On the
"Causes of Hunger and Thirst"

In taking a general survey of the objects of Creation, there is one point which must strike the eye of the most superficial observer viz. that certain of them are endowed with a property called Life, while the others are not; and the only way of drawing the distinction between them two, is to notice the presence or absence of the phenomena by which this Life is manifested.

Thus the Inorganic world, composing the mass of the globe which we inhabit, is formed merely by the aggregation of atoms, either of one simple element, or, as is much more common, of two or some of these elements combined together, so as to form a new substance bearing no resemblance to any of its component parts, but only resulting from the Chemical affinity which nuclear atoms sustain. When one forms, it undergoes no change, neither increase nor diminution, from any inherent action of its own; but remains always the same, unless it come under the influence of some external agent.
In Organic Bodies, again, the presence of life is manifested in its most simple form, by the performance of the functions of Nutrition and Reproduction; the former consisting in the addition to their substance of matters derived from the external world, which are assimilated to as Informe structures, similar to those of which they are already composed; and in the removal of those portions which have already served their purposes in the organism, and become useless; while the Vital principle itself can only be derived from a similar Being which has previously existed, and by its faculty of Reproduction can transmit it to its offspring.

These, however, though the essential, are not the sole phenomena, by which an object shows itself to be endowed with Vitality; but the addition of certain others has determined the division of the Organic World into the two great Kingdoms of Animal and Vegetable. Whilst the members of the latter are only possessed of the functions which have already been mentioned, those of the former, have in addition to them, the faculties of Sensation and Voluntary Motion, by means of which they are enabled to receive and be conscious of impressions made upon their external senses; and likewise, by means of their Volition, to determine the performance of certain motions, which, by their muscular contractibility, they are enabled to execute. Of course great differences exist in the perfection to which these faculties are carried, from the Zoophyte in which no nervous system at all can be demonstrated, to Man in whom they are developed in the highest degree; but still they may be received as the general Characteristic which elevates the Animates over the Inanimate Creation.
Yet, although the difference between these various Classes of Bodies is so great and striking, there is one general principle which is equally applicable to all, viz. that action however produced, is invariably followed by waste of the tissue or substance which is the seat of it. But while in Inorganic Bodies this can only be brought about by external agency—i.e., objects endowed with vitality, are constantly the seat of action and consequently of waste, dependent on the performance of their Organic, and demonstrable of their Animal functions. A corresponding amount of New Material, therefore, is necessary, in order to maintain the fabrics in their normal state and age; and this, which they have the power of appropriating from the external world, by being to certain processes in the interior of their Bodies, is undeniably to build up their various tissues. It is not, however, invariably applied to the same purpose. In the Vegetable Kingdom, the great object of Nutrition seems to be the increase of the bulk of the fabric. Year after year, new layers of lignous fibre are deposited within or around, that which is already formed; and as that solid structure when once organized, has no function to perform in the economy of the plant, it does not undergo any waste, but each successive formation adds to the bulk of the Organism, of which it forms a part.

In Animals, on the other hand, in whom the most solid structures are not permanent, but are constantly being spent by their substantia, the amount being regulated by the activity with which the various functions are performed, we find that the Aliment, instead of being applied for the purpose of increasing their age, is required for the repairation of their wasted tissues, so as to preserve their Bodies in their Natural
Combe "Physiology of Dejection"
state; these being, except perhaps in some of the very lowest species, a total absence of any tendency to constant growth, but a definite form and age, which, while it must be maintained, is never exceeded in a state of health.

Such being the different purposes to which the new Material is applied, in what manner is it obtained?

A Plant depends for its existence upon one spot of ground, from which it draws a constant supply of nourishment by means of its roots; and if the soil be fertile, and the situation favorable to light and heat, it rapidly increases in size. If, however, these conditions be not present, it soon droops and dies, being unable to change its position and seek for better quarters elsewhere.

Animals, on the contrary, not being attached to any source of support, have to put their locomotive powers into operation, to find wherewith to supply their wants. Now this arrangement evidently necessitates that nourishment be taken by them, not continuously, but at intervals; and in order that this may be rendered compatible with the health and well-being of the individual, Nature has endowed them with a receptacle or stomach, in which can be stored up a quantity of food sufficient to meet the demands of the economy for a certain time. But the quantity which they can thus receive at the time is but limited, is ever long exhausted and requires the replenishment, to remind them of which, Nature has further implanted in them, two ever-repelling Instincts, the sensations of Hunger and Thirst, the causes of which I shall in this paper endeavor to investigate.

These two sensations bear so much in common that no great deal of what will be said of the one, will also apply to
the other; I shall therefore, for the present, confine myself to
Hunger, and afterwards make any observations which apply
more particularly to Thirst.

Hunger then is a sensation indicative of an internal want, and
impelling animals to take aliment. It exists from the earliest pe-
riod of life — newly-born infants crying out for the Breast, and
eagerly attaching themselves to it. All animals whether endued
with reason or not do the same; even the young Mammalia
who come into the world, and remain for some time, in a foetal
state, obeying, what in their case, we must conceive exists; an
automatic impulse, analogous to that of Respiration, attach-
themselves to the maternal breast, and remain suspended from
them, till their development is completed.

In Man, it manifests itself by a more or less painful feeling of Vacuity
and constriction in the Pyzastrum region, accompanied by a general
sense of weakness, and looseness over all the Body, and sometimes
by fluctuation of the Stomach and Intestines. When only felt as
is most commonly the case, in that degree which is called Epigee,
it can hardly be called painful; but if prolonged beyond a cer-
tain time, the internal gnawing or tearing pain, reaches a point
of real anguish. This however passes off, and is succeeded by a state
of dulness and slumber. Meanwhile various changes take place
in the physical condition of the Body and the Senses at dif-
ferent periods according to circumstances, succinct to what
is called 'Death by starvation'.

The interval which elapses before the return of the sensation
after it has once been fully appeased, varies in different
animals, and in the same animal at different times. It is
noticed as a general rule in hot Men in Cold Blooded Animals,
in Mammals & Birds, Man in Fishes & Fowl — in those that
live in air, than those that live in water — in Nebuwa or
in Carnarvon; the last instance being evidently well adapted to
the mode of existence of the animate, and the difficulty which the
latter must frequently experience in finding their prey.

The man it may be said to return at least twice in twenty-four
hours; but this interval, and the intensity with which it is
felt, may vary on account of the condition of the individual and
the circumstances in which he is placed. Among these, as having
the chief influence over the sensation, may be stated,
the amount of waste which has taken place in the body
since the previous meal. Thus the man who spends his time
in active employment in the open air, who perspires freely, and
whose respiratory functions are in a state of activity, possesses a
much keener appetite than he who leads a sedentary life; not
but that the latter often makes a far from contemptible figure
at table, but a false appetite which can be excited by a mere
desire of gratifying the palate, is not the compounded with hunger
in the true physiological sense of the word.

II. Prolonged abstinence from food, as in cases of starvation
or recovery from a wasting disease. In these the individual
is always hungry, and although he may eat almost constantly,
and the sensation can hardly be appeased; evidently from the
wasted tissues requiring a continual supply of the means of
repair till they are restored to their original state.

The same principle is illustrated by the fact that in children
who are not arrived at their full development, and whose
vital operations are in great activity, the demand for food is pro-
spectively greater, more frequent than in adults; because
their bodies require not only to be maintained, but also to be
augmented; whereas in old people whose vital operations
are known, and who take but little exercise, the appetite is smaller in degree, and occurring at longer intervals.

We see that Hunger is regulated by the amount of waste which the body has undergone during a longer or shorter period, but there is a third circumstance, which has a material influence upon it, and that is, the amount of Heat which has been generated, so as to maintain the body at the proper temperature.

In most warm-blooded animals the temperature varies very little, whatever that of the surrounding medium may be, so that in cold climates, a much greater contraction, to keep up the tissues must take place, in order to evolve sufficient Heat. This is favored by the fact that in those climates, the atmosphere is denser than in warm ones, so that a larger quantity of Oxygen is inspired, and of course a corresponding amount of food is required to supply materials for combining with it. Again not only does the quantity but also the quality used vary according to these circumstances, the taste being also an indication of the kind which is most suitable. Thus the Greenlanders delight in animal fats and oils, substances which from the great excess of Carbon they contain are peculiarly adapted for him; while the Indian, who lives his time beneath a tropical sun, lives and thrives on a small quantity of Rice. Seeing them that equal health can be enjoyed under both opposite means of subsistence, it is evident that the best method a person can adopt of preserving his health in a foreign country is, to give up as far as possible his previous mode of living, and conform to the habits of the natives.

In cold-blooded animals, however, and those of the warm-blooded ones which hibernate cold does not increase the appetite, but has quite the opposite effect, reducing the temperature of their bodies to nearly that of the surrounding medium, almost entirely
John Hunter's "Observations on certain parts of the Animal Economy"
slowing their vital operations, and rendering the waste which their bodies undergo, so small, that the mere absorption of the fat which they have accumulated during their season of activity, is sufficient to maintain their existence during the whole of their dormant state.

These however are mere exceptions to the general rule that in warm-blooded animals, the appetite is increased by cold (when not carried too far, so as to cause derangement of the functions) and diminished by heat; evidently from the reasons before given, of the equality of the temperature maintained by their bodies in whatever circumstanaces they are placed; but there are other some cases which are found to affect it, and these are observed among us as we ascend in the scale of animals, and find the phenomena of the Nervous System more and more manifested.

Amongst these may be mentioned the force of Habit, people being set in their meals at a certain hour every day, merely from their being in the habit of taking them at that particular time and losing all inclination for them, if it pass without their being gratified. It cannot be said, however, that this has much effect on those, who from their mode of life are entitled to have a good appetite; but chiefly on those others who never feel much at any time, nor employing any of the ordinary means to excite one, such as exercise &c., eat more as a matter of course than of inclination.

Certain mental emotions also, especially those of a depressing character, either prevent the sensation from arising at all, or immediately quell it, even when at its strongest — keeping obeying the general laws of sensation, and giving place to those of a more powerful character, being itself laid aside tranquilled. Good humor & freedom from care, as decidedly favor it — while narcotic substances, by their action on the nervous system and exposure to a very high temperature which depresses the body generally, totally destroy it.
Hunger then, being the sensation by which we are made aware that the Body is in want of Aliment, and also indicative of the amount of Aliment required, is undoubtedly caused and regulated by the general state of the System; but the sensation itself, like all others unconsciously takes place in the Brain, whether the impressions which give rise to it, are conveyed by the nerves. I propose therefore to treat of the subject in two divisions.

I. Does any particular part of the Body in which these impressions originate?

II. How are they conveyed to the Sensory nerves? If then or is there not a special nerve for this purpose?

First, then, as to the seat of the impressions. Scarcely on any point in Physiology, have a greater number of theories to plume been proposed, than on this. Many of them unsatisfactory—many in the highest degree absurd.

Thus many, perhaps the greater number of physiologists regard the Stomach as the immediate seat; and various conditions of this organ have been considered to give rise to the sensation, either directly, by means of alterations in its own proper sub stance, or indirectly, from its influence in causing disturbance of the surrounding viscera. Others leaving the Stomach entirely out of the question, place it in some general system of the Body, as the Circulatory or Lymphatic system.

A third party hold it to be specially caused and preceded over, by a particular part of the Brain, which they call the "Bump of Alimentationness." Others going to the opposite extreme, ascribe it to the "Fire of the Vital principle," the meaning of which it is not very easy to guess; while Magendie described it from all, comes to the following comprehensive, but as rapid...
"Précis élémentaire de Physiotropie"

* "Journal de Magendie" An IV
* "Taras' Physiotropie"
with Dr. Clavmont, not very intelligible conclusion that "Hunger is produced like all other internal sensations by the action of the nervous system, that it has no other root than this system itself, and no other cause than the general laws of organization." For says he, "What well proves the sensation to be only in the nervous system, is that it sometimes continues after the stomach is full, that it does not always develop itself through the throat, that it has been long emptied, and that it is under the influence of habit, going away at the same hour every day." Now that the nervous system is necessary to the sensation is undeniable; but I think it quite plain from what has already been said, that the general state of the system, influences more or less by various circumstances, is the primary cause, while the nervous system only appreciates it, and is capable in certain cases of modifying it.

Furnishing therefore to the original question, whether there is any particular part or gland which acts as the medium of communication between the system at large and the sensuous mind, (as proposed), as the best means of doing so, to examine some of the opinions which have been held on this subject.

Mr. Gaspard and Prof. Dunning, Montaguen both consider Hunger to have its seat in the Vascular Systems of the Body, the former referring it especially to the Circulatory, the latter to the Lymphatics. Mr. Gaspard holds it the cause by vacuum of the Blood vessels, and only to be relieved by the entrance of nutritive fluid into them, and not into the Stomach alone. "It" says he, "when one has Hunger or Thirst, this fluid, being at the same time, small, food or drink, taken in quantity even much greater than the Capacity of the Stomach, do not even charge that organ, but are absorbed with great promptitude; while, on the contrary, the pulse is full and strong, and one
"Suavís imprevista"
"Eats without appetite, and drinks without thirst, the stomach though empty, is surcharged with the smallest quantity. Absorption takes place no longer, but digestion follows by vomiting, convulsions and fever. Hunger and thirst also arise as their causes, all evacuations which empty the vessels as nausea, diarrhoea, diurese. The cause of these internal sensations, resides therefore in the circulatory system, and not in the digestive, of which one may be convinced by observing the constant hunger which torments those who are afflicted with artificial aches, either from the pyriform or although the digestive organs may be full of food or chyme.

Prof. Dumas again refers to excessive action of the lymphatic system, dependent upon the lack of nutritive fluids in the body. He considers Hunger to be an Apathetic State of the System, demanding a supply of sustenance to build up the various organs, as part of their constituents is constantly being carried off by the lymphatics; the absorptive action of which "after having exhausted the nutritive fluids, exercises itself upon the substance of the organs themselves, and causes a sort of unessential leucia, the stimulus of which is communicated to the nervous system, giving about the painful sensation which indicates the want of stoles sustentament." To prove that the absences acted thus vigorously, he starved four dogs, three of which he killed after different periods of atonement, and let the fourth die of hunger. In the first three, the intestines presented a more or less parched appearance according to the time they had fasted, as did also the liver, kidneys, but in the fourth, however, in addition to these appearances, he thought he observed absorption of the internal surface of the intestines themselves, which commenced at several points, and this he took as an index to what was going on in all the other parts of the body. He also found that in animals,
Who were suffering acutely from the pangs of hunger, the desire to eat was completely taken away by the administration of spirits, corrosive sublimate, alcohol &c. — all of which substances, he says, reduce the activity of the Lymphatic System; and from these experiments he comes to the conclusion above given.

How to what do these two theories amount? Is this — that Hunger depends on the want of nutritive fluid in the Body — a proposition which cannot in the least be doubted; but to say that Hunger has its seat in the vessels which contain these fluids, is quite a different thing, and one that will not stand the test of examination. For the doubt the craving sensation is appeased, and the individual improvized, long before the food can be digested and received into the circulation. And if it were not so if the pangs of Hunger were not assuaged till after the digestion of the aliment, what would become of the sense of satiety? Dr. Gaylard's argument then proves no more than that the frequency or constancy of the Blood is an index to the amount of aliment required; and that the stomach having cognizance of the wants of the system, attains to digest the aliment when required, rejects them when superfluous.

Mr. Dumas again, merely goes a step farther back, as he refers it, not to the quantity of the Blood or vessels, but to the action of the Lymphatic System, which is, at all events, one of the causes of that vacuity. This system has, for its principal function, the removal from the tissues of their disorganized portions, the place of which is constantly being supplied by fresh materials; but in abstinence no such compensating addition is made, and consequently the Body loses its substance, till from the action of the Lymphatic System being increased, but barely from its not being antagonized by addition of fresh materials. Hence if the relief of Hunger was what Mr. Dumas supposed, it
Could not be appeared even when the food was injected and had been received into the circulation; but not until it had passed into the substance of the various tissues. There were, under the influence of the lymphatics—-the impossibility of which is at once apparent. Rather is this theory much strengthened by the arguments which belong, forward from the absorption having commenced in the digestive tissues, as this phenomenon has never been observed by the many other experimenters on this subject; and would it not be more reasonable to ascribe the effect of Bumie, alcohol, copperboric acid to their action on the nervous system? One of them at all events, the Bumie has generally had quite the opposite effects ascribed to it, as regards the lymphatics.

Finding them no satisfactory explanation of the effect of Bumie in the foregoing theories, let us next examine the grounds which now go upon, who considers it to be regulated and watched over by a particular part of the Brain. At first sight it would not seem unreasonable to suppose that the meatus which causes the young mammal, to suck the teat of its mother, depended upon some special part of the Brain, the function of which was to give rise to the sensations requisite for the performance of this act; and accordingly Phenologists have decided that a portion of the Cerebrum is endowed with this property. J. A. von Munchin, the founder of the science, did not include this in his system of Phenology, but his followers, particularly Dr. Combe, have in this respect completed the system, and added to the former list of Bumps that of "Alimentativeness"—which Bump is placed above the "questionness" and in front of "Destructiveness."—But have we any proof that this faculty is thus resident in any special part of the Brain? I think not. On the contrary there are cases recorded of children being born without brains at all,
who still cries for, and took the Breast ofMui Nurse, just as other children do. Now, in their case, the heat of the impulse which caused them to do so, could not be part of an organ which did not at all exist. The action must evidently be like that of Respiration, purely automatic and as such, of course a Reflex act. Now, for a Reflex act to be produced, there must be some part of the Body in which the impressions which give rise to it, either originate or are produced, which part, in this case, cannot lie in the Brain. Seeing then that there are such plain exceptions to this theory, it cannot be received as holding good in any case; but the seat of Hunger must be sought for somewhere else than either the Vascular or Nervous Systems.

I have formerly stated, that many, or indeed, most Physiologists are of opinion, that the Stomach, that part of the Digestive Apparatus, into which the food is first received, is the true seat in which the sensation originates, but they do not by any means agree as to what condition of that organ gives rise to it. Thus some have considered it merely to depend on a state of emptiness, when the Stomach, being contracted and occupying little bulk, gave no support to the Liver, which by its weight, dragging on the Diaphragm, gave rise to the unpleasant feeling in the Hypochondria by which the want of food is manifested. Others again find the cause in certain states of the Stomach itself, as "Fatigue of the Contracted Muscular Fibres, when the Organ has been long empty," or "Compression of the Veins of the Viscera and Stomach by the weight of food." And a third party have ascribed it to the action of certain fluids on its coats, as bile and gastric juices.

In the first four of these theories, the peculiar conditions which are supposed to give rise to the sensation...
D. Beaumont's "Experiments and Observations on the Gastric Juice
" and the Physiology of Digestion, edited by A. Combe M.D.
are all consequences of the state of emptiness, and as such are easily proved. The fact is, for we know that after a full meal, the stomach is in general empty for some time before the Appetite returns; whereas were this true, it should be felt as soon as the food had passed out of it, and the adherent to the sides of the organ rubbing against one another were thus removed; and on the other hand, the walls of the organ may be quite effectively separated by many indigestible substances without the sensation being by any means relieved, or at most only for the moment and almost immediately returning.

Again when the stomach is relieved of its contents by any unnatural or artificial means, such as an emetic or laxative, the desire of replenishing it is by no means immediate, which it should be certainly, were the sensation caused by Contraction of the Muscular fibres, and Compression of the nerves of the Viscera.

During acute diseases also, the desire for food is scarcely ever present, although little may have been taken for days or even weeks; but still in such circumstances, the stomach is not only empty, but very frequently irritable, both of which conditions should excite to its possessor a voracious appetite.

These purely mechanical theories are therefore quite insufficient, and there now remains to consider those which ascribe the sensation to the action of certain fluids on the exterior of the stomach, and first of all to that of bile.

This is easily answered, for Dr. Beaumont, who had for several years, the daily opportunity of watching the interior of the stomach of his well-known patient Dr. Parrot, says distinctly, that instead of its being the rule to find bile in the stomach, it is quite the exception; and even in those rare occasions, its presence is due accounted for, by the Antiperistaltic movements of the stomach being excited, and
Kept up so long as to extend to the Duodenum, by some cause, in conjunction to the pyloric extremity, with the elastic tissue, in extraction of the Gastric Juice, as continued vomiting of —

The discovery by Beaumont of the pellagracea, or acid substans fluid existing in the Stomach, gave rise of course to the new idea, that the portionary Vicinity of this fluid gave rise to the sensation of Hunger, by acting on the subsans of the organ itself, when it contained no food to be dissolved.

But, says Dr. Beaumont, 'the principle objection to this doctrine is based upon the fact that the Stomach contains no Gastric Juice, or at any rate, but a very small quantity, in its empty state, or when empty or other violent is not present.' Besides if it were true that it contained a quantity of the fluid, such fluid does not possess the power of producing anything like irritation or inflammation of its walls, and as innocuous to the Stomach as the blandest substans in nature.' These positive facts, proved by direct observation on the living body, completely set aside this doctrine, but still it remains one, the last to which I shall allude, by which Hunger is ascribed to the Gastric Juice, though in a different manner. This is the theory of Dr. Beaumont himself, and coming from one who had such opportunities for observation, it must be entitled to a careful consideration. I give it Beaumont in his own words —

"My impression is, that the sensation of Hunger is produced by the distension of the Gastric vessels, or stomach, whether vascular or glandular, which receive the Gastric Juice, and is believed to be the effect of depletion by this fluid. One reason, among others, for this belief, is the fact that the internal sensations referred to different organs, are caused by some modified action or condition, of the"
parts in the tissues of the organ itself. The modification in the parts to which the sense of Hunger is invariably referred, I conceive to be a distension, by the Gastric juice, of a particular set of vessels or glands, constituting in part the erectile tissue of the villous coat of the stomach. The sensation varies according to the different degree or state of distension, from the simplest desire to the most painful sense of Hunger, and is always or increased in proportion to the application or refusal, of alimentary stimuli to the existing vessels. The greater the distension of the vessels, the more acute will be the pain; hence the difference between a short and a protracted fast. Appetite and Hunger belong to the same class of sensations; they differ only in degree. In this they are like all other sensations. A little increased circulation in the vessels of the brain produces peculiarly vivid, but not absolutely unpleasant feeling, and gives force and energy to the mental actions; carried further, it produces more painful sensations. It is unnecessary to cite further examples. Indeed, it does not need arguments to show what is the subject of everyday observation. It is well known that the pain from acute inflammation is produced by distension of the blood vessels. Let anyone, who is disposed to try the effect of vascular distension, place a ligature around the finger or arm sufficiently tight to arrest the returning blood, and the truth will be sufficiently obvious.

It is, therefore, inferred from the pain, (and in one, it is believed, will deny that Hunger is a painful sensation, whatever may be his opinion of appetite), that vessels (however far extended) and it is demonstrated, I think, in some of the following ex.

"periments, that there are the Gastric vessels. On applying a

"element to the internal coat of the stomach, which in health

"is merely lubricated with mucus innumerable minute

"capillae, the surfoes don't those of the Gastric vessels,
"Immediately throw out a quantity of this fluid, which mixes with the food. This effect is too sudden, and the sensation too opium-like, to account for on the ordinary principles and laws of secreting mucous surfaces. The quickness and relief from the unpleasant sensation which are experienced as soon as the vessels are emptied, are, I think, additional proofs of my opinion. It is certain that at the introduction of every breech, or on the application of alimentary stimulæ to the internal coat of the stomach, a very large secretion of a fluid, which has repeatedly been ascertained to be an alimentary solvent, immediately takes place; and that when the stomach is destitute of food or some other irritating substance, no such secretion can be found in it. And it is more than probable, in fact, almost amounts to demonstration, that a large quantity of this fluid must be contained in appropriate vessels, during a fast, ready to obey the call of aliment. I would not be understood to say that the whole quantity necessary for an ordinary meal is eliminated from the blood, previous to the commencement of alimentation; but that enough is contained in the gastric vessels to produce the sensation of pain or hunger.

In this extract from Dr. Beaumont's work, we see that his chief reasons for ascribing Hunger to distension of the gastric vessels, are the pain which is felt, the rapidity with which the sensation is poured out, and the immediate relief, which follows. But there is no positive proof that the juice is pouring from the vessels, and even Dr. Beaumont's own experiments tend, I think, to establish the contrary. The rapidity with which it is poured out, does not seem to strengthen the doctrine at all, when we consider the quantity of fluids or saliva which are excited in a short space of time, in answer to their appropriate
Stimuli – Sustains has the immediate relief which follows, any greater weight, because, if it were caused merely by the emptying of the distended vessels, any stimulus should have the same effect as that of food – which it has not. In reading Dr. Beaumont's book, we find that he was very frequently in the habit of extracting Gastric Juice from St. Martin's stomach, for the purposes of analysis and experiment. The time when he usually chose for doing so, was the morning, before St. Martin had eaten anything, when the stomach was empty and clear, and when, from the length of the previous fast, one might expect the so-called Gastric Vessel, to be distended to their utmost. In such circumstances, one would suppose that any means by which the juice could be removed from these vessels would give relief from the disagreeable feeling of hunger, and be rather pleasant than otherwise; but on the contrary we find that its extraction was generally attended with that peculiar sensation of fainting, termed sinking, with some degree of faintness” showing. I think, that instead of the accumulated contents of the vessels being merely drawn off, there was an action excited in the Gastric apparatus by an unnatural stimulus, which produced the effect above mentioned.

The following experiment is an illustration of this:

14th January 1838. At 8 o'clock A.M. examined the stomach, which generally healthy, few small eructations patches on the mucous surface – a few mucus. Extracted one and a half ounces of pure Gastric Juice, containing the usual amount of mucous flocculi. It ran more freely than common through the tube. Now could have been obtained but a sensation of faintness feeling at the pit of the stomach, being felt, and complained of.
"This denervation has almost uniformly occurred, whenever the gastric juice has flowed more freely than usual, and has been allowed to run to the extent of one and a half or two ounces, followed by diminution of vision and vertigo on rising. These feelings however subsided in a few minutes, and he feels as usual, and eats his meals with a good appetite." (p. 195)

The artificial extraction of gastric juice then causes uneasiness, and does not take away hunger—two very weighty objections to Dr. Beaumont's theory.

The observations of Dr. Claude Bernard are totally opposed to this idea. He considers the gastric juice to be a pure "liquide extrable," differing entirely from either ordinaryelanodin, eau de toilette, or lumine infusions, and formed by a number of little bodies, which exist in the mucous tissue of the stomach, and through which, he thinks the gastric juice passes as through a filter.

The physical condition of the stomach, which must be present for the exhibition to take place, he considers to depend on the excess of blood, which renders that organ turgid during chymification, and further, that the juice escapes instantly by traversing the tissue of the mucous membrane, as through a veritable filter, which can allow certain parts to pass and retain the rest.

The following experiments were made upon this subject:

1. The abdomen of a healthy dog, which had fasted for a month, was opened, and ligatures put on all the branches of the Coeliac axis except the Coronary. The stomach was laid open, and the mucous surface washed clean and dry with a sponge. The animal was then killed, and the stomach immediately injected, with a force just equal to that of the heart, by means of Botulinus syringes, with eighty centilitres (about twenty-seven ounces) of blood newly drawn from another dog. Carotid. The mucous membrane became instantly turgid,
Nineteenth "Physiology"
and exuded on its free surface, a fluid with an acid reaction just like the Gastric Juice; and to show that it was not previously stored up, but passed through at the very moment, a solution of the Yellow Prusiate of Iron was injected in the same manner, it found its place at once into the stomach.

2. A solution of the Yellow Prusiate was injected into the vein of a dog shortly after he had taken some food. The animal was in no way annoyed, but continued to eat some more. He was killed at the end of half an hour, and his various secretions tested with a Prussate of Iron, by which it was found that the Prusiate existed only in the Gastric Juice arrows, intestinal in the Intestinal Secretions, the Gastric, Salivary, Pancreas, Pericardium or Peritoneum.

From these results Dr. Bernard concludes that the Gastric Juice is a peculiar acid fluid, differing from the other secretions or excretions of the Body, in that it contains all the soluble matters contained in the Blood, which they do not; that it is formed only in the stomach, and even there, only during the process of Digestion, or of course during the influx of Blood from any cause.

Other Physiologists, again, consider it the regular secretion formed by an immense number of tubular glands, opening into the shallow polygonal depressions which abound on the inner surface of the stomach, and give it a honeycomb appearance when examined with a lens. The office of these Gastric Fluids is, by them, supposed to be the production of cells containing the Gastric Juice. "When the stomach is empty," says Dr. Walker, "they appear blue at rest; but are called into activity on the fresh introduction of food. . . . Whilst active in digestion, they fill with cells in various stages of development, engaged in the elaboration of Gastric fluid. In the production of these cells, minute granules appear to be generated at the deeper in
of each gland; two or more of these granules grouping together form
kochii, and are developed into nucleated cells—In the higher parts of
the glands, these parts which are nearest the surface, secondary cells
are developed within these primary ones; the walls of the latter
then appear to coalesce and form the proper membrane of the
gland, while the new generation of cells filled with gastric
fluid, are discharged into mix with the food.

Whatever is these two modes of formation be the true one,
there seems no doubt, that the same state of the stomach is
necessary for either of increased amount of blood in its
secretion, and this is only seen to take place when food is intro-
duced, or the surface irritated in some other manner. The
events of the irritation thus produced, are also quite in accord-
ance with this statement: for when some alimentary substance is swa-
llowed, it is moved about over the whole of the mucous surface by
the muscular contractions of the organ; and increases quantity
of blood it is thus made to circulate throughout its entire extent
and a copious flow of gastric juice is the consequence; while
when the bulb of a thermometer or a burette tube is used,
as in extracting the juice from St. Martin's stomach, but a sma-
ller portion of the organ is acted on, and the amount obtained is co-
paratively trifling. From these, and the preceding objections
it must be seen, that P.'s Blautomo's Theory, though certainly
containing none of the absurdity with which many of the other
abounds, cannot by any means be regarded as settling the
question, any more than they—

What then is the cause of the true heat of hunger? Though
perhaps not all, yet the most of the theories on the subject,
have been examined and found to all imperfect. Are
we therefore to conclude with Dr. Magendie, "That it has
no causes but the general laws of organisation", or attribute it,
to the "Weight of the Vital Principle"? I think not — for though
the exact state of the organ during Hunger has never been ascer-
tained, and we know not even whether any sensible or appre-
ciable change does take place in it, under such circumstances;
still I think for many reasons, it is impossible, not to suppose
the stomach to be the "Point of Departure of the Sensation.
For it is an undeniable fact, that food received into that
organ, completely removes that craving almost immediately,
and long before it could possibly be digested; and temporary
relief could even be obtained by the injection of non-alimentary
substances, as is said to be practiced by some savage tribes, in
seasons of scarcity. The relief thus obtained, however, is very
transitory, and the feeling of want soon returns in greater force
than before. It is this circumstance of instant ease and
comfort being consequent on the taking of food, that we owe
the sense of Satiation, or the consequences of having eaten enough
by that very act to supply the present wants of the economy. This sensation
must therefore evidently arise in the stomach itself, as the
food, which produces it, has not had time to influence any
other part of the Body. Now is it possible that these two sensations
of Hunger and Satiation, the one indicating the want of food, and the
amount required; the latter giving notice when that proper amount has
been taken — is it possible to suppose that these two sensations, or
rather two modifications of the same one, have not the same seat?
So the stomach being doubtless the seat of Satiation, must be that
of Hunger also. Both of them depend, for their existence, on the sympathy
which is constantly kept up between the stomach and the rest of the
Body, and the principle perceived between them is that they act in
different directions. Thus the wants of the various times, being known
"Traité Analytique de la Fixation"
fapsed through one organ—the Stomach, give rise to Hunger; while
the injection of a proper amount of food into the Stomach, before it
goes any further, causes an agreeable feeling of Comfort and refreshment,
over all the Body, which is Satiety.
Mr. Blondot even considers the Stomach may be regarded as a veritable
centre of nervous activity: being to the organs of Nutrition, what the
Brain is to those of Relation; the Central organ of those internal accu-
sations and operations which belong to Instinct, as the Brain is to those
which belong to Intelligence—that it is the principal seat of the
instinctive sentiments, even in the lowest species of the Zoological Scale;
it is, as it were, the proof of existence, the actual animal being only
a Stomach and Appendages; whilst in the highest species the Brain
is antagonised and dominated over, by another principle—Intelligence.
The Stomach, then, he holds to be the Central sympathetical organ of the
rest of the Body, as far as relates to the state of the Organism itself and
the manifestation of its wants.
Of this truth of this last conclusion, I need not say,
rous and consider, that, exactly in accordance, with the amount
of waste which the Body has undergone, the sensation of Hunger
is developed with more or less intensity; the sense of Satiety is in-
dered or increased by the taking of a greater or the amount of food;
and further, that the digestive power of the Stomach, is exactly in
proportion to the wants of the rest of the economy; quickly and
easily disposing of large quantities of food, when really required,
but soon resuming the useless labor, which is attempted to be
forced upon it by those, who eat more from the pleasure of taste
than from necessity. Without these, giving credit to any of
the various sensible Changes in the Organs itself, which have been
regarded as the proximate cause of the sensation, or taking refuge

Paris on Diet.
in many such doubtful hypotheses, as "an enervating state of the Gastro-intestinal nerves, occasioned by an interval of inactivity, in which the vital powers may be supposed to accumulate." I think it more than reasonable to conclude, that the stomach is the organ, in which the sensation of hunger is manifested, and, through which it is at once relieved, by means of the sympathy which exists between it, and the state of the body, which sympathy of course depends for its existence on the co-operation of the nervous system.

This brings us to the second part of the subject viz. How are the impressions which give rise to the sensation conveyed to the sense organs? Is there, or not, a special nerve for this purpose? Upon this subject also, there is great diversity of opinion. Some Physiologists believe the pneumogastrics to be the sole conductors of these impressions, while others assign that function entirely to the sympathetic system of nerves. The whole process of nutrition seems to be under the influence of both the central or spinal and sympathetic systems, though more especially of the latter; but the two systems are so closely united to each other, that it is impossible to say exactly what effect is due to each. The difficulty increases as we ascend on the scale of animals, for, the more that the central or spinal system is developed, the more intimately does it seem to be connected with the processes of organic life.

In frogs, for example, as well as other cold-blooded animals, the brain or spinal cord may be completely removed, all but the medulla oblongata, which must be preserved for the purpose of respiring, and the organic functions still continue to be performed for some days; whereas in man, a slight injury of either of these parts, may occasion great disturbance and even complete stoppage. Probably the powers of radiation...
"The safest view of the question is to regard all the processes of organic life in Man, as liable to the combined influence of the Cordo-spinal and sympathetic systems; to consider that these influences may be combined, that the Sympathetic nerves and Ganglia may be in Man as in the lower animals, the parts through which the ordinary and constant influence of the nervous force is exerted on the organic processes; while the Cordo-spinal Nervous Centers and their Ganglia, are the parts from which the proper sympathetic Ganglia receive supplies of Nervous force, and from which, more often or more regularly than in the lower animals, the processes of organic and Animal life are made to work in connection and mutual adaptation."

The sensation of Hunger seems also to be under the influence of both; as the sympathy which is kept up between the Stomach and the rest of the Body, is generally believed to be the effect of the sympathetic system, while that of the Cordo-spinal, is sufficiently proved by the power of mental emotions, to modify or even dispel the sensation which had been intensely strong only a minute before. Besides, if the mind be in a state of abstraction, or intently fixed on any particular subject, it may not be at all perceived, even although the Body be in a state of exhaustion from want of food; and instances are recorded in which individuals have actually fainted from want of food without ever having felt any desire to eat. In this, Hunger is just like all other sensations, being overpowered by, and giving place to, others of a more powerful character. Antecus, however, to this erging us to the influence of particular Nerves. Those which are distributed to the Stomach are branches of the Pneumogastric and the Sympathetics, and both of these, as previously mentioned, have..."
Brachit "Système Renvoy Sauflinarin"
been considered the Channels of Communication. Numerous experiments have been performed on animals with the view of deciding the question; but unfortunately on this, as well as most other points connected with the subject of Hunger, their Authors do not by any means arrive at the same conclusions.

Mr. Brachet of Lyons, considers the office, proved belonging entirely to the Pneumogastrics by the results of the following experiments. 

Exp. I. "I caused a dog to fast for twenty-four hours, till he was ravenously hungry, and then cut the 8th brain below the origin of the Recurrents. When set free the animal lay down without showing any desire to eat, inspiration being easy, but rather slow. I then offered him some meat cut into small pieces, which he ate, but without eagerness. I then gave him as much as he liked twice over, and he only stopped when his could eat no more on account of the feeling of the pharynx.

In Exp. II the same results followed. Two Guinea pigs were starved for eighteen hours, but by their cries and restlessness, they showed themselves to suffer acutely from Hunger. He then cut their Vagi; and after the operation when food was placed under their very noses, they ate, but when it was removed to the distance even of the length of their nose, they did not rise and follow it. A large quantity being then put before them, they ate till they could swallow no more, having filled not only the stomach but also the pharynxes.

"Can any one," says Mr. Brachet, "in these two cases, mistake the action of the Vagi when Hunger; unless after they was divided, the animals subjected to the operation, did not learn to feel any want? In giving them food, they ate; it is true, but they did not feel the sensation in the stomach, neither were they
L'oeuvre de Lassaigne "Recherches sur la digestion"
"Conscious of Satiation; after filling the stomach, they continued to eat, till they filled also the oesophagus. Digestion could no longer be accomplished, but still one saw them eat with the same indifference as when the stomach was empty. Then they both for without feeling hunger and continued to act as if without perceiving satiation. In these cases two sensations were destroyed, because the nerves which carry the sense of them being cut, could no longer transmit impressions. The nerves, the section of which, destroy this double sensation, are the Pneumogastrics; and they therefore are the nerves of Hunger and Satiation."

This argument, when taken by itself, appears quite conclusive, and sufficient to establish the Nervi as the special nerves of Hunger; but when we examine the results of the same experiments, then performed by other observers, and the conclusions which they draw from them, we find that they neither agree with one another, nor with Dr. Brahe. Some saying that cutting these nerves had not the slightest effect, and others, stating a middle course between the two, holding that the sensation though impaired for the time, returns after the shock to the system has passed over.

Dr. M. Levent and Lassaigne belong to the first class, as the Regel, which in which they operated, never showed the least aversion to eat, almost immediately after the operation; but still they showed no desire to stop after the stomach was completely filled. Far from this showing, however, that the Appetite existed no longer, it would indicate on the contrary, that this sensation existed also in the Intestines which receive no nerves but the sympathetic."

Here then are two diametrically opposite conclusions, drawn from almost precisely the same data.
"Experimental investigations into the properties of the 8th Fq."
do not mention, whether their animals showed any eagerness for their food; but in both cases, the animals are said to have filled their stomachs completely, and even then, I have shown, no intention of stopping. Whether, then, is it correct, agree with Dr. Bracken, that the sensations of hunger and satiety are destroyd together; or without taking the sense of satiety into consideration at all, to conclude with the note, that hunger has its seat only in parts supplied by the sympathetic nerves?

Before deciding that either are right, I think it better, in the first place, to examine the results of some of the numerous other experiments which have been performed for the same object.

Dr. John Reid, whose observations on the 8th pair of nerves, in all its functions, are perhaps the most valuable that have ever appeared, considers that there is positive proof of the sensation being ever totally annihilated by section of the vagus, while there are strong grounds for its occasional continuance. He observed particularly, the effect which it produced upon four dogs, all of which succumbed the operation for a considerable time. Of these, three cocked their ears and looked out for food, when he entered the room where they were kept, after they had been allowed to fast for some hours; and the fourth, the day after he was operated on, was prowling about, apparently for food, and ate with as great avidity, whenever he could find it. Of the dogs, on which he experimented, could, with all the care he could practice, be prevailed upon to take any food, for the first twenty-four hours; but after that time, they generally took it readily, and in variable quantities, at different times; all of which tend to show that if the animal had lived long enough, the appetite, though destroyed, or at all events much impaired for the time, returns to its
Scarlatti "Dissertation Longinale" Societ de Musie in Paris 1829
natural condition or very nearly so.

These observations are quite confirmed by those of Dr. Todd, who found that dogs on which he performed the same operation, scarcely ever ate anything before the third day; but that after that time, the appetite returned and continued to improve, as long as the animal lived. The following experiments are taken from his Paper.

Case I. A dog in which both nerves were cut: Thescytomia performed.

"During the first two days, no food was accepted, but thrust was felt and gratified. On the following days, appetite was developed and the dog swallowed some small pieces of an old turnip that immediately vomiting them. Digestion difficult.

Some days later, the vomiting was not so frequent, and the rejected portions were again swallowed. Although he got very thin, he improved in spirits, waited impatiently for feeding time, and had a large appetite. On the 14th day, he was bled from both auricular artery veins, noting the condition of the blood. On the 20th, the wound was healed, and he was apparently well; but on the 21st, he fell into a state of great weakness, and died on the 23rd.

Case II. A thin active dog. Thescytomia not performed.

Drank but would not eat during the first three days, and had frequent vomiting of white bloody matter. After this time, he commenced to eat, and was carefully fed on Venison, bread, and in small quantities at a time, still continued to vomit.

At the end of a month, he was decidedly better, and not so thin, but was never lively except at meat times. Was often worse, neglected, and died at the end of two and a half months.

From these various experiments it is evident, that section of the pneumogastric has not an equal effect upon all animals.
while some do not eat till some days have elapsed, others show no
aversion to doing so almost as soon as the operation is over; but in
good all cases it is perfectly evident, that if the esophagus
remains to any of the after effects, which usually attend the operation.
The condition returns at a period varying from the first
to the fourth day; though whether it is destroyed for that
time, on account merely of the shock to the system, or
from any special effect of the Bage is much more obscure.
As Dr. Leget found that after cutting the great Stomach
Greve, events nearly similar followed.
There is one point in Mr. Bruchelt's argument, on which he laid
considerable weight, but which is directly opposed by most other experi-
menters viz. his conclusion that the guinea pig had lost the sense
of satiety, from their eating till they filled both stomach and
Esophagus. For Dr. Reid proves that the error into which he fell,
was that of supposing that because the Bleophages was filled, the
stomach must have been so previously; whereas, on account
of Paralysis of the tube, from the previous influence being cut
off, the Bleophages got filled first. This was well exemplified
in a Rabbit, in which he operated. The first mouthfuls were
swallowed without any change in the breathing. Gradually,
however, the breathing became more and more hurried as it continued
to eat, and when the Dyspepsia had become pretty urgent,
it was killed by a blow on the head, before it had made
any efforts to从容. It was immediately opened, and
the Bleophages found distended from top to bottom with
Greve, while only a few spears had reached the stomach.
And an easy explanation of this, is, that the first mouthful
was carried in the usual way, into the upper part of the Bleoph-
ages, but, the muscular contractions of that tube being lost, that
it remains there. As additional mouthfuls were swallowed,
they propelled downwards those which preceded them, till a solid column was formed throughout the whole length of the Pharynx, which compressed the Trachea and to impeded Respiration. But while thus opposing Brechet's conclusions, drawn from his experiments on Guinea pigs (on which, the same effects are pro-
duced as upon Rabbits), Dr. Red seems to think that more con-
servative dignity may be attached to experiment on the Dog, as he (Dr. Red) never noticed, himself, any difficulty of deglutition in these animals; but Dr. Sclater found this to take place al-
most constantly, during life, and on examination of the parts after Death, always revealed the appearances which one would expect—great dilatation of the Pharynx. These in the first Case, which I quoted above, in which it was espec-
ially notice that "deglutition was difficult," the first-
ly, the appearances were: Pharynx extremely dilated—
fully three inches in diameter, above the Diaphragm,
and containing an immense piece of Beef, one end of
which, hung into the Stomach. The Contraction at the
Cardiac orifice existed no more. In the other Case, also,
the Pharynx was very wide, and the Stomach Contracted
into much less than its normal bulk; while in a third,
the stomach was found completely inverted, and filling up
the lower part of the Pharynx, which was dilated to
an enormous extent. From this, it would seem, that,
in these Animals also, the food first at first accumulated
in the Pharynx, so as to cause such an alteration in its
Capacity. It is however, from Discharge, most probably
by the efforts of vomiting; till at last When the Diminu-
ance of the field is much increased, the food is able to pass along
it, the Stomach with much less difficulty; for being merely
a patent canal, and the Cardiac Constriction being no more,
thought it can give no assistance to the passage of the food, it
repels no obstacle.
In this Paralysis, also, we find an explanation of the constant
sensation which is such a constant symptom of cutting the
Pajj; in that, the Abdominal Muscles and Part of the Stomach
itself (which is not entirely destroyed), and the Contents of
the Stomach when compressed by these forces, escape more
easily through the unyielding Cordia, than the Glottis atid
Pylorus. It seems also that this loss of muscular movement,
which extends also to a certain extent, though not so completely,
to the stomach, that is the chief cause of the impairment of
Dyspepsia, which is noticed in these Cases, since whatever exerts
the muscular contractions to their natural force, such as, Declivity,
Salvarem, exciting the lower end of the nerve, or joining
the two cut ends of the nerve together by a Conductor, Opposite
therefore, promotes the Stomach of the food, as dis
tected in the treatment of Niles of Philp, Buddet, (Howe & Snowdon)
and it is further illustrated by the fact that the more digestion
depends on these muscular movements, the more is lost of the
Waste, as in the case of a Fyson operated on by Smith, which
extended to 970, an immense degree, but as not the
least muscular movement took place in this bag, no diges-
tion was accomplished and the animal died on the 10th day.
In animals, however, such as dogs, which survive the operation
for a considerable time, and whose stomachs are supplied with
sympathetic nerves as well as the Pneumogastrics; the natural
motions of the Stomach are in some degree, at least, restored, as
their food is digested, and the chyme propelled into the
Duodenum - The secretion of the Stomach also, though much
Conf. "Math. & Physical of the Revolutions"
learned, or even stopped at first, and gradually restored.

With regard to the operation of Poisons and Emetics, after division of the Vagi, there is also difference of opinion.

Magendie found that a dose of Emetics, given co.

miting, as soon as the one came, as it would in the other.

and in thirty experiments on Mammalia performed by

M. Devergues under Muller's direction, not the slightest

difference could be perceived in the action of Barothe Emetics,

introduced into the Stomach, whether the Preemogastria

were divided or not provided the animals were of the

same species and die (Kuhus). Longt, again, found

that when the same dose of Aymcha was given to two

animals of the same kind which had fasted for the same

length of time, Convulsions commenced in the one whose Vagi

were divided, fully five minutes later than in the one in

whom they were entire; but when they did commence, they

were quite as strong. He also found, after giving Emetics

to two animals, with the same precautions, that division

of the nerves retarded the vomiting for some minutes, and

also rendered the retching less frequent.

What then is the effect of section of the Preemogastria?

Does the appetite return afterwards to its normal state, or do

animals eat merely to gratify the sense of taste? It would

deem that this was not the sole inducement, judging from the

interval which almost always elapses before they begin to take

food, after the operation, the eagerness they show at the

prospect of it, and the various quantities which they take

at different times (Reid). Besides Longt, found that

division of both the Glottis pharyngeal and Laryngeal nerve

made no difference in this respect — all of which circumstances

indicate that a veritable want was felt in the system.
Seeing then that Hunger is that felt after division of the Pneumogastric, the impressions which give rise to it, must, of course, be conveyed to the sensorium by some other nerves; and as the filaments of the sympathetic are the only others distributed to the stomach, we have to regard them as the channels of communication. Their power of conducting impressions is undoubted; and whether the conduction be effectual, by means of the circular muscle fibres which are always found interwoven with the sympathetic, there is no reason to suppose that it is affected in any different manner from the other nerves, except in so far as the impressions are modified by the diffusion of force which takes place during their passage through the ganglia; and the only difference which this causes seems to be that impressions, which, if conducted by a Cerebro-epigastric nerve, give rise to sensations, are, by this property of the Ganglia, so modified or diminished in force as to be unperceived. Thus, in ordinary state of health, the most of the viscera, which are supplied by the sympathetic, are totally unfelt; the ordinary impressions to which they are subjected being arrested at the Ganglia; but when attached by inflammation or other disease, the impressions to which they are subjected, are so much more forcible, as the propagated beyond the Ganglia, and acute pain is the consequence. Numerous experiments also testify to pain being produced by irritation of the Ganglia or Cerebro-epigastric nerves. The conducting power of the sympathetic nerves, then, differing from that of the Cerebro-epigastric, not in kind, but only in degree, we conclude that it is perfectly capable of conveying impressions from the stomach to the brain, and, that, therefore, it is by it, that the sensation of Hunger is produced, after section of the Pneumogastric nerve.

Only one question now remains, then, to be considered, and that is,
Since hunger certainly continues to be felt after division of these nerves, whether they play any share in its production, when entire, or do that function always belong solely to the sympathetic system? The question is of course quite hypothetical, and cannot be decided positively, either by experiment, or in any other manner. But it seems not unreasonable to suppose that, the pneumogastrics being largely distributed to the stomach, being cerebrospinal nerves, and as such, as previously remarked, capable of conducting ordinary impressions to the sensuerum more quickly and directly than the sympathetic, may be the organs, which in their natural state, reveal the wants of the economy through the medium of the stomach, while the sympathetic, though not required to do so, as long as the direct communication exists, may, after this is broken, take the office upon itself, and serve a substitute, if not equal, at all events, but little inferior. If it could be distinctly proved that the sense of solidity ever accompanied by cutting the Vagi, this would seem still more probable: because judging from the fact that a stronger stimulus is required to produce a sensation through the medium of a sympa-thetic nerve, we should conclude that a larger amount of food, and greater duration of the stomach, was requisite before use to the sensation, after the direct communication by means of the Vagi was cut off.

But is this sense impaired? Do animals really eat more without being satisfied? Mr. Brachet gives as his opinion, that undoubtedly he did; Mr. Levert & Lassagne say that their Horses were willing to eat after their stomachs were full;

Dr. John Reid contends Brachet's opinion by saying that the food never reached the stomach at all, but only
accumulated in the bloodvessels; the first motion appearance in Mr. Rediello's dog would seem to confirm this; while the
Pigeon which causes he cut 'attended its crop to an enormous
degree'. Merely favoring the opposite opinion.

From such conflicting evidence, I think it is quite imposs-ible to come to any positive conclusion, on which would be a
theory, but merely mention the foregoing idea, as not im-
probable, from what is known of the relative functions of
the different nerves.

From all, then, that has been said on this subject, I
think I may give as a summary of the whole, that
Hunger is a manifestation, through the Stomach, of
the general wants of the system —
That the change in the physical condition of that or-
gan, if any such really take place (which is improbable)
is quite unknown —
That the nerves which convey the impressions ori-
ginating in the Stomach, to the Sinews, are
probably the Pneumogastrics;
but not necessarily so, because in case of their
destruction, this office may be perfectly well per-
formed by the Sympathetic —
As animals are induced to take aliment by the sensation of Hunger, so are they impelled to take fluid by that of Thirst. This sensation is best described by mentioning the phenomena which accompany it. The first indication is dryness of the mouth and tongue; the saliva diminishes in quantity and turns more viscid, it does not the Secretion of the Mouth. The tongue gets dry and hard, and cleaves to the roof of the mouth; the speech is indistinct, and the voice husky. At the same time the Respiration stops and the veins become very red and dilated. If the artery for liquid be not gratified, the brow gets hot, dry, and irritable, the eyes injected. The Pupil quick, Respiration rapid, and the mouth is kept wide open in order that cooled by the fresh air passing over it. The fluid condition gradually gets more and more acute, and the sufferer often can in a state of Delirium. Thirst is still more painful to support than Hunger; even those who have the courage to starve themselves to Death, being very rarely able to resist the temptation to drink, and in such cases, the want of liquids shortens the period of pain.

Now very considerably.

The sensation is not equally developed in all animals; some apparently, scarcely ever feeling it at all, and living for a very long time without liquid. Vomeronous Birds, for example, hardly ever drink; and Bemut Tassoanaps keep an out for eight months entirely without water. He ate every day, a mouse, a Bird or a bit of meat, but though he existed so long without water, his condition was evidently improved, as he died very thin. Again, many other animals, such as Sheep, Rabbits, or almost never take water by itself, but then the fresh herbs on which they feed contain a large quantity.

In man, the desire returns at variable paces according to the loss which he sustains in the fluid constituents of his Body. Some cases are recorded of people having obtained entirely from drinks for a
Buenos "Physiologii"

op. cit.
very long time, even for months, but then no mention is made of what kind of food they used, and whether it contained much fluid or not. One instance, however, to which I shall refer more particularly afterwars, is given by Levert, Karriga, of a man who did not swallow a drop of water for forty days; but such cases are very rare exceptions, and for the most part, people feel Thirst at least as often if not often than Hunger, and like the latter sensation it undoubtedly depends both in intensity and the frequency of its occurrence on the amount of loss which the fluids of the body have sustained, and which requires to be replaced.

Thirst, according to Dr. Berard, may be considered as manifesting itself in two forms: the one having reference to the state of digestion in the stomach, the other or true thirst, to the state of the blood.

1. The first is manifested after meals, especially when indigestible substances have been taken. In these cases, there is frequently a feeling of weight and uneasiness in the stomach, which, as soon as sustenance is taken, would be relieved, by taking liquid to as to dilute the contents of that organ and favor their expulsion.

2. Again there are three different states of the blood which may give rise to the sensation.

1. A normal excess of the Solid Constituents of the Blood over the Watery -
2. The presence of Intoxicating Saline Matter -
3. Absolute diminution of the Blood in all its parts.

1. The first of these conditions is brought about by evacuation which drains the blood of its watery parts but leaves the solid. Thus if no drinks be taken, for a considerable time, to as a compensation for the constant loss caused by the various secretions, the blood which remains becomes broken down in proportion to and if by any means, such as active exercise these secretions are augmented, the sensation becomes proportionably intense.
This is also well exemplified in certain diseases, particularly acute Cholera.

2. The second is seen in the thirst which follows the taking of spices, salted meats, alcoholic drinks, &c. These substances might be supposed to cause it by irritating the mouth, jaws, and even the stomach itself, but the length of time which the sensation continues, shows that it is kept up after they have passed into the blood. There is also another class of irritants, not to be taken as these, and the nature of which is not so easily explained, but whose presence in the blood is indicated by thirst, as one of the most constant symptoms, by the various Fever Poisons, and the same is noticed in all inflammatory affections, accompanied by a febrile state of the system.

3. As to the thirst, we find that absolute diminution of the blood is a most certain cause, from the constant thirst which harasses those who have suffered severe or long continued hemorrhages, and in those diseases which impair the blood, both as to its solid fluid constituents, as Diabetes, the same effect is produced.

That thirst thus depends on the state of the blood is further proved by the fact of its being produced by liquids however introduced into the circulation; whether by the stomach, by absorption through the skin, or direct injection into a vein.

Being thus, that thirst is caused by the condition of the blood, let us now enquire, as in the Case of Hunger, whether it has any local seat—whether there is any particular part of the Body through which the general want is manifested. On this subject, different opinions have been held, though not so many as on that of Hunger. Some Physiologists, Aginudi for instance, hold that it has now at all. That it is an instinctive disposition, the Result of Organisation, and
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(Blumenbach's 'Physiology' translated by D. Elliotson)
"does not admit of any further explanation"; but having already
seen that its remote cause may be quite satisfactorily explained, as
being owing to the condition of the Blood, I continue the inquiry
as to whether, this general state, is, like Hunger, manifested through
any special part.

Dr. Sydenham considers it to reside in the circulatory system; and that
the same condition of this system gives rise to it, as to Hunger, viz.;
Vacuity of the vessels.

Prof. Dumas again states that "The Cause of Thirst may be ex-
plained by the powerful action of the vascular system, which, charged
with Caloric and Blood produces a species of Inflammatory
Investigation, which being communicated to the nervous system,
brings about the disagreeable sensation, which indicates the
want of liquid." He considers it to be a specific state of the
system in opposition to Hunger which is aesthetic; because it is pre-

erent in all Forms of Inflammation and is relieved by whatever
ameliorates the intensity of these affections, such as Bleeding,
Retention of Pus, &c. While opium, Alcohol & substances which
ameliorate Hunger, increase it.

These two themes now, which advise Thirst to almost opposite con-
ditions of the vascular system, evidently confirm the local heat of
the sensation, while two of the general states which have been
previously noticed as giving rise to it; and, in fact, to say that
it resides in the vascular system, is quite equivalent to denying
that there is any special part of the body, through which the
general want of liquids is manifested, but that it is manifested
equally through all parts of the body to which the Blood penetrates.

As far as I am aware, there is but one other part which has been
especially held to the heat of Thirst, viz., the Mouth, &c.

Blumenbach considers this proximity to the mouth, and the
general state of the Blood, only to act as the remote cause of the
manifestation of the sensation of Thirst.
asking the secretion of those parts, and especially the Thymus. Thus, a little water, he says, when taken into the mouth and merely to wet the parts, lessens the suffering for a moment, but unless enough is taken to saturate the throat, and restore the secretion to its normal state, the relief is quite transient.

Now, since all the secretions of the body are influenced in an equal degree by the condition of the blood, whether its force of the mouth and face, be affected to a much greater extent, than of the other organs, to what can the sensation be accounted for in this particular state? Is it that the constant current of air passing over their mucous surfaces, renders them drier and more dry than those in other situations; and that on this account, the impressions which give rise to the desire for liquids, are conveyed with greater intensity from them than from any other part? No, no! I am not disposed to think this the true explanation; and to show this, the moisturising of these parts with water has some effect in lessening the suffering of thirst. For this reason, I relate the following case.

A maniac, who was seized with the illusion that he was the Saviour, refused to take any nourishment, either solid or liquid; during the Lent of 1821, but determined not eat entirely for 40 days. The attendants tried to induce him by means of Emetics, but he never retained a single one—They likewise tried to have a tube drawn his oesophagus, but he answered that if the succeeded in forcing food and wine in that way, he would bite off his tongue. All attempts, being now unavailing, they left him to his fate. On the 15th day, he became unable to retain any longer from water, but kept eagerly on hand which was placed near him. The attendants, hoping that he would now allow some, watched him with anxiety, but no movement of deglutition took place; he only used it as a gargle and then rejected it. Still it seemed to give him some relief. For during the remainder of the 40 days, he continued to repeat the process every little
While, but could never be seen to swallow a single drop. At the end of that time he commenced to eat and drink willingly, and was soon restored to his usual health. From this they conclude that the local application had some effect, however transient.

But even though it be true that absence of the thirst sensation is the condition which gives rise to the sensation of thirst, still it must be remembered that it is not a strictly local affection of those parts; for the state may be dry and inflamed without any such effect being produced, and the torture of thirst has the resemblance to the pain of a local inflammation.

It is distinctly a special sensation, dependent on the general state of the blood, and the condition of the arteries can only be an index to that of the rest of the body, except, in as far as their condition may perhaps be aggravated by their exposure to a current of air.

We have now seen that thirst is produced by the state of the blood; but there is no uniform state of this fluid which gives rise to it; on the contrary it is experienced with almost equal intensity in quite opposite conditions. It is present after great loss of blood, when the pulse is feeble and fluttering; it is equally so, in fevers. Inflammations, when the pulse is full and bounding, the question therefore is, as these opposite primary conditions, give rise to any similar secondary one, which, when produced by either cause, brings about the same result? I think the explanation is to be sought in the state of the various secretions of the body, which are found to suffer almost equally in both of the cases above mentioned. Thus after great loss of blood, the secretions are diminished or arrested, for want of nutritive material; while in fevers they are oppressed, not from this cause, but on account of the general functional arrangement which hinders their formation, and though the circulatory fluids be abundant...
abundant, and the introduction of substances which check secretion such as opium &c have the same effect. In those diseases also, in which any secretion is immensely increased as cholera or diabetes, the excessive evaporation act in the same way as direct harmanes -

shape; and precisely the same thing happens, when the fluid portion of the blood instead of being expelled from the body, is offered into its great cavities and cellular tissue, for then it is equally out of the reach of the secreting Hands or Membranes.

Seeing then, that there are different conditions of the Blood, which all give rise to Thirst, all arise also in the changes which they induce on the secretions of the Body; is it not justifiable to con-

clude, that it is the latter, or rather the want of the latter, on the various surfaces which they are intended to lubricate and protect, that gives rise to the sensation? How the only de-

secretions of the presence of which, on their appropriate sur-

faces, are conscious in ordinary circumstances, are those of

the mouth and fauces. As their presence is necessary to com-

fort, to their absence at once causes uneasiness, and through

their secretions one is made aware of the lack of secretions on

the whole body, and the necessity of liquids.

Of course in those cases, where Thirst is caused not by want of Blood or its secreting parts, but by functional arrangement, better means can often be adopted for relieving this, as well as the other symp-


toms which accompany it, from the new injection of cold water

(and it was from this that Durers drew his conclusions from the

effect of drinking, minute of doses), but, still the in Clinites

to drink always exists, and recognizes thirst as the same caused

by absence of the order and secretions.

Whether these of the mouth and fauces suffer from, from the

other, from their exposure to Air, is a point which is not of

much consequence; because as the state of these parts is dependent
on, and indicating the state of the rest of the body, any merely local change, such as might be produced in this way, could hardly be supposed to have any effect, as far as thirst is concerned, through the irritation and uneasiness which it produces, it would always add to the general suffering and discomfort.

Thirst, then, shows the greatest analogy to hunger in most particulars. It is produced and regulated by the general state of the system. It is manifested through a particular part of the body, which acts as an index to the wants of the rest. And though the application of liquids to the throat, may precisely like that to the stomach, be followed by a momentary ease, still if enough is not received to satisfy the wants of the economy, the sensation of want almost immediately returns.

With regard to the influence of particular nerves upon the sensation of thirst, there is very little to be said. In fact the nerves which supply that region to which the sensation is referred, are so intricate, and have so many anastomoses between each other, that total isolation of the parts which are supplied by any particular one is almost impracticable, and of course it is impossible to say what effect it has on each.

Sufficient it is to say that no different sensations could be observed after division of any of the Pneumogastric,食道或咽喉神经 (Longe). It is most probably chiefly under the control of the sympathetic system.