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Maxwell
Inaugural Thesis

on

The Maintenance of the Healthy Balance

of Nutrition

in the Body

by

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The maintenance of the healthy balance of Nutrition in the Body.

In choosing such a subject as the present one for his Inaugural Thesis, the writer feels that he is unable for the task of fully setting forth the advantages which would accrue to the medical practitioner, in the discharge of his duties, from a correct knowledge of how the nutrition and health of the body is affected and maintained by the careful workings of Nature. During his studies in the clinical wards of the Royal Infirmary of this city, the writer has often observed with pleasure, how cases, which on former occasions in the days of unsanitary, would have actually treated with potions, pills, and emetics, have, under Nature's efforts, speeded partly in her own ways by the hands of the practitioners, completely recovered. Only from the effects of the disease, but from those in combination with the effects of powerful remedies had the patient to recover.
Nature was not thwarted in her means of cure, as in the dark days of medicine, when the medical man in his attempts to cure - as he said - the disease, only lent it wings to hurry its course, and end the patient it so unnaturally spared.

And the writer, in contemplating those cases, how often thought how great would be the advance in medicine were there only a more complete knowledge of, and more perfect reliance in, the "Vic Medicating Nature," among the medical men of the present day. By following man and more in the footsteps of Nature, Medical Science would not be abandoned, nor the skill of the practitioners be less valued.

"The Homoeopathist says "Pulvis similis curat similis." He gives his infinitesimal dose of nothing, but while he deludes his patient into the belief that the millimolar part of a drop of 0.000 has cured him, does he himself believe it? He knows that the globule did not work the cure, but that the credit of the recovery was due to the attention which he caused his patient to pay to Diet, Regimen, and General Hygiene, by means of all Nature gradually attained the supremacy of by incantation or injuriousness in the part of the patient she had lost.

The Homoeopathist says "Water cures everything" and his
patients believe him. But is that all this quackery amount?

The quack doctor gets a patient whom he finds dyspeptic, hypochondriacal and thinking himself afflicted with all the ills that flesh is heir to. What is to be done? The doctor finds that his patient has been for long living entirely at variance with nature's laws, attempting to force her to do things for which she is quite unable, and enduring torture her attempts to accomplish that she might be done. And what does the Hydropathist do? He finds out where nature first failed, and acts directly to restore those functions which have been arrested and where he cannot as at once restore, allows nature time to assert her powers. By water he clears the skin and stimulates that organ to healthy action; by water he clears out the sluggish bowels; by low diet he rests the stomach, which, probably for many days back had strived but laboured in vain. And thus by act on the one hand, with encouragement on the other, since either is necessary, he gradually allows the system to renovate itself and the patient is restored to health—rest by the power of water, except as far as that is an adjuvant to the workings of nature.

And though not entertaining of the principles of these two bodies of men, yet the Allopathist might with profit take a few lessons from their practice, in trusting more to nature.
and care & physic. Not that he is to stand by, candid & inert, but rather ready & watchful, so that whenever he observes a failing of the body's powers, he should be prepared to administer such remedies as he knows will be useful in stimulating & restoring such decaying strength.

The true medical man never attempts to cure a disease; he only treats it, guides its course and gives the patient a chance of recovery. The self-healing power inherent in all animated beings ought to be known and encouraged - not thwarted - by all who attempt to heal diseases.

The function of Nutrition, which is a great composited process, is the one on the proper performance of which, the health and strength of the body primarily depends. And in the present thesis, it will be endeavoured to be shown, how, in the healthy state, Nature regulates these processes to go & constitute the function of Nutrition, as it maintains a healthy balance between them; and how in disease, where the proper balance is destroyed, the endeavour by various means to restore it. And it is by observing her modes of healing disease, and adopting his remedies accordingly, assisting her when failing, modifying & strengthening where she seems inclined to overpower the proper limits, that the medical practitioner is enabled successfully to cope with diseases.
As the blood is the source whence all the tissues of the body derive their nourishment, it is but right that we should first discuss this fluid, before commencing to consider the influence which, through it, the several textures exert on each other. Though the instrumentalility of the blood, which has not inappty been called "the life of the flesh," the various changes attendant on the phenomena of life are accomplished.

Blood as it circulates in the body is of two kinds distinguished by the names arterial or pure, or venous or impure; and these two kinds differ most materially from each other, both as regards their constitution and function.

For the purposes of nutrition and the prolongation of life, it is necessary that at all times arterial or pure blood should be circulating through the body. Were no blood circulating through the system, death would be the result, and alike would be the effect of a curreation of venous blood. For a time, however, a slight admixture of the two fluids might be compatible with life, as instanced in the Cyanosis of children and in some cases of cardiac pulmonary disease, but long continued this result is death. For the maintenance of life and health, a full five circulation of arterial blood, from which the tissues
Can alone define their nourishment, if necessary.

The differences between arterial and venous blood are

1° in colour, the arterial being bright red, the venous almost colourless; 2° in temperature, that of arterial being two or three degrees higher than that of venous; 3° in the amount of Carbonic acid each contains.

This last constitutes the greatest physical difference, the venous blood being loaded with this gas, the arterial containing some fine dry powder and only a small quantity of Carbonic acid gas; and to this difference also is due the 2° of colour, for it is now believed that this change of colour in the blood is due to alterations in the shape of the blood-corpuscles, to which the presence of either O or CO₂ gives rise. The arterial blood as it circulates carries with it the nutritive materials, which goes to supply the place of the waste and changed materials which the venous blood bears in its stream.

As it is from the one source—arterial blood—that the whole body, in all its parts, tissues in their form and constitution, is nourished, it follows that this fluid should contain all the elements required for this purpose and in this account must be very composite. It has been examined and analyzed by many skilful and experienced chemists, and found to contain, after Blood corpuscles, white
and coloured, and these again made up of many constituents, namely, albumen, digestive matters, fat, various salts, the presence of which is required for the proper maintenance of the vital fluid.

The blood, however, is not a self-maintaining fluid. It has not the power within itself of forming those substances whereby its proper standard is preserved. Hence it is able thus to maintain itself, many of the processes which go on in the body, and many other external to it would be unnecessary. It is required that from without crude material should be taken into the body, and acted on by various changes within, chemically, physically, or vital, in order to be rendered fit for assimilation by the blood or thus by the tissues. And these must also be a continual giving of by the blood, from within to the external world, matters if so retained, would not only be useless to, but come ultimately to deteriorate the fluid. And though in this present state, these matters thus given off, be of no more service in this economy, yet, by a series of changes without, also chemical, physical, or vital, they come through time, to be again fitted in one way or another for entering the body as crude materials. There is thus a continual interchange going on between the body and the external world, which interchange cannot be arrested without danger to all life.
A supply of crude material as food, we therefore assume is to act on our bodies, in order that the blood vessels may be saturated. But, that it may be useful, this food must undergo several processes of change; it must be masticated and mixed with the fluids poured into the mouth, by digestion carried to the stomach, there to undergo important changes by its admixture with the gastric juice; from the organs it passes as chyme into the intestines, where it is again subjected to the influence of various secreted fluids. The nutritive matter now receives the name of chyle, and as it passes along the intestinal canal, is gradually taken up & conveyed to the biliary system of vessels; by means of which it reaches the thoracic duct, along which channel it is carried into the lymphatic system. Henceforward it is pumped into the general circulation at the junction of the subclavian & jugular veins.

The chyle as it passed along the biliary at first presented a peculiar appearance, which however by some changes brought on the fluid as it passed thru the series of connective glands on its way to the thoracic duct, gave place to a corpuscular structure. The corpuscles were found in the chyle, when they reached the lungs. They come in contact with the oxygen of the air, become coloured, & assume the appearance of blood corpuscles, which, in reality, they have now become.
The food substances formerly entangled with the body are taken into it by the several processes mentioned prepared for entering the blood by thus enriching this fluid yet it for being carried forth to minister to the wants of the economy.

It is not a matter of indifference however, what sort of material we take into our body as food, a proper choice of this constituting the first stage of nutrition is most important. An error here will require great care afterward for its rectification.

As regards diet, thus, all kinds of food may be included under the two following classes 1. Neterogenous or picturesque; 2. Non-Neterogenous or Respiratory. Either of these kinds separately taken are useful for maintaining the structure & functions of the body. Both in proper proportions are necessary in order that the tissues may, through the blood be properly nourished. The proportions required of each vary however according to several external agencies.

The Neterogenous articles of diet are called flesh forming, because their purpose is to maintain the structure, and repair the waste of those parts of our body which are Neterogenous compounds. To this class belong Albuminous Animal, Vegetable, and fruits contain as an essential ingredient more or less Niterogenous.
Among the Respiratory articles of diet are the Legumes, to which certain are given, but are recommendable for the large proportion of carbon in their constitution.

Great mental or bodily exercise of any kind, resulting in the waste of these lectures, through which this activity of function is manifested, and if the function of the parts is still to be performed, the renewal of such parts as have this been consumed, is necessary; and the material for such repair is supplied by a diet, consisting of solid nutritious food. Again, in all climates, but especially in those where the atmospheric temperature is considerably lower than that of the body, a certain amount of heat must be developed within the latter, in order to maintain life. For the purpose of producing this caloric advantage is taken of the second class of food—the Respiratory. These consist chemically of C. H. 10, in certain proportions, and the advantage they possess is, that they can easily act upon and decomposed, giving out during their decomposition within the body, as much heat, as the same process would do, if carried on in the Laboratory. All the animal heat of the body is thus chemically produced; and it might be kept up by the decomposition of the heterogeneous tissues alone, but slowly, for these are but little combustible, and a larger amount of them than of the other would be required in order to keep up the requisite amount.
The non-agitated matters in the blood may be considered as Fæcephilões, promoting the wash of the Agitated, for the former being present in minute quantity, the latter, which are with more difficulty replaced, must be consumed in order to keep up the heat.

It is not, however, the mere washing into the body of eiacrious or non-stagnant matters, in certain proportion, that will sustain life. In order to get those articles for replenishing the blood, the various elements "must be converted into albumen" oil is as to produce those elementary molecules found in the chyle, and which form the substance out of which blood and cells are developed. (i) These changes result from the eternal process of digestion.

Certain mineral elements, as the salts of lime, soda, iron, are as essential to the due maintenance of the animal frame, as the two gases already mentioned, and in combination with which in our food they are most generally received into the economy.

Along with those matters derived from the primary digestion, there are continually added to the blood, substances derived from what is called the secondary digestion. This consists in the washing back into the blood those particles of the tissues which have, for the time being, served their purpose in the economy, it must be removed to give place to new materials.

(i) Bennett.
Some of these substances, while some are continually being received into the blood from the decomposition of the tissues as a necessary process, and must be conducted by various channels out of the body, others by various modifying processes are chemically changed and fitted for ulterior processes in the economy.

The lymph or fluid of the secondary digestion is like the chyle, as first molecular, but gradually becomes corpuscular as it passes along the lymphatic vessels and through the glands. From those of the lymph chyle, the corpuscles of the blood are being continually formed, so that whatever loss of the latter may be sustained during life, so long as the processes for the proper formation of those two fluids go on harmoniously, the waste is repaired.

The blood as it rejects in the body consists of a straw-coloured transparent liquid, the aqueous conjunctiva, in which the corpuscles, whose formation has been just described, float and that aqueous containing all the substances necessary directly or indirectly, for the formation of the tissues and excretions, so that also the corpuscles are ultimately dissolved, and if received by the tissues through the capillaries, in the foundation for all the primitive processes of the economy.

In order however that the nutritive functions of this fluid may be performed, its distribution throughout the body is
is requisite for the purpose of thus discriminating the blood we have the circulation, which is performed by means of the heart and vessels, proceeding to and from that organ. To consider at present the mechanism of the circulation would carry us too far; so that having already seen how in part the blood is maintained in its healthy condition, we will go on to consider how from the circulating medium, the different tissues obtain their proper quantity of nutrient fluid.

Every part of the body is supplied with blood vessels from the fluid without which it may derive its nourishment. But all parts of the body are not thus equally supplied. Some organs and tissues which, in the discharge of their functions, are more active than others, require on this account a more abundant supply of blood. Each part of the body has its own function to perform, and let that function be what it may, all exercise of it produces a corresponding waste of the tissues through which that function is exercised, and such decline of function must be repaired. If the functional activity of the organ is to be maintained, the more active the function, the greater waste and therefore greater necessity for a full and steady supply of restorative material being at hand.

It is asserted by some, and there seems to be little doubt of the assertion, that every particle of the body has a certain length of life allotted to it, at the end of which time it naturally dies. It is cast out (or expulsed).
By exercise, however, this period of decay may be hastened. Whether by exercise or not, the particles of the body are continually being changed: old matter is being taken away from the tissues and replaced by new, so that after a lapse of time, the body, though it may seem to be the same as it was, is entirely made up of new particles.

In order that the interchanges between the blood and the tissues may go on, it is necessary, as a general rule, that the former should be in intimate contact with the latter. The function of bringing about this close connection devolves upon the capillaries, which are very delicate tubes, terminating the arterial system of vessels and communicating with the veins. They have thin membranous walls, which permit by the mechanical pressure of substances entering, such interchanges as are necessary between their contents and the tissue around. The number of capillaries, and amount of vascularity of, any part is in great measure regulated by the activity of its function, the amount of waste produced. In some structures no vessels have as yet been traced, such as cartilage, the cornea, etc.; these after they are fully formed, very probably undergo little, if any organic change, as their office is for the most part mechanical. Attraction alteration is induced in them is slow, unless moved, and is greatly enough prepared from the blood circulating in the bodies of adjoining tissues; thus cartilage from the vessels of the adjacent bone.
But organs such as the lungs, heart, etc., which are in constant active use, are well supplied with blood in order to renew the enormous mass of fluid produced.

All the blood issuing from the left ventricle of the heart is loaded with the nutritive elements resulting from the changes wrought on the products of the primary and secondary digestions, and a large quantity of oxygen received in the lungs, and thus provided the arterial blood passes on to the tissues.

During the growth of the body the amount of nourishment taken up by the tissues from the blood is greater than the waste produced; for, owing to the gradually increasing demand for a greater discharge of ordinary function, the different parts of the body must be enlarged and strengthened to meet the demand. In order to this, the waste is repaired and the surplus accumulated. But when growth is at an end, and the body has become fully developed, it is only necessary that the waste produced should be repaired in order to maintain this state. During growth the body increased in size equally in all its parts, but in the fully developed state, increase in size only in one or more organs which, more than the others, have been called on to perform an extra amount of their usual function. As was said before, Nutrition is regulated by pulmonary activity, and examples of our nutrition from other work appear abundant in both health and disease; as when the left ventricle...
of the heart becomes hypertrophied from the increased effort required to overcome obstruction at the aortic orifice; and any one of muscles become enlarged from frequent use. It is also true that diminished functional activity produces atrophy or fatty involution, as exemplified in wasting of the muscles of the lower extremities from long continued confinement to the recumbent posture.

Growth and maintenance are analogous, only differing in degree. In theformer more material is added than is merely required to repair waste, in the latter just sufficient for that purpose is taken up.

But how comes it that from such one source, all the tissues of the body, so varied in their nature and composition, are enabled to nourish themselves and be maintained? In the blood we have the elements of nutrition, but we have not those elements combined into ready-made up, only requiring to be taken up, added to each tissue. And as it is one and the same fluid that is distributed to each tissic portion of the economy and we know that no known tissue of the body exists in the blood, it may well be asked, what have regulative theremo maintenance? There must be some power at work to arrange the elementary molecules, received into the circulating fluid, that this arranging power does not start its influence on the blood while yet in its proper vessel we have seen, so that we must
look outside of them for an explanation of the phenomena.

When the body is examined microscopically it is found that all the tissues of which it is composed are cellular in their structure. The cells are variously aggregated together to form the organs and tissues. Each of the many cells of each organ has its life and death and during its life a function to perform; when it dies it is of no more service and is cast off by the economy. In those cells during their life the elaboration of the nutritive elementary material of the blood is ascertained. But they live, they have the power of attracting matter from the blood, which by a vital property inherent in themselves they transmute, so as to get it for being added to the various parts of the body. These cells also produce their successors that so long as these proceed both growth and function so on the body maintains its similarity of form and constitution.

The ascension merely of an attractive power & these cells would not fully explain the phenomena of nutrition. The physical law can as yet explain how it is that the proper material is at all times taken up by the different sets of cells; so that we must ascribe to those minute sustainers of the frame, not only a vital power of attraction but likewise a vital power of selection, whereby in health they are enabled at all times to furnish a suitable panthea from which the various tissues they compose may be renewed.
We find these laws of attraction and action governing in
all life as well as in healthy growth. A marked growth
as a tumour, so long as it is supplied with blood, will
attract select materials, which it will accumulate itself
and increase in bulk.

Secrecy was for a long time supposed to be something
opposed to growth, its object being to abstract matter from
the body, while growth tended to add to it. But by more
accurate investigations into the subject, it has been ascertained
that the same laws now regulating growth are in force here.
By the maturation, decline of cells, variously endowed with
their vital powers of attraction and action, all the functions
of the body are formed. When these secreting cells have fulfilled
their functions, they break down and are ejected; their place
being taken by new cellular formations, which in like manner
fulfil their duties and die. In breaking down the matter
while they have reached in their interior are liberated. Some
of these reactions are immediately forced off along with
the producing cells; others are, either directly or indirectly,
recycled back into the blood, and more important purposes in
the economy. Of this latter, the subcutaneous, peritoneal, hepatic
sections are examples, the three mentioned being of great service in
preparing for assimilation the food taken in by the mouth.

A similar re-use is probably made of some of the

matter taken back into the blood from the worn out tissues of the body in general. Sir R. Kaye's theory is probable that the fatty remains of the lately inorganic tissues are taken up into the blood, to serve to assist in the formation of the necessary secretion.

By a combination of cells such as those whose functions have just been described, the different organs of the body are formed by means of these organs, the various functions of locomotion, sensation &c. can enacted. By means of cell-life alone can these organs perform & be maintained in a fit condition for performing their functions. Cells are in truth the social agency whereby nutrition is carried on, & by the peculiar life of each cell or all of cells only, can the body be maintained in a healthy state. In the words of Sir R. Bennett: "A plant or animal is in fact a living creature, composed of millions of corpuscles the sum total of the lives of which make up its own."

On account of the constant destruction or waste of tissue that is going on in the body, a constant supply of new material to supply the place of such waste is required, and the same whence such repair is obtained we have before said to be the blood. But should there by any neglect or otherwise be a deficiency in the blood of its necessary solid or liquid ingredients, the want is made known by two feelings — hunger & thirst; the former
expressing a desire of want of solid food, the desire of liquids.

That these two sensations are not due merely to an empty state of the stomach or dryness of the juices, is now pretty well agreed upon by physiologists. All are satisfied that they are caused by a condition of the system at large, produced by an abnormal state of the blood. But the mind refutes the sensations to the point before mentioned, as those from which it generally receives such impressions.

Taste, resentment, for instance, when from interocular matter deposited in the mucous glands, the Chyle is altogether obstructed in its passage to the blood, or what does pass is from the faulty condition of the glands imperfectly fitted for entering the circulation, a continual craving for food is present. For a short time this craving for food is appeased by the introduction of food into the stomach, but as long as it remains with unabated force, the system being little if at all benefited by the ingesta received, the momentary relief being the result of a false impression on the mind. In these we have great anæmia and wearing away of the tissues whilst little or no desire for food is felt. But the end is not thus, by the onlooker in the great weakness anaemia which accompanies such diseases. The unconsummation of this need by the patient may be supposed to be owing to derangements of the nervous system, whereby the mind is unfitted for receiving such impressions, as would render it aware of the want of the economy. During convalescence from illness, when the winds
has regained its former activity, the wants of the economy from the great previous waste, an uneasy felt, and great care and watchfulness are necessary in our endeavors to appease the most acute of hunger.

For the production of these two sensations, hunger and thirst, we have the nervous system brought into play, and there can be no doubt that this system exerts an unbounded influence on the nutrition of the body, both in health and disease.

The nervous system, like all other parts of the body, is made up of cells, which, while they possess, in common with other cells bodies, the power of attracting and filtering from the blood their nutritive material, are endowed with the property of conducting impressions determining nervous forces; the latter either mental or motor.

The cells forming up nervous tissue must be kept in constant repair if their functions are to be performed. And as by the nervous system, the nutrition of all parts of the body is considerably influenced, it follows that its functions being disturbed by some already existing deficiency in the nutritive processes, such arrangement will be greatly increased from want of its regulating power.

Any thing interfering with the due supply of nervous force to any part of the body, as of the Ophthalmics will induce paralysis of the muscles involved, and if the sensory fibers are affected anaesthesia of the part which those fibers are distributed.
In those parts also in which the influence of the nervous system is accompanied various changes occur which show that the healthy balance of nutrition is gone. The immediate agents of nutrition are present, the tissues of the blood, both finely dispersed in proper working order, but yet the muscles dwindle away. Erythrocyte takes place not the healthy tissue, alteration of the skin occurs from agencies which before would have had little effect, all showing that the influence of the nervous system is necessary in order that the proper relations between the tissue and their nutrition may be maintained. It may be that through the nerve distributed thus, the cells receive a stimulus, to perform their functions, by exercise the stimulus is increased but in paralysis is altogether in abeyance. In leprous and other forms of diseases where the nervous stimulus is not altogether ceasing, but is weak, the same unhealthy nutrition is characteristic.

That the mind acting through the nervous system influences to a great extent the course of many disease is often well explained. All depressing thoughts, as fear, forebodings of evil, tend to render hard the cure of many diseases; while hope and confidence aid greatly in recovery, other things being favorable. Great hopes however are often entertained by patients for whom all chance of recovery has been given up. This is often true in the last stages of disease and is glad
It shows that the mind acting through an imperfectly 
governed medium, is unable fully to appreciate the extent and 
danger of the disease under which it is suffering. This 
state has been called Euphoria (Euphoria).

Imperfect nutrition acts unfavorably on the nervous system 
and an improperly nourished nervous system reacts with double 
intensity on nutrition in general, inducing many varied dis-
cases.

We have seen that for healthy nutrition there are 
required, a healthy quality of the blood, a proper quantity of 
that fluid to each part; a healthy state of the part to be 
nourished and a certain influence of the nervous system 
regulating all. We have considered the three last of these 
requirements, and also in part we have seen how a healthy quali-
ity of the blood is maintained by a proper performance of the 
junctions making up the Primary digestion, and the absorp-
tion of their proper constituent materials by the tissues. Diseases 
of Nutrition may arise from an increase or diminution in the 
blood of any of its constituents, and these two states may be 
produced by an increased or diminished amount of material 
introduced into the blood from without or from changes in 
the assimilative powers of the tissues. The assimilation 
by the tissues must indeed be precise & perfect, to maintain 
the blood in its healthy condition. As fermentation
obtained. Each part of the body, in abstracting from the blood the materials necessary for its maintenance, acts as an excreting organ in regard to the others. If the organs did not take materials for their nutrition, fibres of their other constituents might come to be in excess in the blood; the bones failing in their supportive functions, the salt of bone it might be too abundant the healthy standard of the blood departed from the proportion to the amount of disturbance, the nutrition of other parts of the bodily framework would be interfered with.

The blood, as a floating agent, has its function to perform, and in order to perform that function must be properly nourished. It has been already shown how its nourishment is effected; but how precise must be the assimilation of matter by the blood in order that the individual peculiarities in the nutrition of the various bodies of the body may be met. Long after the infection of the vaccine viri, the system is no longer capable of being affected by the blood with the same poison; for instance, the blood assimilated to its altered self, the materials derived from the primary and secondary digestion that it is no longer amenable to the influence of the poison. No doubt, the assimilation to the healthy standard is as perfect as we thus see it to be to the most sanitarily altered.

By sneeze, diarrheas to which are merely the result of increased functional activity of the eye, bowels to the
Blood is often enabled to rid itself of those conspiracies which being present, deterio- rate it, and render it unfit for fulfilling its functions. But normally and at all times there is being given off from the circulation, cast out of the body a certain quantity of refuse matter; and our attention will now be directed to a consideration of the means whereby these excreting processes are accomplished.

From arterial blood, through the thin capillary walls the tissues derive their new materials; or through the same delicate walls the refuse thrown out tissues are received back into the circulation, and the blood removed. We saw that in arterial blood a large amount of oxygen was carried; one of the purposes of this gas is now fulfilled. It mixes with these waste matters, converting them into new chemical compounds, more fitted for being taken up into the circulation, and more easily eliminated from them. The principal of these new compounds thus formed are Carbonic acid, water, and others. The heat evolved whilst these changes are being communicated is as great as that produced by like chemical combinations in the Laboratory. The heat produced by the union of O. with the blood in the lungs to the chemical transformations in the capillaries make up altogether the amount of animal heat in the body. On this activity of the circulation, inspiration, the temperature of the
body depends.

The blood being now seen, it is unfit for sustaining life, and in order to its purification many processes are at work. The presence of a large amount of Carbonic acid we noticed before as the grand distinguishing character of venous blood, and the first change this fluid undergoes is being relieved of this gas, and having restored to it the bright red color of arterial blood. These changes take place in the lungs when also a large amount of water vaporizes in at the same time given off. And thus purified from this water, the blood is sent to the left side of the heart as arterial blood. But arterial though it be, yet many substances remain in it which if retained would be most pernicious. At all times in every part of the circulation, there must be a certain proportion of waste matter flowing. The true urine, and for instance, which will find its way into the blood and pass from the left side of the heart, do not all pass on in a direct stream to the kidneys to be excreted. They are diffused throughout the general mass of the blood, truly a portion of them directly reach the kidneys from the heart. But these organs, being in full healthy operation are continuously acting on the blood that reaches them, believing it of what they extract it contains, and it is only when the kidneys are deficient in their function, an accumulation
of which take place in the blood that serious consequences result.

It is most important that these refuse matter be passed out of the economy, for if retained, they act as poisons. Some of the excretions are directly passed with as soon as they are separated from the blood; others are carried by one organ, re-enter the blood, and are carried to other organs, where they finally disappear.

Certain of the excretory organs, properly so called, act in concert, the activity of one being increased, in proportion as the other is diminished. As we have variety in the kinds of food taken into the body, so we have variety in the effects another discharged thencefrom. Our food consists principally of hydrocarbons and allied matters, combined with mineral matters; and our excretions are of like nature. And so, we have organs for separating hydrocarbons from the blood, in the form of carbonic acid and water, (also organs for separating the nitrogenous and mineral materials).

The excretions from the lungs (as they are the first excreting organs, the urine, blood product) consists of CO₂, that is, produced by the disintegration of the tissues, their union with oxygen, and received directly into the blood. Ultimately connected with the lungs in the discharge of their excreting functions, we have the skin and liver,
From the former we have a daily secretion, to a considerable amount, of carbonic acid, the amount being attended according as the lungs are active or depressed in their functions. Just the skin and lungs are associated in this way has been proved in cows, where, by covering the body of an animal over with an impermeable varnish, so that no exhalation from the skin could take place, so much carbonic acid accumulated in the blood, that the lungs were unable of themselves to get rid of it, and the animals died, with all the symptoms of asphyxia.

The carbonic acid which we have thus been given off by the lungs, was that which was received into the blood, as the result of the union of oxygen with the carbon and hydrogen of the disintegrated tissues. But another source of this secretory product of the lungs, is the conversion into this gas, in those organs, of substances formed in the liver.

The liver is associated with the lungs, for the purpose of purifying the blood from one source of light carbonic, but the means by which it does so are indirect. It is a secreting organ, and in order to supply it with the materials necessary for its secretion, a distinct separate supply of blood is sent to it.

During the digestion of the food in the stomach and
Industries, many substances pass directly into the blood vessels of these parts; those substances being chiefly, fat, chyle, and dregs. The blood, contained in these vessels returning from the alimentary canal, together with that from the Pancreas and Spleen, is collected into one channel, the Vena Porta, and conveyed to the Liver; and from this source the secreting cells of the latter organ obtain their material.

The substances formed in the Liver from such blood are Bile, sugar, etc. The principal function of the Liver is no doubt to secrete Bile, which secretion, as an excretion is jetted off in two ways. It is first poured into the bursa during the process of digestion, and exercises some important influence on the food passing through the gut. It is most probable that it acts on the fatty matters and may be supposed to render them more capable of being tasted up by the lachrymal duct, for according to experiments by Schwarben, animals from whom the Bile was taken by a fistulous opening, died with all the signs of inanition, such signs as would result from a want of Hydrocarbons in the blood. Part of the Bile, including the colouring matter, passes along the alimentary canal; it is discharged directly for use. The greater portion, however, is with the food taken up by the lachrymal duct, conveyed to the blood and exerted
to the Lungs, where it is given off as Carbonic acid, formed by the union of Oxygen with its constituent. If all the bile were to be passed out by the Stomach, it would be a great waste of material; for by its operation in the Lungs, it contributes to the keeping up of the animal heat.

The bile absorbed from the Intestines must be greatly changed as it cannot be found as such in the blood that which passes right through the alimentary canal is but little altered. In whatever way, the bile must by some mode of operation be got rid of; and it is found that where the action of the Lungs is depressed, more bile is passed with the feces.

Should there, by any obstruction, be a hindrance to the passage of the bile from the Liver into the Duodenum, it accumulates in the Liver, and, unchanged, is taken up into the blood by the Hepatic veins, and circulating with the blood produces jaundice. Yet an effort is made to get rid of this mortific material. The urine and bowels are called in to give their assistance, and excise large quantities; and if once the obstruction to the proper path of the bile be removed, these organs easily get rid of the exprofluvium that still remains in the system.
The bileous secretion, thus taken up directly into the blood, is not
got for oxidation, digestion by the Reins at Carbonic acid.
By the skin and kidneys it is given off as bile: and therefore
from this large quantity of obsolete material being passed with
without undergoing chemical transformation, there is a great
waste of what, in health, is subservient to the maintenance
of the animal heat. It has also been found that when the
bile is prevented from entering the intestine, coming with
the food, that a larger quantity than usual of the fatty ele-
ments are passed by stool; so that here again we have a
large amount of unconverted matter passing out of the system.
And as it is necessary that the heat of the body should
be kept up, fuel must, in these cases, be obtained from
other than the usual sources. And thus if jaundice be
long continued, emaciation of the body results; due partly
to the imperfect digestion of the food from want of bile,
and partly to the excessive waste of the tissues required to
keep up the animal heat. The feeling of coldness, generally ex-
perienced in jaundice, may be due to the imperfect supply
of proper combustible material, or perhaps rather to the
poisoning influence of the bile circulating in the vessels of
the brain, rendering that organ unable rightly to appreciate
the sensations produced in it by the impressions received
from the general surface.
Another of the functions of the Liver is the secretion of a substance, resembling hydrated starch, which, so soon as it is taken up by the Hepatic veins, is converted into pepperagar, and at such conveyed to the Lungs, where it is oxidised, and given off as C\textsubscript{2} H\textsubscript{5} OH.

Different views are held by various writers about this peculiar function of the Liver, and the excretion of the product. Some suppose that only a small portion of the Sugar is thus exhaled, & that the remainder is carried into the circulation, and gradually assimilated by the tissues. But if this were the case, sugar should be a normal constituent of the blood, whereas only in that of the Hepatic vein is it found. Again, it may suppose that this Liver secretes a substance which he calls Hyperaline, and which, he says, in the healthy state of the circulation is not converted into sugar, but under certain morbid conditions it is, and then produce the characteristic symptoms of Diabetes.

The fact of Diabetes being sometimes produced by stimulation of the respiratory organs, as by chloroform, thus hindering the due oxygenation of the blood, might favor Bernard's view of the decomposition and excretion of the sugar not by the lungs, but the fact of forced respiration implies a more rapid altered condition of the blood, so that the Hyperaline of Davy might thus also be transformed into sugar, injuries to the brain...
may act in producing Diabtes, directly, according to Ber-nerdi's Theory, by interfering with the Respiratory functions; or through their interference with those functions, altering the Blood, and so converting the diabetes of Pity into Diabtes.

Whether be the correct Pathology of Diabtes, it is sufficient for me at present to show, that the Liver is an organ devoted to the purifying of the Blood from Hydrocarbons. This is the mode in which it does so have been noticed by the presence of bile, sugar, or Leucopine. It also secretes from the Blood a quantity of free fat, which sometimes becomes too abundant in the organ to interfere with its functions.

Another mode of relieving the Blood from an excess of Hydrocarbons is the deposition of the substance around the surface of fat, constituting adipose tissue. The fatty matter is not here entirely thrown out of the Economy, but placed in such situations and under such circumstances as enable the Blood for the time, while if again required they can easily be re-taken up into the circulation.

As regards the agotised matter, the principal channel for their excretion is the Kidney; their elimination now can not being the sole function of this organ. The kidney purifies the Blood by separating from it a large quantity...
of water, which, by holding in solution the heterogeneous products of disintegration—urea, taric acid—together with certain salts, render those substance more capable of being discharged. The solution passes out of the body as urine.

In the discharge of its functions of wasting affecting, we have intimately connected with the kidney, the lungs, and skin, but more especially the latter. The amount of water separated by either of those organs depends on various circumstances, which increase or diminish the activity of any one of them. The amount altogether is dependent, in part, first, on the amount of liquids which is taken into the body as food or drink.

For the most part, the water excreted by the skin is in the form of vapour, but when, from activity of the skin, the quantity is increased, or from lygerometric change, what is excreted, cannot be properly evaporated, it becomes visible on the surface as sweat. In summer the discharge of water from the skin is usually large, while from the kidney the amount is diminished; and vice versa is the case. And in certain diseases where the function of the skin is impeded, a larger quantity of water than usual is passed by the kidney.

But from any emaciation, the kidney itself may come
The unequal distilling of double duty, and the
water void thence become superfluous in the blood
Shure must be, in order that the mechanical process
of exsanguination be performed, giving in between the blood's tissue,
may be properly performed, a proper dilution of the blood
Shure by failure of the organ which serve to maintain the
proper standard of the blood in this respect, the circulating
blood becomes too watery, the aqueous superfluous must
be got rid of by some other means. For this purpose the
thin walls of the capillaries, in those parts of the body which
are loose or distended, allow the water to pass through it thus
release the blood from its overplus. And when the functions
of the urine kidneys be an extraord, their activity heightened
by therapeutical means they take from the blood so much
of its watery ingredient, that the precious effusion is nec-
ecessarily taken up again into the blood to maintain the
proper standards of that fluid.

This will not account for all forms of dropical effusions
but is merely brought forward to show how the proper dis-
charge of this function of the kidneys and urine is intimately
associated with the proper constitution of the blood, and
therefore with the healthy constitution of the whole body.

These dropical effusions though thus at first luc-
blood, yet, by their gradual increase, may be productive of great harm, and ultimately cause death by the mechanical impediments which they offer to the free play of important parts.

The water thus passed by the kidneys serves as a vehicle for the excretion of several substances, among which are urea or uric acid and various salts, of which the phosphates constitute the greater bulk.

Urea is, in the healthy state, the most common of the most important of these substances. It is a product resulting from the decomposition of the nitrogenous tissues of the body, and their union with oxygen. The first change in these tissues undergoes in the urine, the uric acid, in which state they would remain were there an unimpaired supply of oxygen. But enough of this gas being present, the uric acid, with itself, in most of its salts is very insoluble, is converted into the more soluble bases, thus render more fit for elimination. There is always a small proportion of the uric acid in the urine of man, which may be accounted for by his carnivorous habits, the carbonaceous food which he takes requiring a certain quantity of 0. which to unite renders the amount necessary for the nitrogenous products rather less than it ought to be.
Ade is, however, the most important solid complement of the urine, and, like all other excretory products, it may become in excess in the blood. We said before, it escapes at all times, in small proportion, in the blood, and it has been found that, by the urine, as well as by the kidney it may be excreted. This fact is of importance to bear in mind in the treatment of uraemic poisoning; for by keeping the function of the kidney active we may in a measure relieve what can only be cured by a due arrest of the functional activity of the kidney.

Thus uraemia results from the accumulation of urea in the blood. This uraemic agent affects principally the nerve centres, producing coma, convulsions, etc., according to the portion of the central spinal system engaged. As means of relief are, the elimination of the poison as quickly as possible, either by the natural excretory channel, the kidney, its activity being heightened by Diuretics, or as shown before by an increased action of the skin, or by increased action of the bowels. Most commonly however the uraemia ends fatally from the great power of the poison.

As shown by Siemhs, and confirmed by other
obviously, it is not wholly by the presence in the blood, of an unusually large quantity of these that this poisonous residue. They state that it is only when decomposition of this salt into Carbamate of Ammonia takes place, that poisonous symptoms occur. Persons in the last stage of small disease have their blood highly charged with this, yet no convulsions or convulsions arise, probably because the peculiar poison for the transformation is not present. As acid is a constituent of every healthy blood, we can easily imagine, how a slight amount of urinary poisoning ought happen, if this theory be true, even without any hindrance to its elimination by the kidneys.

The salts excreted by the kidneys may be in excess, either from using food containing large quantities of this, or from rapid disintegration of these bodies which contain them. They may be deposited in the kidney or Bladder as calculi, and give rise to various dangerous and fatal symptoms.

Although mainly we regard for the excretion of inorganic materials, yet sometimes the kidney may be found acting as an eelctor of Carbonaceous substances, as in jaundice, when the urine becomes very dark colored from the presence of Bile. The normal following months of the urine is probably also a non-oxized phenoloid.
The elimination of the solid excreta is accomplished by means of the intestines, whose tube terminates by a pruned opening—the Anus. The evacuation by this channel consists of those parts of the food which have escaped digestion as they passed along the canal, together with portions of certain of the fluid secretions poured into the canal, and insoluble salts; the whole constituting the feces, which in the healthy state are semi-solid, but from various causes may be altered in their consistency.

The substances thus got rid of are for the most part insoluble and indigestible, and like all other effects of retained within the body for any length of time, are apt to induce many bad and even fatal consequences. The symptoms thus produced in other and distant organs are not perhaps so much due to any irritation of the alimentary canal by the retained fecal matter, as to the impediment which such another offers to the free performance of their secretary functions by the various glands of the minute and some of the joint. These glands eliminate from the body certain materials, whereby they tend to preserve the proper standard of that fluid; and if their functions be arrested, the blood cannot be rendered abnormal, and thus changes may induce disease in any part of the body.
By the use of certain drugs the activity of the intestines and certain secretions may be greatly increased and the quantity of its secretions augmented, the excess being chiefly in the amount of water, whereby they pass more freely, and by this means the intestines may be made to act vicariously with the kidneys, when the functions of those organs are in any way arrested.

By observing how in some cases these complementary functions take place naturally, we are led to infer, that in disease with imperfect functional activity in one organ we may endeavor with great hope of success to excite a supplementary action in some other. The only channels for excretion which have no supplement in the intestines, and its utmost efforts can, for the most part, only be achieved by acting on itself.

We have thus, in the preceding pages, endeavored to show how the different parts of the body are indissolubly associated together, for the purpose of maintaining the life and health of the whole frame. We have seen how the least deviation from the healthy state in one part, inducing in it imperfect action, threatens irregular or completely hindering the performance of its function elsewhere.
functions, will cause things here, corresponding
deviations in other, it may be distant parts. In medulla
things which these changes are wrought in the blood,
alterations in which however are not primary.
 fatty as all the process we have described
from harmoniously, the circulating medium retains
its normal condition; but any interference with these
processes immediately produces a morbid condition
of the fluid.

Thus, by improper diet, substances may be added to
the blood, which rapidly deteriorate it, or the blood, from
inadequate air or imperfect respiratory action, may sus-
perceive its due supply of Oxygen; or the tissues may fail
in abstracting the proper quantity of materials from the
blood, for their own nutrition or the formation of secreting
or reparative actions, which, when formed, ought to be elimi-
nated, may be retained and taken back into the
blood. By all these different ways the vitality of
the blood may be impaired. By an imperfect
supply of new materials also, though what is received is
properly enough taken up, the blood becomes poor, the
wants of the economy cannot be supplied, and to the
body wastes and dies.

In all disease the blood will eventually be found
asked in some way found its moment standard. But by acting directly on the blood, we do not attempt to arrest or get rid of the disease. The only true and safe means is to endeavor to restore to their healthy state those conditions on which the health of the blood depends.

We therefore give proper aliment, endeavor to have that aliment properly assimilated by the blood, so that the blood taken up in correct quantity by the tissues. We must also take care that some astringent matter get rid off by their proper channels, so that no accumulation thereof may take place in the blood.

In all so-called Blood diseases, we must act not on that fluid directly, but endeavor to preserve all those conditions, whereby the stage of our victim primarily affected was disturbed. And thus only can we hope to combat the diseases successfully.