The circumstances affecting it
by
George Edward Wright
Gastric Digestion,
and the Circumstances affecting it.

By Gastric Digestion we mean the fitting of food in the stomach for the changes which it has to undergo, after being discharged through the Pyloric orifice, and the absorption of fluids which do not require to undergo further change in the alimentary canal.

In treating this subject, after giving a sketch of the arrangement of the organ adapted for Chymification, I shall endeavour to state, as shortly as possible, what is known of the nature and nutritive power of the different kinds of Aliment, and then to mention the various circumstances which accelerate or retard the digestive process.

The subject is one of vast importance not only to the Medical Profession but to the community at large; for, a knowledge of the
laws which govern the proper perfor-
mance of the functions of the stomach, 
must ever be in the minds of those 
who may be called upon to restore that 
viscera to a normal state, after it has 
deviated from the healthy performance 
of its function.

When we see daily what gross neglect 
is paid by individuals to the circum-
stances which affect their digestion, 
and consequently their health, we 
do not at all wonder that dyspepsia 
is so common; nay, we even wonder 
that it does not occur more frequently.

Far be it from me to advocate a 
fastidiousness in the selection of articles 
of diet— I believe that of itself is inju-
rious, as tending to render an indi-
vidual morbidly alive to the sub-
ject of his feeding, and all the more 
liable to Hypochondriasis, should 
any thing go wrong with his diges-
tion. Faulty digestion is produced 
and kept up, not so much by the 
use of any particular articles of 

...
diet, as by the indulgence in too large quantities of them; by irregularities in the hours of taking meals; by an undue abstraction of nervous force, when digestion is going on; by faulty mastication; by the indulgence in Alcoholic stimuli, and other circumstances to which it will be necessary hereafter to allude.

In accordance with the arrangement previously mentioned, the first thing which comes under our notice is the Stomach. This is a dilatable and contractile bag, admirably adapted for receiving and acting upon the masticated aliment. It has three coats, viz. serous, muscular and mucous.

The serous coat is so arranged as to allow of the extreme changes in bulk and position to which the viscus is naturally subjected in the performance of its function.

The Muscular Coat consists of longitudinal, circular and oblique fibres of the
the unstriped kind.
The longitudinal fibres, continuous with those of the oesophagus, spread out over the surfaces of the stomach, not entirely covering them, and are continued on to the small intestine.
The circular extend from one end of the stomach to the other, being much thicker at the small end so as to form a sphincter around the pyloric opening. The oblique fibres arch over the great end of the stomach, spreading out on its surfaces and gradually blending with the circular.

The mucous membrane of the stomach is separated from the muscular coat by a thick layer of loose areolar tissue, and is arranged in numerous folds or rugæ.

The arrangements for secretion are such that, from the numerous involutions of the secreting membrane forming the alveoli and tubules, there is packed up in a convenient space a large extent of secreting surface.
The areolar tissue forms a stratum in which the vessels and nerves subdivide prior to forming pleureses in the mucous membrane, which is composed of a simple membrane (i.e., basement membrane and epithelium), tubular involutions of that membrane, and the ramifications of vessels and nerves in a fibrous matrix between these tubules. — The surface of the mucous membrane is marked with shallow depressions which do not disappear on stretching it; they are about \( \frac{1}{200} \) of an inch in diameter and occupy about \( \frac{1}{8} \) of the depth of the mucous membrane; they are formed simply by an involution of the simple membrane, and are consequently composed of a basement membrane and columnar epithelium. These depressions, or alveoli, divide into smaller tubules, occupying the remainder of the depth of the mucous membrane, and ending in blind...
blind extremities, which are separated from the lax, areolar tissue before mentioned by a layer of denser areolar tissue. Nervous ramifications and vascular pleuses are distributed between the tubules; the whole being held together by a firm matrix. Near their closed ends the tubules are lined with a spheroidal epithelium.

Towards the pyloric end of the stomach the alveoli are considerably elongated. The tubules arising from them being proportionately thickened in account of this elongation they have received the name of pyloric tubes. We naturally infer that there is some difference in the digestive power of the pyloric and other parts of the stomach; that perhaps the acid products are furnished by the one more than the other.

Having now given a short sketch of the structural arrangement of...
the stomach, it will be necessary to enter shortly into the changes which take place on the introduction of food.

First then, with regard to the movements of the stomach, the muscular fibres contract, and during the process of digestion, the food is closely embraced and triturated in such a manner as to bring it into relation with the gastric juice. The pyloric orifice is closed, so that nothing but the finest pulp can pass through it; but, digestion of the digestible matter being over, the irritability ceases, and unmasticated portions of food may pass through into the duodenum.

During fasting the mucous membrane of the stomach is covered with a viscid, mucous, occasionally slightly acidulated; but, on the application of a stimulus, as the food, the mucous mem-

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brane exhibits a faintish red and swollen appearance from the increased afflue of blood: a pure, colourless, slightly viscid fluid, having an acid reaction, then commences to distil from its surface and mingle with the food. This is the gastric juice, which has the peculiar property of reducing and dissolving alimentary matters. Before the experiments of Dr. Beaumont, Physiologists had come to the conclusion that the mucous membrane of the stomach was the seat of a secretion which took the chief part in effecting those changes which the food undergoes in the stomach. The experiments of Reanwin and Spallanzani had tended greatly to confirm these opinions: these gentlemen had introduced perforated tubes, containing digestible matter into the stomachs of dogs and cats, and found on remo-
impossible the food could have been subjected to any mastication, still, it was softened and digested. The gastric juice has not only the power of exerting a solvent action on the food but is also strongly antiseptic. It owes these properties to an organic principle—pepsin, and to the presence of acids, chiefly perhaps of hydrochloric acid. Experiments made with this fluid obtained from the stomach of man or animals have admirably illustrated its properties; and it is found that an infusion of the mucous membrane of the stomach when acidulated with hydrochloric acid has at a proper temperature the power of reducing animal substances as perfectly as the gastric juice itself. If water and acid alone be used no change is produced, and if the infusion of mucous membrane be used unacidulated rapid putrescence takes
takes place.
A proper temperature is of the highest importance: it should be about 98° or 100°, if too low no influence is exerted on meat beyond the prevention of putrefaction.
From the foregoing facts it is easily seen how a vitiated condition of the gastric juice in the body gives rise to the unpleasant symptoms of flatulency, flatulent eructations &c; for, if it is unable to exert its antiseptic influence on the food, the latter could not be placed in more favourable conditions for decomposing, having the requisite conditions of heat and moisture.

Having sketched briefly the arrangement of the stomach, the next important matter to be considered is the aliment itself; for the knowledge which we possess concerning this we are chiefly indebted to the able researches of Baron Liebig.
Histological review of tumors in Botswana.
Food is grouped primarily into two kinds.

I. Albuminous: distinguished by containing nitrogen, and which enters largely into the composition of muscle, nerves, and other tissues.

II. Non-nitrogenous—food nourishing the tissues in which nitrogen is not contained; for example, the secretions in which carbon abounds, as the bile; and, more especially, for keeping up the animal heat, by uniting with the oxygen in the lungs; the carbon supplied by the destructive assimilation of the tissues, not being sufficient for that purpose.

Nitrogenous food exists largely in the vegetable kingdom, in the form of vegetable albumen, vegetable fibrin, and vegetable casein; but it is
found, in the largest proportion, in the flesh of animals, which possesses a greater nutritive power than all other kinds of food; the cause of this being that the fibrin of muscle and the albumen of blood, contain the same elements in the same proportion, and the chief constituents of muscle is fibrin, which is nothing more than albumen in an organised form.

The non-nitrogenous elements of food are derived from the fat of animals and the amylaceous constituents of vegetables. They are very essential constituents of the food of man, tending as they do, to prevent the wasting of the tissues by uniting with the oxygen, and keeping up the animal heat. If there is not a sufficient supply of non-nitrogenous food, the organised tissues are decomposed in order to supply the demand for combustible material and wasting of the body necessarily ensues.
The Herbivora derive their food, both plastic and respiratory, from the vegetable kingdom, and supply the Carnivora with these in a more highly organised form. Man is is omnivorous; and, having a digestive apparatus adapted for either kind of food, has the power of selecting his aliment from either of these sources; and instinct has taught him to combine them in proper proportions, and adapt them to the circumstances in which he is situated: if in a cold climate, he naturally requires more respiratory food, and if undergoing severe exertion, bodily or mental, he requires a good supply of nitrogenous food, in order to meet the wants of the system, incurred by the waste of material consequent on such exertion.

Man from his artificial mode
of life, and the various injurious agencies to which he is exposed, is especially liable to disease of the digestive apparatus; either, primarily, from direct irritation, from the use of inappropriate food, or, secondarily, from derangement in some other part of the frame. Hence a great object in alimentation is to supply, with as little possible irritation to the digestive organs, such material as will be most readily converted into blood and matter necessary for respiration and, here the importance of the subject strikes us; for, if the elements of food be not supplied in accordance with the wants of the system, or if, from a derangement in the digestive process, there is inability to supply the blood with materials necessary for the nutrition of the tissues, disease must ensue.
A knowledge of the nutritive power and digestibility of various articles of diet is, therefore, highly desirable. The investigations of Baron Liebig are of the utmost value in the elucidation of the former point, and those of Dr. Beaumont the latter; though too implicit reliance should not be placed on the experiments made on St. Martin, for there are so many circumstances which tend to modify the rapidity of digestion under different conditions. It varies greatly according to the amount eaten, the nature and amount of exercise previous and subsequent to a meal; the interval that may have elapsed since the last meal; the state of other organs, as the nervous system; the state of the weather and of the general health. In many of Dr. Beaumont's experiments these
conditions were not carefully noted.

Man derives his food chiefly from the flesh, fat, milk and eggs of animals; the roots, stalks, leaves, flowers and fruit of vegetables, together with oily, starchy, gummy or saccharine matter derived from various parts of plants. Most of these substances require cooking in order to fit them for the process of gastric digestion, as they are not adapted for food in the conditions in which they occur naturally; hence they are subjected to the agency of heat and water, and the admixture of certain condiments, which, by acting through the sympathetic system, on the salivary and gastric glands, promotes a flow of their secretions.

Heat, by softening the fibres and coagulating the albumen of flesh, renders it more easily masticated and
and salivated, and more readily permeated by the gastric juice; and in the case of the manufacture of bread by favourable fermentation, it renders the dough spongy from the diffusion of carbonic acid through its mass, and also by bursting the starch granules, renders them more susceptible to the action of the saliva. Water, besides assisting heat in dissolving the substance which connects the constituent tissues, also forms a vehicle in which the most nutritious elements of the food may be dissolved or suspended, as in the preparation of soups, vegetable infusion, &c. In order to make a good soup from flesh, the water should be added when cold, and slowly heated to ebullition; in this manner it becomes slowly impregnated with the soluble and savoury matter of the flesh.
other hand, we wish meat to preserve its nutritive power when boiled, it is put into the water when that is at the boiling point; the albumen on the surface is coagulated, and the pieces of the meat prevented from escaping. But meat cannot preserve its nutritive power if good soup be made from it.

In the roasting of meat the heat should be strongest at first. No article of diet is of such high value as flesh, which being composed of the constituents necessary for the renewal of the tissues, repairs these with the least expenditure of organic force. It contains fibrin and albumen, which reproduce these elements in the blood; fat for the respiratory process; inorganic constituents necessary for sanguification. Bread contains besides it, amylaceous constituents, vegetable albumen and fibrin, and also the salts which
which are essential in nutrition. The separation of bran from flour is not desirable, as it adds to its nutritive power. Eggs, and the seeds of many of the Leguminosae, take an important part in alimentation, from the amount of their albuminous matter.

Milk, containing albuminous, fatty and mineral matter, in proper proportions, is capable of supporting life alone, and hence is of great value as an article of diet.

Various kinds of food differ considerably as to their digestibility, and as to the effect which they produce on the digestive organs. Although man in a healthy state is not affected sensibly by any ordinary kind of food, yet a great portion of the community, from their mode of life, have digestive organs more or less sensi-
tive to the influence of certain sub-
stances. It is a matter of curious ob-
servation that some stomachs ab-
solutely refuse to tolerate substances,
which under ordinary circumstances,
are comparatively easy of digestion.
Whether this refusal depends upon
congenital idiosyncrasy, or upon
association, perhaps too subtle for
our appreciation, it is difficult
to determine. We incline to the
latter opinion; for, given a nutrition
substance, and the conditions neces-
ary for its digestion, which may
fairly be assumed to be present in
such cases, we must account for the
peculiarity under the head of associ-
ation; or perhaps in the Physiology
of digestion there may be elements,
which as yet have escaped observa-
tion, necessary to the digestion of cer-
tain substances, and which, in the
idiosyncrasies referred to, are awant-
ing, or present in too small quan-
tity.
Dr. Beaumont infers from his experiments that solid animal or vegetable food are more susceptible of chymification, according to the looseness and divisibility of their textures, and that incipient putrefaction, by rendering the muscular fibre tender, favours the process; that vegetable substances generally are digested less rapidly than animal; and that of individual articles, seal and pork are most slowly digested; mutton, beef, and fowl are more digestible than these; turkey, lamb, young pig and potatoes are still more readily digested; fish, milk, tapioca, and barley more so than these; and that gastric digestion is most easily accomplished on rice, eggs, salmon, tripe and venison.

With regard to fluid substances, the suspended and coagulable matters retained for the action of the gastric juice, whilst the liquid is absorbed in rapidity, proportioned to the
the want of it in the system, and the turgescence in the vessels of the coats of the stomach, when there is a plethoric or congested condition of these vessels, the absorption of watery matter is effected with difficulty. But there are circumstances affecting gastric digestion even more important than the kinds of food taken. Amongst the first of these may be mentioned mastication and salivation. Want of teeth, by disabling a person from fulfilling these conditions properly, is a very common cause of indigestion. The molar teeth may be decayed and tender so as to induce the individual to swallow his food in masses which cannot fail to prove a source of irritation to the digestive organs. These defects may be in a great measure remedied, and cases have occurred of individuals who had been habitually subject to dyspepsia, ob
...taining an immunity from its attacks by having recourse to the aid of the dentist. Food in order to be fitted for the changes it has to undergo in the stomach, should be properly broken down into a pulp, thoroughly mixed with the saliva, which not only acts chemically on the starchy matters, but, also, by entrapping air, probably renders each morsel of food more readily permeated by the gastric juice. Taking leisurely is very important for the fulfilment of these conditions. This rule is very commonly broken through : persons who are absorbed in commercial and professional pursuits are especially liable to fall into this error. From their anxiety to return to their occupations, their meals are often hurriedly dispatched, or if the meal be postponed until the hours of business are over, very probably...
a length of time has elapsed since the last meal as to induce them to bolt their food from sheer hunger. And this is apt to lead into another error viz—that of eating too much; the feeling of hunger not being allayed until more has been eaten than the stomach can readily digest. When food is masticated properly, and eaten slowly, each morsel excites a fresh flow of gastric juice, and by becoming impregnated with this, its digestion is ensured. But there is not time for this when successive portions of food are swallowed rapidly; the stomach is distended before there is time for a thorough admixture with the gastric fluid, and digestion consequently goes on slowly and ineffectually; and this evil being often aggravated as it is by over-repletion, we can readily see a fertile source of gastric disorders.
Dr. Beaumont is of opinion that the gastric juice is supplied in proportion to the quantity of aliment naturally required, and that if food be taken in excess, a certain portion of it remains undigested, proving a source of irritation and pain. It is doubt this rule holds good in many cases, but there are persons whose digestive organs are strong enough to overcome this difficulty. That, in fact, when there is no protest on the part of the stomach, a plethoric condition of the system ensues, and a morbid state of other parts, such as the eliminative organs, which in their turn react on the digestive apparatus. Hence renal and hepatic diseases are thus common in those who do not undergo sufficient exertion to use up the nutrient material wantonly introduced into the system. There can be no doubt that
that a moderate quantity of food at proper intervals is of the highest importance for ensuring a healthy state of digestion. When the quantity of food is small and the secretion of juice abundant, digestion goes on very rapidly; whereas, when a very full meal is eaten and the supply of juice insufficient, digestion proceeds only a certain length; that part of the food for which the stomach is unable to supply juice, undergoes fermentation, giving rise to distressing symptoms, which are not relieved until the stomach, recovering itself, pours out a fresh supply. The quantity of food, therefore, should be such as to satisfy the appetite without producing a feeling of oppression or indisposition for bodily or mental exertion.

Taking food too soon after a full meal is equivalent in its results to taking too large a quantity of food at once; hence the advantage of taking meals at intervals.
at stated hours, and thus allowing a sufficient time to elapse between them, so that the food of the previous meal may not only be completely digested, but also, that the stomach may have had a period of repose, in order to recover its tone and obey adequately the stimulus caused by the introduction of a fresh meal.

Besides these conditions, the kind of food taken has a considerable influence on the rapidity of digestion; some substances requiring much more gastric juice for their solution than others. As a general rule, vegetable is not so easy of digestion as animal food; and fat meat as lean; but individuals differ considerably as to their power of digestion of different substances, and it is well for persons of weak digestion to consult their own experience on this point, always avoiding overexpletion with any kind of food and the indulgence in stimulants which only
afford temporary relief.

It is necessary to consider the age and occupation of the individual. At maturity, when the parts have attained their full development, the active habits of youth are exchanged for the comparatively sedentary occupations of middle life, and there is consequently not such a demand for nutritive material; the quantity of gastric juice is, to a certain extent, limited; hence, gastric disorders are very common in those who continue the dietetic habits of youth after the full development of the frame; for during growth copious materials are required for nutrition, and the law of tolerance, as it were coming into play, there is a copious supply of gastric fluid. The same remarks may be applied to those who are engaged in active exercise, and in whom there is consequently a waste of material.
Gastric digestion is influenced considera-

tionably by the state of the general
health and of the nervous system.
In febrile excitement the supply of
gastric juice is very scanty.
Intense nervous excitement, or depres-
sion, checks the secretion, and hence
the necessity of avoiding a full meal
under such circumstances; although
there is not much danger of an indi-
vidual falling into this error, seeing
that the feeling of hunger itself is
not usually present.
Mental relaxation, as in cheerful con-
versation or light reading, is conduc-
tive to digestion; whilst occupying
the mind in intense study, is highly
injurious. Neither should the bodily
exercise be too great after a meal; a
state of quiescence even being better,
although, after an ordinary meal,
gentle exercise is favourable.
Condiments, with the exception
perhaps of common salt, although
not absolutely necessary, influence
the
the flow of gastric juice by stimulating the mucous coat of the stomach. The use of these has been objected to on the ground—that although temporary advantage may be derived from them, they tend to debilitate the organ, as is the case with the employment of other stimuli. It is probable that much importance need not be attached to this argument. In the case of the ordinary condiments, they are useful in promoting a flow of saliva during the mastication of insipid food, and the influence they have as a cause of indigestion is very small when compared with alcohol; and besides, there is not such a liability to take them in excess.

With regard to tea and coffee, their universal adoption seems to be an argument in favour of their use. Of the fact that they are not indispensable, ther
is no doubt. They present nutritive matter in the shape of their mineral constituents, and have an exciting and vivifying influence on the system generally. If they were dispensed with, popular inclination would most probably discover some more noxious agencies; the desire for nervous stimuli being almost universal. Their moderate use has probably no evil effect on the digestive system, but the abuse of them, as is the case with other substances, is attended with evil consequences.

Having given a digest of what is known of the Anatomy and Physiology of the Stomach, of the properties of the gastric juice, and then mentioned the kinds of food used by man, I have endeavoured briefly to state some of the principle circumstances which modify the action of the...
stomach or articles of diet, ordinarily digestible. Beyond this we
have not attempted to go. The
field has been so extensively cul-
tivated by men eminently fitted
both by their native talents, and
extensive culture, that we feel
certain nothing original will be
expected at the hands of a stu-
dent. The subject appeared in-
teresting to us not so much from
affording scope for curious spec-
ulation, but because there is no
class of diseases so common as those
of the digestive system. There is
hardly any disorder in which
the stomach is not, more or less,
implicated. The medical man lies
to encounter gastric derangement in
every step of his practice. Hence
the necessity of being thoroughly
acquainted with the conditions
under which a normal state of the
stomach may be obtained.
It is a matter too of observation
that
that such diseases as have been re-
ferred to, are due, not so much to
ignorance of the laws of digestion,
as the wilful neglect of them.

The majority of men either do not
possess, or fail to exert, that moral
control which is necessary to a healthy
state. Too often the efforts of the
physician are balked by obstin-
acy or weakness. This, however, is
not to deter him from pursuing his
duty. He must be prepared to
meet with obstruction, and to re-
itrate those truths on which phy-
sical well-being depends; feeling
assured that the facts will assert
themselves, and that too if not lis-
tened to and obeyed, with a voice
of terror. Nature ever moves silently
and uniformly in her track; those
who are obedient to her sway ex-
perience her protection, but those
who set themselves in opposition
are crushed.