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"Exercise."

Its Physiological & Therapeutic Effects on the Human Body.

Michael W. Cowan.
On the Physiological and Therapeutic effects of Exercise on the Human Body.

In entering into an enquiry as to the various modes in which substances may act on the individual of a species, or the separate organisms which constitute its individuality, we are beset by a series of difficulties arising from the number of component parts, and from the intimate relationship and dependence which each organ has to or upon one another.

To afford an illustration of the truth of the above statement, we need only refer to the actions of those remedies to which the physician resorts when he is desirous of obtaining what has been so called a "specific effect," i.e. the result of the action of some remedy not procurable so far as is yet known by any other agent. But not only are we entitled to select these as instances to illustrate
demonstrate our illustration but we may turn to innumerable substances from the mineral and vegetable worlds, whose actions though relied on, and confidently anticipated when administered, are nevertheless far from being comprehended in their correlative effects. And whence is it that we are constrained to acknowledge the imperfect mode in which for the most part the physician when called upon, must meet the demand? Is it that his armamentarium is not sufficiently comprehensive, and does not afford him those faculties of which he would gain he in possession, and which he imagines may exist? No! However extended may be the instruments or means which he enjoys, these avail nothing as a matter of course, if their mode of action are not fully comprehended by him. To the attainment of such an end—the perfecting of that knowledge already acquired, though our utmost efforts to be directed and not to much to the enlarging or complicating, I should rather say, these means of
of which we are already in the enjoyment. By this it is not meant that we should maintain a total indifference to what is found to be beneficial from whatever source derived, but that we should continue to attain to a correct knowledge of how far those means we now enjoy can be rendered even more serviceable than when in our empiricism we resorted to their use, in short, we ought to extend the sphere of rational medicine, which at no time rejects true specifics but on the contrary encourages us to discover more than we at present possess.

We have said that difficulties meet us on every side, and these it must be confessed will continue to surround our path more or less, so long as we withhold investigation from or turn from our attention to, the nature of the action of the remedies in our employ, in a physiological point of view. It is true that even here we are, or may be encountered by the assertion that we can set no definite terms to health, that we cannot define with geometric precision that condition of the human frame, nor can
with absolute certainty affirm that such and such a body is in perfect health, because it is said to be more or less a varying and comparative term differing according to individual constitutions; the standard of health in one man being what another would positively style disease: Yet we can, however, make use of the word ‘health’ assigning to it a particular meaning, such as that condition of the body in which its functions are carried on with perfect consonance to the individual, and though this may not be a strictly logical or philosophic definition, yet for our purpose it is sufficiently exact and is for general discourse accurate enough. In contrast to this the term disease will then signify that the functions usually carried on by the body have departed from the standard above indicated to a greater or less extent; that whereas in the one case we have the ordinary phenomena of life maintained in uninterrupted harmony, in the other, some part or parts of the machinery of vitality, so to speak, have assumed a new plate and now cause the subject of the change to experience in greater
or less measure, discomfort, uneasiness, or positive and rapid progress to death, primary disorder always preceding change of structure.

In all our researches after such knowledge as that to which we now direct our attention, viz. the physiological actions of a declared agent, we must confess, that apart from that incertitude which is occasioned by the qualitative state of the body, we are particularly in danger of attributing to our agent false actions, and of withholding from the balance what another's practiced eye would readily discover; and by which therefore we are involved in the liability to establish false theory on inaccurate investigation. Moreover, we are all familiar with the insurmountable difficulties to be surmounted in enquiring into any subject where effect may only be secondary to changes which have been wrought on some body or organism whose functions were not under immediate cognizance. Thus it is in the case of the human subject when we wish to arrive at an accurate and true conclusion as to the phy-
physiological or therapeutic virtues of a specified remedy. We have multifold considerations to keep constantly in review before the mind's eye; we have to bear in remembrance the relationships which subsist between one organ and another, between the whole and the several component parts, the amount of dependence sympathetically maintained by one part from another, and beside many other apparent complexities, the probable secondary and ultimate or remote effects. And it may not be out of place thus early to remark that, though the obscure and immediate results which medicinal agents exercise on the individual parts of the body, are difficult to be attained or to be accurately defined, yet their consequent, ultimate, and palpable effects if we may be permitted the expression, are for the most part very readily and manifestly perceived. To elucidate more clearly what we mean, we may illustrate it by instancing the results which are discernible from those evacuating or purgative remedies in which together
gether with their plainly indicated effects, there is combined no concomitant sign indicative of the time the therapeutic action is manifested, and so likewise with most of our other remedies from the different classes of medicines in the Materia Medica where no premonitions are afforded us.

But certain drugs there are, amongst which we may mention Sodine, Bichloride, Mercury, Arsenic, Strychnia, which in a peculiar manner forewarn us of the approach of some action for which we resorted to their use and which are always developed prior to the accomplishment of this object, and without which we would not anticipate the effect sought for in their administration. These acco-
teedent symptoms are constant, and occur in health as in disease, so that we can thus divide into two, the actions of remedies. Of these two modes of action of remedies used by the physician, one at least generally results when employed, and that independently of the other, and these are denominated 1. The Physiologic and 2. The Therapeutic actions. By the
the former we mean, that action resulting from the use of any substance or means of appliance to the body in a state of health, which either may excite a temporary or permanent morbid, or may cause merely an evaded condition of the healthy functions and which may or may not be recognized in the body in a diseased state. By the latter we signify that action exercised on the body in a morbid condition by an agent or means of appliance, which may or may not prove effectual in the alleviation or removal of the obstructions, abnormalities or depraved state of the system.

Let us now direct our attention more immediately to the subject of essay, and endeavour to elucidate the physiological effects of exercise on the human subject.

I. When we regard the human body in its uniform and collected appearance, and contemplate it, not in its several parts, we are struck at every day to day we behold the beautiful symmetry which the Omnipotent Creator has bestowed on it, and view the apparent and
and continuous aspect of identity or likeness of change which it exhibits; and it is only when on reflection our thoughts are turned after lapse of years upon the individual frame, that we can discover some wonderful metamorphoses. But when with more scientific eye, and more enquiring mind, we turn to the constitution of its parts, and trace the various phenomena and processes through which in one short day that body or those parts must pass, and more especially enquire into the source of all its nourishment, viz. from one great and all important fluid, "the blood," we are brought to the conclusion that the apparent sameness which collectively we behold in its parts, is only a semblance of identity. There exists in each organ of the body, and there is diffused through the minutest parts of the same, a power of assimilation by which it is maintained by some vital power inherent in its separate organisms, yet during this change of particles which obtains at all times of the life of
an individual, there is an outward uniformity of configuration dissimilar in proportion to the change which transpire in the human laboratory. It is not, however, by the assimilating power alone, that the changes in the living economy are carried on: for whilst there is a restitutions principle, there is likewise a destructive one, which, acting in its own sphere and manner, unlike the hollowed rock which has been channelled out by the incessant dribbling of the trilling cascade, where there is the reparative process to fill up the tiny vacuity we have in animated beings continuous waste, and restoration or interchange of particles, a building up of tissues subjected to "wear and tear". The duration of the particles which go to the formation of any part in the vital economy, it is evident must be limited, and therefore at length destined for decay; and it is a question of extreme nicety to what extent the continuous functions carried on, precipitate their final usefulness, and necessitate the development of successive reparative supplies. And if it be granted that there is a law, (which
(which fact supports) bearing upon the gradual progress to decay, independantly of exercise, of the textures of the body, we might reason a fortiori that because on the one hand we had such a tendency inherent in the parts, ergo, when exercised the particular part would be hastened immoderately to its final loss of function.

Such indeed we are forced to admit would naturally ensue, could we imagine a part, or the whole of the body to be inadequately furnished with nutriment proportionally to the amount of exercise undergone. And this is exactly what experience and everyday life teaches; that where much exercise is undergone, to keep up the waste of the tissues, and to maintain a standard of vigour of parts, an increase in the nutritious principles of the food must be had recourse to, and where the labour is not of so active a nature, there is not that urgent call for increase, which in the former instance was necessary, but where we aim only at an average, moderation is the sole requisite; whilst on the other hand if the supply of nutriment be not in proportion to the amount of labour and
and expeditiveness of strength, we find then a diminution in the powers of endurance, and a gradual state of
misation is engendered, not only in a part, but in the
system generally. On this manifest law depends much
of the importance to be attached to the due regulation of the quantity and quality of the food necessary for
the support of those in constant employment in
manual labour, and it is a principle so familiar to
all that no further comment is necessary.

This physiological principle being signified, we are by a process of rea-
soning naturally brought to consider what connection
exercise bears to the muscular tissue of the body, to what
degree it promotes its destruction and further develop-
ment. Not otherwise is it with this than with the
body taken collectively, for this element in its con-
struction is subject to similar laws, and constitutes
as it does one of its most conspicuous components,
it illustrates a general principle, and the change
and conditions of the body may often be judged of
by the manner in which this exists and is de-
veloped.

We have alluded already to the process of au-
tri-
trition in which there is constantly maintained in the animal economy a succession of acts of digestion and absorption, this combination we perceive to be carried on through one medium and that is the blood. From this is incessantly poured forth in the healthy condition of the frame those principles which each texture appropriates for its peculiar use, and osmotic process being present. At the same time that this influence is at work, there is that system of vessels busily employed, whose special work is to carry off that changed matter which not only is of no use to the part, but which by its longer retention might prove most injurious; this being borne along may still furnish to other parts what they so much desire, so that while there is appropriation of one particular constituent of the blood to one separate organ, there is negation by the rejection of certain other constituents, and the throwing away of certain effete matters, establishing by one and the same act, assimilation in the first instance, excretion in the second, and new formation by the secreted substance with the blood, this latter being a necessary con-
sequence of the two first acts. This area which exists in the urine of most animals is found in solution in the blood, and is derived for secretion from two sources, one of which is the disintegration of certain animal tissues, as the muscular.

When the muscles therefore are called into play, we must have co-ordinate changes, and these in proportion to the degree of exercise undergone. As each muscular fibre has separate fasciculi combined in it, and these again are resolvable into their sarcolemmal with contained primitive fibrillae which undergo changes as the ultimate particle of matter, we know that they have a limited duration as such, so we are entitled to conclude that these fibrillae must as they are exercised be brought to sustain the changes which would in due course follow at a much earlier period. This we learn to be one effect produced by active exercise; and as one act of mind, the consequent of a prior, itself often becomes the generator of yet another and more intricate one, so here, this product of exercise is the precursor of a series of
of consequences, whose results we often aim at securing, when we prescribe this as part of a curative treatment. For while destruction or the induction of minute disintegration is the immediate result, assimilation we know to be the secondary one. Nor does this assimilative power take place merely to the extent of replenishing to exactitude that which by the prior process was lost, but it may extend itself to a development much exceeding the former standard.

And in order that this end should be accomplished, it may readily be conceived how that a larger supply of the nutrient fluid would be required to be transmitted through the muscular tissue. Accordingly it is found that the arteries of the parts exercised increase in their capacity, and in proportion as the number of the capillary vessels is great, so will the enlargement and tonicity of the part progress. The containing vessels if small and numerous, forward this state more speedily than where the vessels are larger, because their aggregate contents must exceed those of larger vessels, and because they are more generally diffused through the substance of the muscle.
though not entering the fibriulæ of which it is composed, absorption taking place without the fibriulæ.

The mere increase or rapidity, however, in the circulation cannot of course accomplish such ends; otherwise in many inflammatory diseases and very fevers we should have increase of the original textures, which is not the case; for in those affections we have a change in the constitution of the fluid, and loss of appetite, unless some monstrous occur in which case digestion and assimilation are deranged; in addition to which we have only to remember that as the oxygen which is inspired must unite with carbonaceous matters to form carbonic acid, and no assimilation proceeding, the carbon contained in the body is absorbed, and manifest waste ensues.

We have illustrations afforded us of the increase of development in muscles, in the arms of the blacksmith, the legs of the tight rope dancer, the loins of the porter, and indeed, in all those parts of the interfering particular trades or professions economy, which are exposed to constant and vigorous exercise. Not only, however, are the muscles enlarged but we find the character of the texture modified, the muscles and textures have

more
more consistency, tonicity and strength.

A familiar example in which the texture of muscles from exercise is distinguishable, is afforded us in the fact of a manifest difference which exists in those domestic fowls which are used by mankind as articles of food. If we look for instance to those birds which rely mostly for safety on flight, what do we perceive? We at once remark that the development of the muscles which regulate the flying movements is peculiar, that not only is it more full, but the comparative toughness is one feature characterizing the excessive function which during the life of the bird those muscles had sustained. Look again to the condition of the legs of such fowls as use these, more than their wings, and the phenomena presented are similar but reversed as to the special muscles.

As a further illustration of the effects of exercise on the muscular parts of the body, (though this is on an involuntary muscle), how often do we find from the enormous functions which the heart occasionally has to sustain in consequence of other diseases latent in the.
the body, a state of that organ wholly in
compatible with health, in short it may become
hypertrophied, and assume somewhat the
appearance of a voluntary muscle, which,
like those of the blacksmith has been ren-
dered through excessive exercise increased
in bulk and consistency.

Thus then as far as regards muscular accli-
modation, this progresses as may well be imagined
more favourably after the excitement to contracti-
ility than when an abstinence from all commo-
tion is observed. By the well regulated inter-
sicion of excitement to, and rest for, the mus-
cular tissue, we have laid the foundation for
future facilities in the actions to which the
various muscles may be respectively called and
it is to the knowledge of this fact that those
trained to peculiar occupations which require
the energies of this department of the physical
economy, owe a great share of their success.

It is in such illustrations as those we
have adduced that we witness the sensible ef-
fects of exercise on the muscular element;
from the habitual employment of those
voluntary
voluntary muscles we likewise perceive that a greater control and exactitude are possessed over individual parts of the corporeal frame, so that what at one time was really voluntary has been erroneously thought by some to have become involuntary: it is not so, however, for this would of necessity imply the want of will or ability to bring in subjection to the will, all acts of body and mind, which had been exercised for some continued duration, and would be tantamount to a declaration such as this, viz., that because an action seemed to occupy the divided attention of the actor, ergo the act is an involuntary one.

II. We come now to the second division of the subject of the effects of exercise, and proceed to the consideration of how, or in what manner the circulation in the body becomes affected under such an amount of exercise, as is not inconsistent with the healthy condition of
of the animal functions. And first, for the better illustration of our views, let us, as we gave an outline of the process of assimilation and disintegration when speaking of the muscular element, give a general idea of the circulatory system.

For the continuous supply to the body of matters which shall act as a proper substitution for those losses and transformations which are hourly being carried on in the body by the tiniest act thereof, or conception of the mind, there permeates by means of proper agencies what one might call a living fluid, in which is contained all that is essential for the process of nutrition, for in it, i.e. in the blood, are found the principal constituents of what we discover in the textures of the economy, though many modifications and chemical changes are constantly being effected to, and from one common centre does this vital fluid come and go, in its changed and ever changing condition. The Heart is that centre, and with pythic action...
just impartiality does this dispense its boun-
ties in a healthy state to all parts of the
body, with impulse which varies in
each individual of a species. The nutrient
duct vessels conduct blood from this end-
less fountain, and as they recede from
the heart they diminish in capacity,
not that we do not find small vessels be-
side this organ, but that the ultimate ra-
configurations of the arteries act as the imme-
diate depoents of the replenishing food, for the
separate tissues. Pursuing in an opposite di-
rection from the fluid which we have just
traced to its extreme point as it were, we en-
counter another, virtually the same as a fluid,
and yet not the same; the same—no could we
perceive by sight as with eagles eyes the mysteri-
ous liquid, we could discern no change
of fluid—and yet not the same, for we
would perceive—as if by magic spell a change
in colour and constitution, which were gra-
dually attained, and that by the mixture
of impurities and effete matters which
had served their special purpose in that
part of the body, whence they were making their way to the heart. The stream is directed, which having reached it passes into another organ, the lungs, for the purpose of eliminating in the form of gas those impurities which in its original state rendered it incapable of performing the same purposes which the arterial was so well qualified to sustain, and of imbibe from the atmosphere surrounding us that elemental gas which can restore to it its nutritive properties, which may have been in the mean time supplemented by new matters from the primary digestion of the food. Such being a brief outline of the ordinary phenomena of the circulation in the human body, it becomes us now to enquire in what manner this is affected by exercise.

And in the first place, there can be little difficulty in explaining or accounting for an increased or accelerated flow of the blood, whose results are so speedily manifested in our beholding externally the changes which are under-
degone on the peripheral ramifications of the blood vessels. The voluntary fibres of the muscles being contracted by means of the functions exercised by the brain originating "will," excites a determination of blood to that part, and one theory we would desire to recommend as tending toward this. We shall for the present, as it has no immediate connection with our subject, set aside the fact that by emotional acts we frequently are conscious of an increased flow of blood to the face, and that chemical agents can procure a similar result; but we only now notice that the contractility of muscles induces very plainly what we designate determination as a general term.

We are all familiar with the acknowledged fact that heat when applied to the surface of the body or to an internal part, excites toward that part an increased current of the "living stream," and so.
so long as in that particular locale the blood circulates more rapidly than is its wont, we shall have an increase of the temperature of the part. Now we hope shortly to prove, that from the heat manifested on action of the muscular together with other elastic tissues in the body, is dependent a greater or lesser degree the increased flow of blood. From non-organized bodies we may succeed in developing a certain amount of heat by extension and retraction of the fibres of those bodies upon which we make our experiments. Take for example a piece of caoutchouc band, and if this be drawn out and placed over a body sensitive to heat and cold such as the face, on tension we are forced to admit that the temperature of the band has risen, but in organized bodies likewise we have the same phenomena illustrated, and it is interesting to observe it. When I take a piece of intestine in which there are muscular fibres, and subject it to
to the action of a pair of bellows, marking the temperature of the intestine previous to the experiment, I find that the temperature rises, and that in proportion to the intensity of the contractions of the muscular fibres of which the intestine is partly composed. In like manner, subjecting the same to the action of a battery a like effect will be produced. And what practical deduction may be drawn from this fact? The following may be surmised. When we have partaken of food to any amount, the stimulus which is thus imparted to the stomach, causes it to develop those peristaltic movements peculiar to it and the intestines; and in this exercise of its muscular fibres there is generated no doubt a certain degree of heat, which operates upon a similar principle as the induction of an increased flow of blood through those parts to which we apply a sponge warmed in water, to remove a flow of blood though of course far from that degree which we find in the latter case.

It has been shown by M. R. Bœquezel and Freschet, that the muscles on their contraction and expansion increase in their temperature from 1\(^\frac{4}{5}\) to 3\(^\frac{3}{5}\)°. No one can deny that this law is general, which it is.
that heat draws the circulatory fluid more plentifully to the part to which it is applied or where it is manifested, the circulation must, by the amount of contraction of the muscles and elastic tissues undergone during exercise, be quickened. This view of the matter is too apt to be overlooked by some, but it doubtless in part accounts for the animal heat generated more in young adults than in old persons.

But in another manner are the effects of exercise seen upon the circulation in the body. By the contractile power of a muscle being called into action, there are changes necessarily depending on this dynamic force. So by such coooping and contracting force of the muscular fibres being exercised, the bulk of the muscle becomes altered, from the peculiar mode of adaptation and conformation which each muscle is disposed or as it were precipitated to assume when in this active state. And while it is so modified in character it must be conceded that it can only be so changed at the expense of those other tissues which surround it, and those parts intimately connected...
connected with it, amongst which of course are ranked the blood vessels. These assuming to themselves new capabilities, or at least modifications of their natural state from the pressure exercised on them, must likewise exhibit characteristic changes in their containing power, and that, by which the circulation is propagated. As for example when a set of muscles, let us take for clearer view that of the forearm, is in a state of contraction, pressure is exerted on the veins in that part, which, were no provision for such contingency afforded, a manifest injury would be the consequence. But see and admire in this as in the whole of the minute constitution of our bodies the wonderful wisdom of Deity in providing for every, even the minutest obstruction to appointed ends. In those veins are here and there placed valves, which are called ever and anon into use, for preventing the total obstruction of the blood and its re-gurgitation. Pressure being exerted on a part or contraction of muscles which nearly resembles it having occurred, obstruction in that part is.
is occasioned as far back as the valves on the distal end, and then and there, act as an impassable barrier beyond which, in that direction the blood cannot move; it must therefore find egress by some other exit, which it speedily obtains, from the fact, that a free anastomosis is maintained. We have, therefore, no obstruction to the passage of the blood, may we have a positive advantage, for the muscular contraction forcing the blood more rapidly forwards, causes a more ready passage by the anastomotic vessels which are capable of distension. In bleeding at the bend of the arm therefore, we might expect that by muscular contraction of the hand and forearm we should have an increased flow, both in speed and quantity which accordingly we have.

From what we have already stated we think that we have proved satisfactorily that from muscular contraction there is a degree of cotection of arterial blood to the part, and we have just shown that the venous blood is sent with greater freedom and velocity to the centre of circulation, it is not...
then a matter of difficulty to conceive how that the heart must during exercise contract both more rapidly and more powerfully, occasioning a greater amount of blood to pass through the capillary system of vessels, and in this manner is afforded an explanation of that rubricund state of the body into which during active exercise it is thrown. Under this head, by the effects of exercise on the circulation of the blood, we might of necessity require have extended our remarks to a much greater length, but enough having we think been said, we may now with propriety proceed to the consideration of the third series of effects we proceed from the active energies of the body being called into requisition, those produced on the secretions and excrescences chiefly those of the abdomen. In passing we remark, so far as Respiration is affected (for on this we do not purpose treating), it becomes stimulated under exercise, during which the oxidation of the blood becomes as it were purified, that is intensified or quickened, from the more free intercommunication with the air with which we
we then come in contact.

III. Here we adhere to the strict and limited definition which by a close analysis we should be inclined to assign to the term "secretion"; we might then perhaps forfit a claim to treating in a systematic form the correlative effects of exercise, we must therefore comprehend under the term secretion those changes which are being carried on by elimination from the blood, there being found there substances in the form in which they are excreted. For instance, we know that urea exists in the blood, so likewise carbonic acid, &c. These not requiring special glands to separate each secretion, though having a medium of exit which however, does not become entitled to the name of a secreting gland such as the pancreas, mammals we may consider under this head. The more important of the secretions thus comprehended would we shortly draw attention and we shall first speak of the secretion of the gastric juice, and the effects of exercise upon it.

I. This fluid the great requisite for
for the purpose of bringing the food received into the stomach with rapidity into a state of solution, and into a molecular condition it is necessary to keep in remembrance is not secreted into the stomach save only when the organ into which it is discharged is undergoing a stimulation to its peculiar office by some substance placed in intimate contact with its lining membrane. From the tubular follicles whose mouths open into the inner aspect of the stomach, the gastric juice is emitted, and to account for the source of the fluid we must not forget that surrounding these minute tubular glands, there ramify these minute capillary plexuses, which more or less profusely we discover to be distributed throughout the whole body, and which we conclude must be the source of the gastric fluid; therefore, as the stimulus is kept up, in general, in like ratio will the fluid secreted be, unless overexcitement and want of repose be disregarded. Now it being the case that its secretion is occasioned only during the reception of food into the body and not during the
the intervals of repose, as bile is secreted into the gall bladder, it might be asked, can any effect be occasioned by exercise on this most important adjunct to digestion? As the secretory cells derive their nutriment directly from the blood circulating in the capillaries surrounding the tubuli, the fabulm taken therefrom by the cells must have been undergoing those changes which give to the gastric juice its specific qualities. Any circumstance therefore by which either the circulation is promoted in that part, or by which the vital action in these little glands might be increased would necessarily augment the secreted juice. It may be that the blood contains in greater or less quantity the peculiar fabulm from which it is derived by the cells, but indubitably the glands themselves beside drawing nourishment for their cell walls, develop within their area their characteristic contents, so that besides the abstractive or attractive force which these exercise and which depends on the capillary circulation in the part being active or languid, there...
there is some chemical change superinduced.
As a certain extent the flow of
gastric juice is regulated by the influence of
the nervous force on the circulation, and
if we can prove, as we hope to do in the pro-
per place, that by the exercise of the body the
nervous system and energy are strengthened
for the performance of the special functions
and duties required, we can by analogie reasoning esta-

It is shown that those cells which are the secretive
agents in the tubuli of the mucous lining of the
stomach, are more largely supplied with that
source of nutriment and secretion, from which they
are called upon to eliminate their peculiar
product. These cells then are both the reservoirs
of, and agents in producing that fluid,
and whilst they increase it under the action
of the stimuli received into the stomach, or per-
haps merely pour it out then, they are depen-
dant on much of their vitality and extent
in effecting its secretion on nervous energy
and the state of the circulation. It has al-
ready been shown in the former part of this
paper, that from the exercise to which we
occasionally
occasionally subject our bodies a more general diffusion of the blood takes place from which it may be concluded that here, as elsewhere, a more ready passage of blood, and under favourable auspices, passes through the minute arteries which are to be found here.

Does it then become difficult to draw some conclusion? The fabulum which formerly was moderate is now increased, and the cells increase in their functions, i.e. secretion of the gastric fluid, in fact they are found, or doubtless would be so, distended. Is not this an intimate connection with the phenomenon of hunger? These cells may be capable of containing a certain quantity of fluid, beyond which, from pressure on the nerves, and sympathetic relations an impression may be conveyed to the brain. This impression may depend on the state of distention to which the cells may be subjected, and the number of the cells, and the state of the other functions of the body. The bursting of these cells by an applied stimulus, no matter what that be, taking place, the distention is removed and a temporary
temporary cessation of hunger is occasioned, the duration lasting in proportion as the stimulus proved proper or improper, in quality or in amount, the extruded fluid being in the form of the gastric juice which is then fit for its own uses.

And of course the secretion may be continued as the stimulus is maintained, within certain limits formerly named. May it not be the case too, that the blood's constituent parts being rapidly exhausted both here by secretion, (during fasting), and in other parts from the wants of nutrition, that the general system feels in such a depressed state, and feeds upon its own tissues. Let us then see that the gastric juice is modified as to its quantity by exercise; we proceed to the consideration of

II The secretion of the Liver, the Bile.

The circumstances necessary for the proper secretion of this fluid demand a more full and minute examination than we are entitled in this paper to give, where we only desire to see how exercise affects it, indeed our knowledge is not extensive on this subject, and great uncertainty exists concerning the bile. It has been assumed that the secretion takes place from the blood which flows through
through the portal vein, and that the purposes served by the arterial blood, which is contained in the hepatic artery, contributes merely to the nourishment of the tissues composing the organ, viz., to the branches of the hepatic and portal veins, ramifying on their walls, and of those of the ducts peculiar to the liver; others think, and perhaps more properly, that the bile is secreted from both, the arterial blood having first acted as the nutrient of the liver, and then by its passing into the portal system formed a part of the blood from which the bile is separated. That the bile has a distinct purpose to fulfil in the animal economy is proved by the fact of the general presence of the liver in animated beings; and that besides eliminating Carbon and Hydrogen, it has some other object to accomplish in the stomach or intestinal canal is proved, by the mode in which it enters the duodenum, in most animals as in Man, and its direct entrance into the stomach in others. It is of consequence, therefore, to be apprised of what power or exercise is possessed in modifying the ordinary process of its secretion.
If it be doubted whether the gastric cells do, during the intervals of digestion, maturate fluid which on demand shall be poured forth, in the case of the liver it is otherwise, for it has never been denied that the bile is poured forth at all times more or less into the gall bladder, which acts as a reservoir of in the reception of what shall hereafter serve the purposes for which it is destined. The changes which are developed in the blood of the portal vein when it has reached this gland exhibit that a complex function is possessed, or that two ends are obtained by means of the liver.

From the portal blood is abstracted by means of the hepatic nucleated cells, as the immediate agents of secretion, those constituents in it which would prove injurious by their accumulation and which we see on obstruction of the circulation of the liver; and at the same time we have the conversion of the albuminous principles found in the portal system into saccharinic and fibrous to a certain extent. We perceive fat developed in the vesicles, tending often to fatty liver.
as that formerly adopted it might be conjectured that during exercise there must be a modification of the circulation in the liver, and there must be a certain influence generated on the secretion of this organ. For the principles which more peculiarly distinguish the bile, in a great measure are derived from the waste of the tissues of the body and their changes, and we know that it is by the blood alone that these influences are transmitted to the livers, or it is this medium through which these principles pass. We cannot accurately tell the amount of increase or diminution which this undergoes, for comparatively speaking we are all in the dark, as to the exact quantity secreted in a healthy state, our means not being capable of demonstration as in the case of the secretion by the kidneys. That the bile must vary in its amount we cannot deny, if we admit it depends on the waste of the tissues to any extent, and as during the increased action of the body the disintegration of the particles called into play, is more speedily accomplished, exercise must have its due effect in regulating the amount of bile secreted.
The bile there can be little doubt may act as a nutrient to the body in some measure, for part of it is reabsorbed into the system, and part escapes by the intestines, but what is retained occasionally permits the body to carry on its functions tolerably well for a time, with no emaciation and when food has been withheld, and on the other hand, there are cases where food being taken but the bile being obstructed, emaciation occurred.

We have positive indications that exercise bears some relation to the secretions of the liver, in the fact that those individuals who lead lives of comparative inactivity in respect to the use of the bodily functions, as those engaged in the walks of literature, and those whose duties are performed in the sitting posture, have in a marked degree a tendency to hepatic diseases, in which disorder the secretion of the bile bears a prominent part. We may regard this as proceeding from a want of exercise, which creates a listlessness in the system of the liver, the venous circulation becoming languid.

But the function of respiration has an intimate bearing on the amount of the bile secreted so that it should be found by the combustion which takes
takes place by the elimination of the hydro-carbonaceous matter in the lungs, would alter the circumstances relative to the production of bile. The union of these two functions, respiration and bile secretion, or their dependance on each other, is seen in the effects of change of air in some diseased conditions of the hepatic organ. When there is a defect or stoppage in the secretion of the bile, the respiratory organs sympathize, and vice versa. Hence the liability to liver diseases in warm climates, where due regulation to the diminished receptives of the constitution is not attended to, likewise why bilious fevers, and diarrhoea occasioned by the excreta of irritating bile passing through the intestines are so prevalent there. This may be a cause why spirituous liquors which abound in Carbon & Hydrogen have so great a tendency to generate diseases of this organ, their throwing more work on the lungs and liver than these can readily or conveniently accomplish.

The more familiar we become with the purposes which are served by the bile, the more extended will be our knowledge as to the physiological
gical and therapeutic effects of exercise in relation to it, but much is wanted to complete the series of ex-
periments which have been made from time to time
to ascertain more accurate conclusions than
have yet been arrived at. From what light
has been thrown upon it already, we can only
speculate that the amylaceous and sugary
principles are brought into solution by bile,
that this absorption in the intestines may
be forwarded, the non-oxidised principles be
intended for passing off and aiding in
the evolution of heat.

III. Amongst the secretions of the abdomen
we come now to that which in many points is
peculiarly interesting and instructive, and which
we have more palpable means of investigating,
and concerning which therefore there is less differ-
ence of opinion. We mean the secretion of the va-
rions substances contained in the secretion of
the kidneys. The effects of exercise upon the function
of the urinary depurants, we have more ready
means, we have said, of attaining, for the products
of decomposition &c. in the urine are open to our
inspection, chemically and microscopically, but be-

for entering upon these we must content ourselves by shortly considering the purposes served by separate individual parts of the kidney, and the ordinary constituents in the urine.

In considering the secretions of the gastric fluid and the bile, we saw that the cells peculiar to the different secretions had a specific secreting power, and that the blood traversing each organism afforded the elements of what these cells separated or elaborated. Now in the kidney we have a double agency at work for the fulfilment of the purposes required. The Malpighian bodies which are found in the cortical substance seem to act in such a way as to cause to escape from the blood an excess of the watery constituents in the manner clearly stated by Mr. Bowman "It would indeed," he says, "be difficult to conceive a disposition of parts more calculated to favour the escape of water from the blood than that of the Malpighian body. A large artery breaks up in a very direct manner into a number of minute branches, each of which suddenly opens into an assemblage of vessels of far greater aggregate capacity than itself, and from which there is but one
one narrow exit. Hence must arise a very abrupt retardation in the velocity of the current of blood. The vessels in which this delay occurs are uncovered by any structure. They lie bare in an cell, from which there is but one outlet, the orifice of the tube. This orifice is encircled by cells in active motion, directing a current to the tube. These exquisite organs must not only serve to carry forward the fluid which is already in the cell, and in which the vascular tuft is bathed; but must tend to relieve pressure from the free surfaces of the vessels, and so to encourage the escape of their more fluid contents."

And whilst this part of the process of counteracting the excessive liquidity of the blood is maintained in efficiency by the Malphighian bodies, there can be little doubt that the office of the cells is for the effecting the separation of the solid constituents which we find in the urine. If we draw our attention to the substances found in the urine in a natural condition we shall thus see what proportional change is being carried on during exercise, for we must now state that this secretion derives its solid contents.
tents from the waste that is being carried on in the system, and from those nitrogenous principles which are unnecessary for the healthy functions of the body, and must therefore be separated from it.

The proportion of solid organic contents of the urine, have varied much according to the various researches of those who have examined it; but we have become acquainted to a greater or less extent with the nature of those substances which are found therein. That which more immediately affords the essential or characteristic property of the urine is Urea, which is derived from the nitrogenised constituents of the various textures of the body, and no doubt likewise from the superfluous nitrogenised aliment, being eliminated by the action of the Kidneys. Now when the muscular parts of the body are called into exercise, it has been found that this constituent in the secretion of the renal cells has been materially increased, leading us to connect this fact with some immediate changes that may be produced on the muscles themselves, and which even though they were not changed in their molecular destruction directly into this may
may at least generate a substance, or yield rather one, which by chemical transformation will develop the urea as found secreted. Creatine and creatinine found in muscle have been supposed to act in this capacity, and have been thought therefore by changes in their constitution to yield urea. The creatine is largely found in the muscular element, the creatinine is supposed derivative from it, certainly not yet having been attained as to this. Whether or no this creatine be the true source of urea, there can be no doubt that the truth is unaffected, that the muscles being excited in a moderate degree increase the proportion of urea. And we are not wanting in facts to bear this statement out.

The observations of Professor Lehmann & Dr. Simon go to prove this, for the former ascertained that by violent exercise the amount of urea found in the urine was increased from 32 ½ to 45 ½ parts the former number representing the secretion from a moderate amount of exercise. Dr. Simon remarked that the quantity of urea was double after two hours violent exercise from what it had been at a previous examination.
ation on the same morning, partly we may suppose, however, to depend on some nitrogenized food taken into the system, and which would of course cause a marked variation in the quantity of urea excreted.

Another of the essential ingredients in the excretion of the kidneys is uric acid. Concerning this much has been said on both sides as to whether or no, this may yield the constituent we have just considered. Liebig holds that the uric acid which is found in the blood, but not in the muscles is the chief source of the urea and allantoin, and that the process of conversion is dependant on the amount of oxygen taken into the system during respiration or from the quantity of water consumed in a given time; uric acid, according to this view, being subjected to the action of oxygen, resolves it into allantoin and urea, a further supply of oxygen changing the latter into the former into the latter, into carbonic acid and urea.

This process, so it remarked, was prevented by him artificially of course, but in how far his experiments formed an indication of the natural production of urea, we cannot tell. It may be that the theory is correct, but we cannot receive it as
as an ultimate fact.

There seems to be a close connection between the amount of carbon thrown out of the system and the ureic acid in the body, and the circumstances which would seem to favor the production of ureic acid are those in which carbon is retained in the system. Where therefore the function of respiration is inadequate to the task imposed on it, we may expect a tendency to this deposit. We see at the same time that exercise which favors the respiratory process must run in an opposite course, for it seeks to bring in a large amount of oxygen and thereby to remove the inclination to its formation by the more perfect oxygenation of the blood and the removal of the carbonaceous matters. It must therefore be apparent that in the one set of circumstances we have (namely during exercise), an increase of the urea, at the expense of the tissues; and that on the other hand these circumstances must alter the amount of ureic acid, diminishing it. When accordingly we have diminished urea, exercise increases it, and repose favors the maintaining of a larger amount of ureic acid. Simon in his Chemistry showed that in the urine of a man in training to run...
races, a remarkable change in the components of the
wine occurred; before running, the uric acid in pro-
portion to the urea stood in ratio as 1. to 9.3,
and after running it had fallen to 1 in 34, fully
bearing out what we have said above.

If we search for further evidence to prove
the changes to which we have referred with re-
ference to the proportions of urea and ur-
ic acid found from the effects of exercise,
we need only direct attention to the relation
subsisting between the function of respiration
in men and women; for from the nature
and habits of the former we may conclude
that the act to which we now refer must
be more invigorating, and this may be seen from
the deductions of Mons. Bequerel who found
that the average of

- Urea in the urine of men was 13.838 in 1000 parts; and of
  uric acid
    "     "     "     0.391 "

  The proportion of uric acid to urea is here 1 to 35.4.

  The average amount of

- Urea in the urine of women was 10.366 in 1000 parts; and of
  uric acid
    "     "     "     0.406 "

  The proportion of uric acid to urea is here 1 to 25.5.

Again.
Again the same author holds by his analyses that if we take the proportion of uric acid expelled from the body in twenty-four hours to be, for a female, 100, then, what represents during the same space the amount from a female is 112.5. Whence may this arise? It must arise in part as doubtless, from the exercise to which the body is subjected, and which is greater in man than in the other sex generally, and from the respiration being more active, greater facilities being afforded for the proper exchange of gases contained in the body and abstracted from the atmosphere, their pectoral development being greater likewise, and in addition perhaps from their food being of a more exclusive character.

Thus then, we perceive that in direct proportion to the exercise of the body and the area and uric acid found in the urine, the former will occur when exercise is engaged in, and according to the strength or amount of it taken, and the latter where little or no exercise is taken will bear a relative proportion, like wise the latter will be augmented as the food
partakes of an excited character. Part of the indications for the treatment of such diseases as exhibit an excess of uric acid, is plain.

Uric acid which likewise exists in minuscule quantity in the urine of man is increased in proportion as the food is carbo-aneous, and as there is an inactive state of the system, carbon being its want. Where respiration is impeded, or bile increased, we then must have from analogy the uric acid increased too, which is a fact. If we do maintain the hypothesis, and consider uric acid to be the source of urea by the oxygenising process, and we remember that uric acid is present in large quantity when the organs of excreting carbon are prevented from eliminating it by any obstruction, we can account for the diminished amount of urea when the acid we now speak of is in excess, and how exercise can in some measure rectify the deficiency of the one, and the overabundance of the other.

Lactic acid is found in muscular substance being generated there, but it
it is supposed, that ordinarily it is by the
function of respiration dissolved speedily, and
only where retained in the body abnormally,
or when produced in so large quantities as
to prevent its escape by respiration, is it
found to be present in several secretions,
and amongst others in that of the kidneys.
Exercise in this case may be a means of
causing its evolution from the muscular
tissue, and when found in the urine,
and sweat can thus be accounted for.

The researches of Dr. B. Snes prove
that during exercise the alkaline sul-
phates of the urine are increased, but
more from the nature of the food,
than from the amount of exercise.
From the disintegration of the nervous
matter of the body, the alkaline phos-
phates are augmented, as likewise from
increased muscular exertion there is a
greater amount in the urine from the
tissue of the muscles undergoing a like
change; chlorides, however, are more depen-
dent.
dant on the ingesta than upon muscular exercise.

From these considerations we gather the following: that the excretion of the kidneys is peculiarly modified by the different modes of life pursued by us at separate times; at one time being unusually acid, at another acid, at one time presenting modifications of its contents from the nature of the food received into the system, at another time, from the exercise participated in, and at a third from the state of the system with respect to the excretions and secretions of the other depurant or secreting organs.

IV. The excretion from the body of those substances which not being necessary for the support of any part, form but the residue of the ingesta received and which have therefore escaped absorption, together with the additions received in the alimentary canal, need hardly be named, for from the repeated general statements which have previously been submitted in the foregoing head, it ought not to be difficult to deduce the physiological
physiological effects of exercise. The secretion of the bile, part of which passes along the intestines, has a wondrous effect on the manner in which the feces are discharged; for if it be wanting or in diminished quantity, there is then constipation present; whereas if the biliary matter be unusually large, the opposite effect is produced, i.e., diarrhoea is the consequent. Anything therefore which changes the proportion of the liver's secretion, must to a certain extent, affect the excretion of the bowels.

Likewise we find that as the various muscular organs, or parts of the system acquire new and increasing strength, independent of nervous action, so are we entitled to conclude that the muscular striae, which are found to pervade the whole alimentary tube, cause by their duly regulated contractility and repose, by their increased tonicity under exercise, and their increased peristaltic movement, the feculent contents to be discharged more regularly and
and more easily than otherwise. Such, we know from the lessons of experience, to be the direct and beneficial effects of exercise in as far as the extirpation of the faces is concerned.

For need we be detained by the consideration at any length of the function by means of the skin, which during exercise is called upon to pour forth more largely its secretion from the sebaceous glands, hair follicles and sudoriparous glands. It may at present suffice if we remark that between the kidneys and the skin there subsists a most remarkable relationship, for while the one discharges its peculiar secretion, the other is diminished as regards the same substance set free by that act and vice versa.

The secretion of the pancreatic juice we likewise must resist entering upon, indeed, what much we do know of this, is after all, but comparatively fragmentary, and it would be beyond our province, therefore to discuss a matter with so little foreknowledge.
for knowledge to guide us.

V  Let us now briefly consider the physiological effects of exercise on the nervous system. The tissue of muscle, with other parts of the human frame in the introductory part of this paper, we proved to be temporary in their duration; and both the nutritive and disintegrative processes are established to be dependant on the amount of circulating fluid transmitted through the body, the extent of exercise undergone &c. and we saw from illustration that individual organisms or muscles were developed according as these were varied. Now, that nervous matter is subject to the same law, we have ample evidence in the fact of our observing in the different secretions of the body the peculiar products of its decomposition; but not only has this been demonstrated, but it has likewise been sufficiently proved from the researches of various authors, that the nervous system having once been disturbed in its functions, and received a check as it were in its maintenance or development,
is more rapidly brought into that state which is most suitable for exhibiting and accelerating the disintegrative process; and likewise that if not entirely deprived of those conditions necessary to the proper functions of a part, exercise properly regulated can restore to some extent the original qualities and integrity forfeited.

The state of the nervous system is in a most striking manner dependant on the elemental constitution of the circulatory fluid, a dependance which seems to demand that the blood be in its most pure condition to secure the unimpaired functions of the nervous centres. The blood if deprived of oxygen to any extent, experiences shortly injurious effects attributable to the condition which is produced upon the brain, the source of nervous action and volition. If this be deprived from receiving that just supply which is necessary for maintaining its integrity, we very soon perceive the fatal consequences which inevitably must ensue from such a defect for the oxygen which is absorbed into the sys-

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ten by means of the circulation acts as a stimulus to all the functions of the human constitution, which being denied, the nervous economy is specially and injuriously altered. Considering, therefore, that during the exercise of the various parts of the body, more especially in an uncontaminated atmosphere, the oxygenation of the blood is maintained may easily improved, the functions of the nervous centres must be more or less deprived of that tendency to a deprived state to which we have referred, and proportionately improved, in fact the physiological effects of exercise on nervous matter must be that, (dependant as it is on the quantity and quality of the nutritive fluid supplying it), its wanted capacities and endowments are strengthened.

From an inactive state of the nerves and likewise from pressure exerted on their substance, a condition analogous to the atrophied state of muscles from desuetude of their active properties is engendered. The fibres of which the nerves are constituted, are drawn into closer contact.
or shrink, and an evidence is visibly afforded as of the waste of their tissue. It has been disputed, on the other hand, whether from much exercise an increase of bulk in the nerves would supervene, or a state of hypertrophy exist in proportion to the work that might be entailed on them. From analogy we might infer that as in the muscles this takes place, so might it be produced in the nerves but not of course to the extent indicated in the former case, but only to a limited degree.

A continuance of but a trival amount of exercise or expenditure of nervous energy, causes, as it is protracted, the nervous power to become gradually weaker and more effeminate, so that in course of time pain may be produced, and function lost; but interpose rest, and in the result we have a world of difference, for we produce exactly the opposite phenomena. We, as it were, hold out new inducements to nervous and muscular action, forwarding all the healthy functions, and introduce a tendency to growth or development in
that particular texture, if indeed our hypothesis as to increase in bulk be true.

In what we perceive every day of our lives we have full proof of the correctness of these statements. For whence the languor we feel stealing over us after continued exercise, bodily or mental? Whence the improvement in our mental and bodily functions after a remission of gentle exercise? Whence the suppression of the powers of vicious for some time after we have been exposed to too intense excitement of our mental organs as on driving some stunning light? Why the frequent dropping down after great exertion in men and other animals? The answer may be partially founded in these last cases in the fact that the vital powers have been too severely taxed and that beyond the endurance of the nervous system. As to mental exertion, we perceive in the stimulation of nervous mental power a most striking sympathy existing with the other vital powers of the body, such as debility and exhaustion thereby induced through...
out the system, and we have in this one cause at least, why cerebral diseases are often present in those whose intellectual powers have been excessively exercised.

II Exercise as a Therapeutic Agent.

Having thus terminated the primary division of the subject, it remains for us to determine in what circumstances we could trust to exercise as a remedial agent, having partially sketched its relations in a physiological point of view; in short our enquiry must be, in how far can we make the known physiological actions of exercise subservient to the modification or rectification of the body in a diseased state. And first we must never forget that many states of the body though indicating the use of this as a curative means, require much more than can be supplied by it alone, it forming only a part of the treatment necessary, as it likewise, often, from the very nature of the disease comes in at a late stage of the treatment. In the succeeding brief remarks it will be unnecessary, (indeed the task would be herculean) to consider all manner of diseases in.
in which it might be beneficial, but we more
advantageously generalize, or name a few of those
diseases in which it is chiefly indicated, and
in which it is found to be of most decided
service.

I. First, we may mention that state of the Musc-
elles, in which exercise therapeutically, will be of greatest
use in correcting the abnormality in their texture.
When we have that debilitated condition of the
muscular fibres, by which their power is much
reduced, where, either the process of interstitial ab-
sorption has been unusually excited, constitu-
ting a disease, or where the assimilative powers are
exceeded by the disintegrative process, we have clear-
ly an indication for those restoratives of the
tone of the muscular organs which shall coun-
teract the downward tendency which is present
in these affections. The state of debility may a-
rise from a diminution in the quantity of blood
transmitted through the parts, which again may
supervene on a false nutrition, by which we mean
an inadequate nutrition, and as we have seen
that exercise acts both in the capacity of a pro-
moter of the digestive process and of the circula-
tion.
tion in a physiological point of view, its direct influence in these affections of the muscles would be to cause the blood's passage to be more liberal, remove the flabbidity of the muscles, increase their tone, promote nutrition.

Or the debility in the muscular textures may depend on the nervous matter having been disturbed in its functions thus acting on the capillary circulation and retarding muscular assimilation, which exercise, acting beneficially on the nerves, obviates more or less, and causes the blood to pass more freely round, i.e. both to and from the different parts.

Or where the parts have been in an inactive, atrophic state, and atrophy has been the consequence, this is removed alone by resorting to the improvement of the general system, and calling those parts which have thus been unused into exercise, at first moderate and progressing steadily. It is almost unnecessary to remark that the muscular fibres on which all muscular energy is dependant, require that there should be intervals of repose, for if they are not provided with this, the objects desired, must inevitably not be attained, from the debilitated and exhausted
exhausted condition entailed on the muscles, in consequence of the uninterrupted expenditure of nervous and muscular energy.

II. There are diseases in the circulation of the blood too, where the therapeutic effects of exercise are seen to advantage. In some the constituents of the blood are deficient, or changed in quality, in anaemia for example the red particles are diminished, and there is therefore paucity of the blood, which requires that the constitution of the circulating fluid must be improved by other means besides exercise which acts here secondarily, but not less effectively on that account. In functional diseases of the heart, there is rarely inducement to moderate regular exercise.

In Plethora where in addition to there being a superabundance of nutritive matter, which commonly there is in such a state, there is very often combined a vitiated condition of the blood, which may arise even when there is only moderate nutrition, from a deficiency in the elements of the blood, and a malproportion of some of its constituent parts, to which we shall hereafter refer. The plethoric state frequently proceeds from
from inactivity or sedentary habits, in which the nutritive and secreting organs have become atonic. To bring the various parts of the body into the condition favourable for proper secretion of the different matters in the blood, must be attended to, as a characteristic indication as to when we are to resort to exercise. For the healthy elimination of certain matters from the blood an amount of arterial action is needed, and for the increased performance of this function of separating the different constituents, it is but just to conclude, that a proportionate improvement in the circulation will be required, which exercise accomplishes.

Gout is a condition of the body intimately connected with the state above represented, for in this disease we find that the nutritive matter is contained in the blood in an exalted degree, which may proceed from the abundance taken into the body, or from the diminished expenditure in regard to its peculiar secretions, in which circumstances the relative quantities of its essential parts are considerably altered, and the gouty state is thus
Thus frequently generated. That an altered state of the blood exists in this disease cannot be negatived, and that it is connected with a plethoric condition which leads to a morbid circulating fluid is evident from the fact that the attack or paroxysm occurs more immediately with a remission or return of a temporary plethora, admitting that there has been during the interval a state of suspens
ion as it were; or some exciting cause being present such as excessive evacuations, the suppression of na
tural ones or customary aperitves, intemperance, study fatigue, sudden change from full to spare diet &c. we may see its development, but the plethora is the ac
companiment to it, and the violence of the attack is proportionate to the plethoric state.

In this disease there can be no two opinions. We think on the question of the applicability of exercise, for its agency is invaluable, for next to the regulation of the food it stands forth pre-eminent as one of the best means of relieving the system of the tendency to the re
turn of the paroxysm. If this be unattended to, there follows upon every indulgence or improper assimilation, an attack, the more tions
tions from blood and system being defective, or at least misdirected. Sedentary habits therefore are opposed to the cure of this disease, and exercise for warding it, and to a much greater extent than the use of stimulants, which, not infrequently supplant exercise, which, however, must be superior to the other resort, as it leaves no depressant action as must ensue whenever stimulants are taken. Yet we are not to conclude that we must thereby disregard their proper use. In gout therefore, exercise is the main prophylactic, and indeed though rigid abstinence be observed it must not be concluded that an attack will not supervene, where the blood becomes vitiated which it would do through indolence, excremen titious matter being retained.

Rheumatism likewise has in those instances in which exercise can be resorted to had its advocates, may even has had claimed for it, its cures, to wit: a noted case recorded by Dr. Marcet of the chemist Scheinerus who made exercise his remedy and cure. Med. Chir. Trans. Vol. III p. 310

We might have dwelt at greater length on some diseases of circulation where exercise is of use in its own sphere but we proceed to name one
one or two diseases of the abdominal viscera in wh
exercise is not contra-indicated but in which we
have every reason to believe that it is of vast
service, and likewise of thorax partly.

III. In the different forms in which dyspeps-
ia may exhibit itself, exercise is clearly indicated
as one of the best means of dissipating the ten-
cency to its continuance, and of relieving the bo-
dy from the state in which it is then found.

The functions of the stomach and intestines are
during this, languid, being unable to fulfill
the purposes for which they are destined, and
this being the case the system generally suffers
to a greater or less degree. The condition of the
dyspeptic we might very naturally conclude
would be materially altered by exercise regular-
ly and vigorously maintained. When we re-
frain from exercise the functions performed
by the stomach are much retarded, and if
we consider the pathology of dyspepsia in
so far as our limited acquaintance with it in-
dicates, we are led to the conclusion that con-
ected with it the secretion of the gastric juice
is abnormal, being impaired which may depend
on
on the local capillary circulation in part; and that the muscular fibres on which the peristaltic movements of the stomach depend are in an atomic state, prohibiting thereby the due agitation of the food, and steady propulsion towards and through the pyloric orifice. If then the food received cannot receive its proper solution from the deficiency of the juice naturally provided for that purpose, by adopting all means for exciting the amount we may facilitate the process of nature. Now as during exercise physiologically viewed, we proved the increased flow of the gastric juice and the mode in which this was effected, we are inclined to suppose that the same ends are accomplished in the dyspeptic. But of course exercise is not to be used single-handed we must regulate the diet to be.

Disturbed functions of the nerves supplying the stomach may occasion partially dyspepsia, as likewise may passive congestion, in both of which exercise is indicated: it acts as a tonic through the general system, and whenever torpor of the intestines is present, it
may be regarded as a " sine qua non."

In hepatic diseases we have frequently in indication for resorting to exercise as a means of assistance to those remedies which are used as correctives of the depraved condition of the liver; and this in the more strikingly impressed upon us, from the well admitted fact that those persons who lead lives of comparative inactivity in the exercise of their bodily functions, such as those engaged in the pursuits of literature, and those whose duties are performed in the sitting posture, have in a most marked degree a peculiar tendency to hepatic diseases. We may regard this as proceeding from a want of exercise which causes a stasis or stasis in the system of the liver, the venous circulation of this organ becoming languid. And whenever this is occasioned the secretion of the bile will be retarded, for the most part diminished, for the liver is kept in a state of passive congestion, the vessels being gorged, effort pressure on the small gall-ducts, and hence the bile's passage is impeded.
through them. And when there is a tendency to excessive secretion of bile we seek to increase the supply of oxygen, to burn, or consume during respiration, matters that would require the further extension of the digestive or resolvent function of the liver.

Likewise, in affections of the kidneys, or in those states in which variations in the quantities of the different constituents of the urine exist, there is frequently indicated the necessity for a greater or less amount of exercise, whether or not the improvement is anticipated from the stimulation to digestion which exercise affords, or whether it more directly affects changes which lead to the elimination of the matters which are abnormal in the circulation. Such conditions as exist in the uric acid diathesis, where it is found excessive, muscular exertion and exercise are essentials in the proper treatment, for by them the process of its elimination from the body, whether by conversion into urea or other chemical forms, is materially advanced. Where the salts are in excess or in diminished proportion, exercise may modify their amount though...
though great variations may be present as to these, without indeed exciting any very urgent symptoms.

In the first stage of Phthisis we have instances recorded where exercise has accomplished everything that could be desired in the resorting to it, for if we must believe what is written, cures have been effected solely by this. It cannot at least be denied that an abstinence from exercise, is one of the very first causes which tend to develop the tuberculous disease. For the body being permitted to carry on its functions only tardily, at so great distance of time are the digestive processes deranged, nutrition is abraded, their growth and development having received a check, these speedily is manifested a literal Consumption. Exercise in this disease, therefore, may with all justice be considered part of the prophylactic treatment, by which it is warded off.

IV. We have indications, frequently, in addition to diseases of digestion, circulation, and secretions and secretions, to resort to exercise in nervous
Nervous and mental alterations of function, for nervous and mental development proceed with proportionate regard to exercise; for as bodily exercise is needful for the proper maintenance of the animal functions so is it with respect to mental energy. The physiological law we endeavoured to establish was that in proportion as any living part is called into exercise, so were its functions increased or promoted, its bulk enlarged, its proper powers facilitated and more susceptible to action within definite limits determined by the individual constitution. It is thus that the mind must be called into regular exercise for the proper expansion of the intellect and for its further development just as is the case where muscular energy is desired to be improved; but as the mind is dependant on the state of the body for its degree of vitality, the necessity for exercise to preserve the entirety of the latter being acknowledged, we can perceivc how important a matter it is to have that due exercise which is necessary for the proper or improved manifestation of intellect. Much indeed might be said on the improvement of Nervous
nervous diseases experienced from the regular employment of exercises, just as in many other disorders which we must however omit. We proceed to speak briefly of the nature of exercise, after which we shall conclude this paper by running up the evil effects from neglect of, & the beneficial results from engaging in, regular moderate exercise.

The nature of exercise varies much; it may be either of an active or a passive kind: the former comprehending those exercises which proceed from the powers of our bodies being called upon to requisition, such as walking, riding on horseback, running, rowing, dancing and the like; but the latter class, comprising carriage exercise, sailing, etc., we have also recourse to, as therapeutic agents. Riding on horseback combines active and passive exercises.

Walking as we have classified above is one kind of active exercise, which calls into activity almost all the functions of the economy, circulation, respiration, secretion & evacuation are promoted and the animal heat is excited. But that it partake of a fully beneficial nature, there must be an absence from all mental function.
during its employment, for by the mind being fully engrossed there is produced a nervous exhaustion equal to that of muscular exertion if not greater. It is therefore impossible to procure those good effects of exercise which we desire if the mind is continually on the stretch.

In the cure of diseases advantage is taken of those exercises which combine the active and passive exercise in one, as horse-riding, and this form is peculiarly adapted for certain diseases. Lydénham was fully alive to the beneficial effects of this species of exercise, he insisted on it in strongest terms, and thought it of inestimable value if employed with constancy and under similar circumstances as those to which we have referred in speaking of walking. Whilst discoursing of the method of cure in chronic diseases he observes: "Nothing among all the expedients which have hitherto come to my knowledge, so effectually supports the spirits and strength, as long and constant riding on horseback" (Diss. Epistolarius). And again in his treatise on Gout, where he indicates the means for the prevention of the paroxysm by exercise, he says, "riding on horseback is far preferable to all..."
all others for this; in truth I have frequently considered that if any person were acquainted with a medicine which he chose to keep secret, of equal efficacy in this, and in the greater number of chronic diseases, with a constant and persevering exercise on horseback, he would speedily accumulate the most ample wealth. And further to express his full conviction of the value of this exercise in consumptive complaints, he uses such strong terms as these: "in short, however fatal consumption is deemed to be, and actually is, since it destroys two-thirds of those who die of chronic diseases, yet solemnly affirm, that neither is mercury a more effectual remedy for the lues venerea, nor Peruvian bark for agues than is the exercise just recommended for consumption, provided that the patient be always careful to sleep in dry linen, and that his journey be sufficiently long."

Sailing is admirably adapted for some forms of disease, phthisis among the rest. From defective exercise a relaxed condition of the more solid parts of the body is occasioned, a diminished activity in the passage of the
the circulating fluids, a tendency to stagnation in the capillaries, a diminished amount of secretions and secretion, an accumulation of fat, a consequent torpidity in body and mind, little expenditure of matter or function, structure changed, nervous energy defective, impairment of all the functions mental and bodily, and diversified diseases are engendered thereby.

By exercise, to sum up, the muscles by being compressed, propel the blood which is usually transmitted through the system, more readily, and in a condition which is more favourable for its fulfilling its various purposes in the economy, and in this manner the assimilative and secretive organs together with the disintegrative process, maintain a just balancing power by lessening the tendency to the maturation of any poisonous matter which collect in the different organs of the body. The blood being returned to the heart more rapidly requires the functions of the respiratory organs to be more active, causing thus a reflex action on the blood, and a more favourable depurant action is carried on by the proportionate effects on the amount of secretions and excretions.
The nature of such exercise must of course be entirely regulated by the peculiarities of constitution, age, and habits, and when employed as a remedial agent dependant in amount on the strength of the individual. The time likewise during which it should be taken ought to be attended to, much depending on this: for if we engage in it at a time when the body does not require its use, we then inflict an injury on the process of assimilation. If again we lend to the process of nature in digestion the timely support of moderate exercise, we accelerate the digestion and invigorate the body, stimulating it to a healthy increase of its functions.

Michael W. Cowan.

"Venienti occurrite morbo."