Essay
On
The Function of the Capillaries
By
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The Function of the Capillaries

It is more than a century ago since some physiologists were led to suspect, from the observation of various phenomena, which they could not explain, that the blood while passing through the capillaries was subjected to a force independent of that of the heart, which adjusted it in its circulation. Various conjectures were then formed, and it was supposed that this force either existed in the body itself or in the capillaries.

Various arguments have been brought forward in relation to this subject, which have either been altogether rejected or considerably modified and true.
ones have been supplied as physiology in its progress has swept away former
errors, or revealed new truths, and yet
notwithstanding ever at the present day
diversity of opinion exists. — The question
is an important one, and it will be
interesting to enquire shortly into its
nature, and for this purpose I intend to consider

1st. The action of the capillaries
on the circulation of the blood.

2nd. The part they take in the
various vital processes.

The diameter of the capillaries
or intermediary vessels of the human
body varies from 3/500 to 5/1000 of an inch,
their average diameter being about 3/1000 of
an inch. They consist of a thin mem-
brane in which are embedded nuclei,
projecting outwards on the exterior of the
descended, and also, according to some un-
noticed cells. It has been disputed whether
they form an altogether distinct system
of vessels from the arteries and veins,
or not, but from the mode of their development at first, and their peculiar functions, it seems a legitimate conclusion that they are a distinct system of vessels. Of course they have certain functions in common with the larger vessels, but they also perform those of which the latter are incapable.

Their functions are of a much more vital character, and their structure corresponds to this. In the larger vessels there is a great quantity of fibrous and elastic tissue, the properties of which are purely mechanical, with a small amount of involuntary muscular fibre or contractile tissue, while the whole structure of capillaries is analogous to involuntary muscular fibre. Thus we see that the character of the component tissue of the vessels corresponds to their function, the larger vessels being principally composed of tissues whose action can depend on their physical properties alone, but these vessels have some vital properties.
also, and accordingly, we find a cer-
tain amount of tissues of a correspond-
ing kind. The capillaries on the contra-
ry, whose functions are far more of that
character which we call vital, are also-
composed of tissues analogous to that
which we know to have vital actions.
There is no abrupt limit, however, between
the two, as the contractile tissue increases
in the coats of the arteries as they be-
come smaller, till it reaches its maxi-
mum in the capillaries. The uniform-
ity in the size of the capillaries, in the
same tissue, and throughout the body,
also favours the theory that they are a
distinct system of vessels, although
Miller is opposed to this view which
is that of Richard.

In the first place
then have the capillaries any in-
fluence on the circulation of the
blood? Of course all the laws
of hydraulics hold good here.
The current is rendered much plower-
on account of the increase in diameter of the capillaries over that of the arteries, and in addition, by the friction which must be very considerable in such minute ramifications, and frequent subdivisions. The angle at which the vessels come off would be thought likely to have an influence on the current, but such is not the case in a closed system of vessels completely filled whose contents are constantly under pressure. But in addition to these merely physical effects, there are many phenomena, which show that there are other effects produced by the capillaries on the circulation, which cannot be referred to any physical law. If the capillaries in the web of a frog's foot, or any other transparent membranes of a living animal, be watched under a microscope it will be seen that the blood will stagnate, or even go in an opposite direction from what it did before, in some of the vessels, the stagnation giving place to movement.
after a time. Attempts have been made to explain these changes by asserting that variations of pressure, and position and motion of the animals, are always the causes of these changes, and hence merely the results of mechanical causes. These however cannot be satisfactory to any one who has watched these variations, for they can be seen when the animal is perfectly passive when no pressure or other mechanical causes can be conceived to exist.

Moreover an attentive examination of the circulation will impress the mind with a conviction that the phenomena observed must be dependant upon causes operating on the heart, and are alike inexplicable either by supposing them to result from the action of the heart or vessels or from the operation of extraneous causes. The following observation throw much light on this question and I think very valuable because made recorded without re-
Reference to the present subject by Mr Wharton Jones - "He says when an artery is cut across, it immediately becomes constricted, even to obliteration of its calibre, upwards in the direction of its trunk, and downwards in the direction of its ultimate ramifications. The flow of blood is thus arrested and the immediate consequence is, an ex-pangyrous state of the heart, to which the ramifications of the artery lead. But this state of matters is out of long continuance. In the course of a minute or two, relaxations of the walls of the artery, and dilatation take place both above and below the wound. In the upper part of the artery, the flow of blood is re-established as far down as the first considerable branch proceeding from it above the place of section. By this branch the stream of blood passes off. In general, none of the blood, except a stray corpuscle now and then, enters the artery further
although it has become dilated down to the place of section, where, however, the cut end of the vessel continues closed by constriction. Into the part of the artery below the section, blood, of course, no longer enters directly, but enters however, in a retrograde direction, and very slowly, by one set of branches. It passes out in a direct course, but still very slowly by another set of branches. The blood which enters the artery below the section, in a retrograde direction, regurgitates from the capillaries and veins to which the branches lead by which the blood enters, and if the cut artery has a direct anastomosis below the section of another artery, blood also regurgitates by that anastomosis. Now in this experiment, why is the flow of blood re-established in the upper part of the artery only so far down as the first considerable branch proceeding from it above the place of section? Why is it that "In general, none of the blood
except a stray corpuscle now and then enters the artery farther, although it has become dilated down to the place of injection. Can this be explained by any "vis at actio" or by any mechanical force? is it due to any other cause than some power in operation at the capillaries to which the vessels lead, which draws the whole of the blood passing through the vessel in that direction?

When an animal is killed in any ordinary way, the circulation is said to seem to be kept up in the capillaries, long after the heart's action has ceased, a considerable impulse is given to the blood in this way, as in seen by the distended to which blood is projected from a vein which has been opened in a body a short time after death has taken place, by yellow fever. A cardiac fociuses too, are sometimes seen, in which the circulation has gone on till birth, and no communication between them and any propelling force.

The movement of the blood which takes
place in the early embryo towards the heart, and the varying degree of activity of the circulation in different places, while the heart is the propelling source for all alike. All these phenomena seem to point to what some have called a "capillary power." The circulation of the blood in the capillaries after the action of the heart has ceased has been repeatedly seen by experiment. The following is related by Dr. Wilson Phillips. A ligature was thrown round the vessel attached to the heart of a frog; the heart was then cut out. On bringing the web of one of the hind legs before the microscope, the circulation in it was found to be vigorous, and continued so for many minutes; at length gradually becoming more languid. But in the hands of other observers this experiment has not been attended with such decided result. Thus Dr. M. Hall relates the following. —

A ligature was applied round the web of a frog; the circulation in the web,
which was previously very vigorous, was almost immediately arrested, first in the Capil-
laries then in the veins. In the arteries
there was a pinnular oscillatory motion
of the blood for ten or fifteen minutes.

The globules of the blood proceeded slowly
onwards for some seconds; then they
all at once, a rapid retrograde move-
ment of the blood, apparently through the
same space. This oscillation was repeat-
ed; the globules of the blood were again
moved alternately in progressive and re-
trograde directions as before.” Descriptions
of the same time have been given by several
observers. Haller appears to have performed
many of these experiments, but not with
a very uniform success. Mr. Lavry
appears to have performed these experiments
with very great care with a generally
uniform success. In one he says—
"The Medulla Oblongata of a Frog having
been divided, the chest was left open &
the heart & great vessels were exposed. The
web was then placed under the field
of the microscope, and the circulation observed. It was apparently in all respects normal. The white of the heart, with a portion of the vessels, was then cut out with scissors by a friend, while we watched the circulation. Its rapidity was immediately and strikingly diminished, but the blood continued flowing in the smaller arteries oscillating same direction for some few seconds, then the current in the smaller arteries oscillated, moving slowly backwards and forwards, its motion in the veins being very slow, but uniformly progressive. The capillaries seemed gradually to empty themselves into the veins — another frog was prepared in the same way, and a ligature passed beneath the aorta, while the circulation, which was natural, was observed, the ligature was tightened. The circulation almost immediately became much slower, but continued to move for more than a minute progressively onwards with considerable speed, appearing to be in
all respects natural but slow. In between two and three minutes it gradually stopped. In addition to this the chloroformed other frogs performed the same experiments with same results. That after all sucking force was cut off the blood continued to flow slowly onwards through the capillaries and emptied themselves into the veins. Relying therefore on the above experiment one could not subscribe to such a statement as "whenever the action of the heart ceases or is impeded the whole circulation stops & when the action of the heart is prevented from reaching the blood in any of the blood vessels the flow of blood ceases almost instantly."

A physical principle has, however, been put forth by Poiseuille, thought by some to be sufficient to explain them all. It is thus stated if two liquids communicate with one another—in a capillary tube, or in
a porous and parenchymatous substance, and have for that tube or structure.
different chemical affinities, movement will ensue! that liquid which has the
most energetic affinity will move with the greater velocity, and may even drive
the other liquids before it." Now Arterial
blood, between which and the tissues,
the various changes have yet to occur,
must have a greater affinity for the
liquor than venous blood in which these
changes have occurred, and therefore
drives it on. But this is scarcely ade-
quate to explain all the phenomena,
such as the effects produced in the cir-
culation of the blood in the capillaries of
a part by local stimuli, when we have
no reason to suppose that the nu-
tritive process is stopped, and yet
the circulation will become slower,
and altogether cease. If in the cases
alluded to of the acardiac foetuses
and in the few cases which have been
met with, in which the heart after
death was found to have undergone such degeneration in its structure that it must have been impossible for it to have propelled the blood as usual, if in those cases the circulation had been entirely kept up. The nutritive operations going on in the tissues, the circulation must have become stagnant in those glands which only perform their functions at intervals, such as the Salivary, testicles, &c., and very nearly so in the tissue which undergoes very slow nutritive change such as the bones, tendons, &c., that this stagnation occurs in those glands and tissues we have no reason to suppose. But is there any reason why the Capillaries should not aid in the circulation? There seems to me to be none, but if we reason from analogy, the reverse. It is well known that the capillaries have a contractile power as they may be seen to contract 1/3 in the tail of a tadpole when cold
is applied. Mr. Lister would make out it is the small arteries that only contract. He says that they are about the size of the true intermediary vessels, but distinguished by the presence of nucleated cells instead of nuclei, disposed irregularly, instead of longitudinally along their walls. But this is by no means proved. Miller again maintains that they have no contractility, except what resides in all the soft tissues of the body but that they have the power of contractility on the application of certain stimuli, may be demonstrated. This contractile power is not subject to some stimuli, as galvanism, but some kinds of undoubted involuntary muscular fibre are subject to the same laws. But when an interrupted current is passed, the circulation ceases, whether by the capillaries exerting some influence on it, or by its stopping the nutritive process in that part. I cannot say, but more probably the former.
supposition is the true one. It is well known that in the healthy state, the capillaries are in a state of passive contraction, most important in the animal economy called their tonicity. The derangement of the vital function induced by the loss of this tone is proof enough of its importance. It would be out of place to enter on these derangements here, as my business is with the physiological state.

But even an active power of contraction could not produce a constant current through the vessels, if we consider them as analogous to cells we see that such a current could be produced, but how? we can neither tell in the one case or the other.

We know that in the interior of cells, currents in a fixed direction are produced, but here we have the same conditions, namely the membrane of the capillary tube corresponding to a cell wall, and in fact originally it was so,
and a nucleus, represented either by the blood corpuscles or the nuclei im-
b juxtaposed in the membrane; and with the same conditions why may not the
same phenomena present themselves.

phenomena of the circulation in plants and in the lower types of animals be-
fore the heart has appeared also favour this view. And Mr. Fenwick has shown
that there is some propelling power in the lymphatics beside the "vis atergata," and
why may not the same exist in the capillaries. If we suppose these
modified cells to have the same power of contractility, as voluntary muscular
fibres, this explains that impetus in them, or rather shows, that it is not
different from what is observed else-
where in the animal body. If we
suppose involuntary muscular fibre
cells opening into each other, and
having the power of producing a cur-
rent, we have capillaries. This view
I shall bring more prominently for-
wards in another part of this paper, however. It does not follow from these considerations that in the healthy state, the capillaries take an active part in the circulation of the blood, for it has been found that the heart has the power to send the blood the round of the circulation. It explains abnormal occurrences, however, showing that the capillaries have the power of producing them.

We see this "capillary power" to be under the control of the nervous system to a considerable extent. Thus when a frog is killed in an ordinary way, the circulation is kept up for more than a quarter of an hour, and this is also seen in the lượnginty of warm-blooded animals, but when the brain is crushed by the blow of a hammer, it instantly ceases. When the spinal cord of a frog is gradually taken away, no effect is produced on the circulation, but if it be deci-
...deuly destroyed it immediately stops. Then an infusion of tobacco is applied to the brain of a frog after the heart has been removed, the circulation is at first quickened in the capillaries, then becomes slower till it ceases: thus showing that this power of the capillaries to carry on the circulation is under the control of the nervous system. The phenomena of blushing, erection, &c., are to be attributed to the influence of the nerves on the capillaries, and not on the tissues through which they pass. This subject is one of great difficulty on account of the impossibility almost of distinguishing between what is to be attributed to the capillaries, and what to the tissues through which they pass. —
And now I shall take up the important consideration, whether the capillaries have any influence in the processes of nutrition, secretion, excretion, and absorption and what that action is.

Müller and other physiologists are of opinion that the blood vessels have nothing to do directly in these vital processes except as dividing the streams of blood into very small portions, and offering in the extreme tenuity of their walls, the best possible conditions for Osmose to take place. These merely physical and mechanical actions must indeed be held the chief use of the intermediary vessels, and we have no right to refer anything to a vital law, which can be explained on physical principles at present known to us. But when the phenomena observed cannot be so explained, then we must refer them to a force or principle of which we attempt to conceal our ignorance, by calling it vital. So an all the actions
Known to be performed by the capillaries then, be referred to mechanical and physical laws at present known?

But before I enter on this question, I shall consider whether, reasoning from known facts we should expect the capillaries to have vital functions; or whether the occurrence of these in them would be inconsistent with any known facts or with general principles of the animal economy.

I shall also put forth a theory which has occurred to me as capable of explaining some difficulties, or at least of including some otherwise anomalous facts under the laws of the vital forces and rendering very probable the view that the capillaries serve more than merely a mechanical end.

In descriptions of the development of the capillaries in our tissues, and in the embryo at first, various accounts have been given of their formation. I shall take the received account of their development
in the embryo, where the development
of all tissues is seen in its most typi-
cal form. It is said that between
the mucous and serous layers, a layer
of cells is seen which become triangular,
by sending out extensions off their walls.
These extensions of different cells
meet one another, and open into each
other, so producing the first capillary
networks, and this process takes place
in all the tissues supplied with blood-
vessels. Now in reading this in con-
nection with the determination of the
functions of the network so formed,
the idea came into my mind that it
might tend to throw some light on
the question. Their functions in the
various processes by which the animal
economy is upheld are said to be merely
mechanical and physical, affording
the most favourable conditions for
the various physical principles to be
brought into action. Does it not
seem strange that such a change
should have come over the vital manifestations of the cells, that whereas before, it performed actively all those processes which are yet no chemical, physical law explains, nor even cellular, and which therefore we refer to that power possessed by that which has life alone, is it not rather remarkable that now, when the only appreciated change that has taken place, is the extension of the cavity, so that it communicates with those of like cells, these manifestations should cease, and the same membrane only afford favourable conditions for physical principles to be manifested. Before, we saw the cell wall absorbing its fabulum and enlarging itself, and we are now told that the same cell wall has no absorbing power. This cell structure is all but universally distributed, and upon its healthy action, all the other cells of the body depend for their fabulum, and for the removal of their
waste materials. The capillary network is very different apparently, from ordinary cellular tissue but really the difference is not so great. In order that they may perform their function, which is the supplying of all other tissues with nutritive material, and removal of their effete matter, and also supplying the oxygen necessary for those matters to become effete, their own contents must undergo a continual change, fast too rapid to be performed by diffusion from cell to cell. They also serve as a part of that complicated function to connect the processes going on in one organ or set of organs, with those of another, supplying the liver with the requisite venous blood from the intestines and abdominal viscera and the kidneys with their blood from the muscular and nervous tissues. All this is provided for by the beautiful adaptation of their being made to communicate with each other, and be connected to a great propulsive organ, and system.
of arteries and veins, which thus may be looked on as accessories. That this should in any way affect their functions as cells, we have no reason to suppose, as we actually see cells becoming elongated and forming tubes, yet still retaining their functions as cells, in involuntary muscular fibres, nerve-tubes &c. But it may be said what is their function to correspond to the selection of bile by the hepatic cells, oil by the fat cells &c.? Of course it would be inferred from the nature of the case that their functions would be of a far more generalized nature.

The sapubium of the renal cells is urine, that of the capillaries is blood, the fluid which contains the constituents of all other tissues in the body put together. In the brain they have to absorb effete nervous matter, in the intestine the food, and in fact nearly all the substances which can enter the body in any way must be absorbed by them. It may have to be supposed that they want the
selective power possessed by all other cells, and we have their condition.
The cells of inflamed tissues are supposed to lose their selective power,
while the attractive power remains and this is the normal state of the
capillaries. That they may have transforming power over the blood is
not at all improbable, when we consider that more liquor sanguinis is ab-
sorbed by the cells in the different tissues than is made use of, and some of the
matter may not be in such a state of decay or alteration, but that they
may serve in the organism again, although they may have already formed
part of some of the tissues. And we know that when more nutritive materials
are taken, there are required for the support of the body, they undergo very
great changes before they are thrown out by the excretories. The cells power
excited by the capillaries may have something to do with this. The nuclei
or nucleated cells imbedded in their walls would seem to point to serve to some such power as if the liquor sanguinis was cured or obstructed by their walls, for we know that delicate membranes, can nourish themselves in - dependently of such nuclei, as we see in the capsule of the lens &c.

The capability of the nervous system to produce arrangements of nutrition depending on an abnormal state of the capillaries would seem to show that they had some such action.

But it may be argued against this view, that the nuclei of the origin of the nuclei of the original cells are wanting, and they are by some held to be the essential part of cells. In account of the development of the blood corpuscles they are said to be produced from the original cells nuclei either directly, or by those nuclei dividing, and each part forming a blood cell. Now the nuclei and cells imbedded in the wall of the capillaries
come there, I have not been able to ascertain, but some of the original nuclei are most probably adjacent to the walls remaining there. This fact that the nuclei of the capillary cells become converted into blood corpuscles, instead of any way going against the hypothesis, is the only thing required to complete the analogy on which it is founded. The blood corpuscles are now known to have the structure of nuclei, and perform their function.

Before, we had the cell walls and thus cavities communicating, and now, we see their nuclei so modified as to act on the contents common to the whole system and to circulate through the communicating cells, instead of being confined to one of them.

We have here all the conditions implied in our idea of a cellular structure, but some of the particulars modified serve a special purpose in the economy. This would favour the view of Schwann, the discoverer of cells,
Somewhat modified, who supposed that all organic structure was composed of cells, only instead of cells, if we say cells or their homologies it would be nearly correct. As in the vertebrate skeleton we trace many homologies, only by studying their embryonic state, and development, so in this case, we would not so readily trace out the homology of capillaries with cells, if we did not study their development. As we see that the forms of vertebrate existence can be referred to one common type, so I do not see any reason why the various elementary tissues should not have the same relations to some typical form as all the forms of vertebrates. That the typical form, for most of the elementary structures, is the cell; I think we cannot doubt; as the ovum is only a cell at first, and cells are the only histological components
of the embryo in its first stages of development. This would be a histological morphological if I might use such a term, of course such a branch of science exists as part of the study of development, but whether the nomenclature is proper may be questionable. And we need not confine ourselves to one type of elementary form, but may suppose that the cell may be the type of one class of elementary forms of structures, as the typical vertebrak is the type of all vertebrak, so the membrane or any other form may be the type of another class, as we have types of form among the invertebrate existences.

I shall now consider whether there are any phenomena in the processes of Nutrition, Secretion, Excretion, and absorption, which this theory of capillary action would elucidate in any way. I shall Nutrition in the
first place. The capillaries have very little to do directly with this process. They supply the necessary conditions for it by furnishing the substances required to form the cells, and by carrying the superabundant materials. But beyond this they can have very little direct action in nutrition. When their functions are disturbed, as in many of the capillaries we have nutrition in the parts which they supply, also interfered with, as in parts after they have been inflamed, passive constrictions, some dropsies &c. The effects of the various stimulating liniments, and rubbing employed to remedy this condition shows that it is the capillaries that are affected.

It is an interesting question what effect the rapidity of the movement of the blood in the capillaries has on nutrition? Whether that process goes on best when the blood moves slowly, or when it moves with more rapidity. We know that at night...
when the process of building up the previously hard wrought tissues is going on with the greatest rapidity, the circulation is slower than through the day. In the processes of the synovial membrane contiguous to cartilage, which contain the nutritive vessels of that non-vascular structure, the capillaries are dilated into loops. Of course this will have the effect of greatly lessening the rapidity of the blood in them. The slowness of the circulation in bones, is thought to favour the deposition of carbonate of lime. These facts would seem to favour the idea that the slower the blood circulates in the capillaries the more rapidly nutrition goes on, "caeteris paribus". But then we know that in infancy and youth, when all the processes are going on more quickly, the circulation is more rapid than in adult age. The truth seems to be made out in this case by considering the other functions of the capillaries, besides supplying
nutritive material is the act of carrying away the effete matter, and that nutritive proper or the building up of tissues goes on more rapidly when the movement of the blood is slow while the evacuation of effete matter and the absorption of alimentary matter goes on more rapidly when the rate of movement is increased.

Thus, violent exercise which causes great waste of the muscular tissues and therefore great production of carbonic acid and necessity for oxygen excites the circulation. This may be explained by the predominance of a physical force in the one case, \& of a vital one in the other. Nutrition is a vital process, while the evacuation of carbonic acid, the absorption of oxygen in the lungs, and of some of the alimentary matters in the intestinal canal, is to a considerable extent dependent on exercise.

In nutrition also, the substances required are those of which the
greater part of the blood consists, while in secretion, the matter to be eliminated forms but a very small part of the blood, and therefore the more blood that passes through the excreting organ, the greater also will be the quantity of the products of that organ. In the case of the alimentary absorption, the increase of the pulse twenty beats per minute, as is sometimes seen, may be partly due to the influence of the amount on the heart, as well as to any process going on in the capillaries, or influence excited by them.

In some cases the capillaries would seem to favour the development of organic structure in contact with them, as we see in the granular matter organized around the capillaries, in cases of fibrinous exudation from them, such as occur in inflammation.

I shall consider their action in secretion and secretion at the same time, these two processes...
being so similar, that we may say the functions of the bloodvessels are the same in both. In ordinary secretion and excretion, the bloodvessels stand in the same relation to them, as they do to nutrition, with this difference, that in those cases in which the substances to be eliminated present in the blood, of course being only in very small proportion to the other constituents of that fluid, they are excreted more quickly, the more rapid is the rate of movement, as has been stated. But they seem to have a more direct influence than this;

Thus it is Watson thinks that there is one form of secretion in which the fluid is secreted by the capillaries independently of any greater pressure on them than usual. It is a curious fact also, which some explain by the physical arrangement of the elements in the membrane, that the amount of albumen in the fluid of the different serous cavities, varies according to the friction to be endured
being least in the arachnoid, just in
the peritoneum, then comes the pleural
cavities, and lastly the synovial mem-
branes, in which it exists in greatest
quantity. We see also masses of pig-
must surrounding the bloodvessels in
some parts of the web of a frog's foot,
which must have been secreted by these
fibres. How is the copious secretion of foetid
gas into the intestinal canal under
the influence of any exciting emotion,
as sometimes happens, to be explained,
except we suppose the capillaries to
be under nervous influence and having
a true secretive property.

Now I shall consider the
action of the capillaries in absorption.
Perhaps the most difficult of all to
determine precisely, yet proving more
clearly than any other, the vital char-
acter of the capillary function. The
great difficulty is to determine what
may be done by osmore, as distinguish-
ed from absorption of a vital kind.
remove into the capillaries. This is greatly favoured by the rapid movement of the blood in them. All other cells and membranes have a power of selecting some special material which we see at once cannot be owing to any physical principle, while the capillaries have to absorb blood, in which is contained all the fluids of the body in some form, and many foreign substances besides, not naturally forming part of the body. Some substances such as the NOMALI poison the blood vessels seem not to absorb, but then we find that the same is the case in the dead body, and it must be owing to their incapacity for as such. If we could prove that the nervous system can directly influence capillary absorption, this would show it to be partly vital, for the nervous power could not possibly have any effect on a physical law. Magnetism stimulates absorption could it have any influence on odors?
The capillaries, as has been often stated, carry away the effete matter, and of course they must absorb it first, and I think it would be going too far to suppose that this whole process of "intestinal" or "superficial" absorption is carried on by osmose. Some of this is carried into the current of the circulation by the lymphatics - not the effete matter but that which is still fit for nutrition. Whether it be the excess of chemical compound out or matter which has served a purpose in the economy, yet is not in such a state of chemical change as to be unfit for further use, therefore these vessels must have a selective power to refuse to absorb the effete, and only take in the nutritive.

And if they have such a vital property whose walls are as far as we can see the same as the capillaries, would it not, a priori, be legitimate to suppose that they were not destitute of a corresponding power? This is per...
they have, when in effusions, they are
made to absorb the fluid by stim-
luation such as rubbing, counterirritation
and the influence of dressings, can
only be explained by supposing that
they increase the absorption or absorptive
power of the capillaries. We cannot
suppose that they would have any in-
fluence on a merely physical process.
It is found that a solution will gain as
much as an ounce in weight in half
an hour by cutaneous absorption.

The absorption of ali-
mentary substances from the intestinal
canal is another process in which the
capillaries play an active part. They
not only absorb nutritive materials
and water themselves, but the absorp-
tion by the lacteals cannot go on
without the circulation in the capillar-
ies and in the higher invertebrata, there
are no lacteals at all. When liquid
is taken into the stomach, it is quasi-
ly absorbed, and the more quickly
according to the previous cutaneous
transpiration, or other cause lessening
the amount of fluid in the blood.
Some hold this to be the result of
indolence, but then strong alcohol
is almost immediately absorbed into
the blood, and it ought to cause an
osmotic current as also strong
solutions of various salts. But it
may be said that there is an osmotic
current first till the liquid is sufficiently
diluted, and in fact Reibig explains
the action of the saline purgatives in
this way. Such solutions will pro-
duce the same effects, however much
they are diluted.

In the foregoing pages I have confined
myself more particularly to that part of
the subject in which I felt most interested
so that the latter division of the paper
has been very briefly touched upon.

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James Allan