



AN
INAUGURAL DISSERTATION

ON

The Circulation

SUBMITTED TO THE
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Very Good P.F.G.

The Circulation

By this term is understood the flow of blood through the organism in which it exists.

The term circulation naturally presents to the mind three elements necessary to its existence and a purpose or object which it is destined to fulfil in the economy where it abounds.

The first of these elements is an easily transmissible fluid which ^{may} be appropriately styled blood.

The second element required are vessels for the transmission of this fluid which are found well developed in the arteries and veins.

The third and last element necessary to complete the circulatory apparatus is force with which to drive this blood through its appropriate

channels of conveyance,

This force is beautifully displayed in the muscular tissues of the heart which acts like a beating engine and is the fountain of the circulation.

The combination of these different elements form what is called in all living beings the circulation of the blood. The purpose or object to be fulfilled by the circulation as referred to in the outset is to supply nutritious materials for the support and maintenance of the system.

The blood is made up of nutritious constituents and being conveyed through every organ and brought into contact with every tissue yields up to them such materials as they may select according to their respective wants. The nutritious principles thus yielded up to these organs and tissues are assimilated and appropriated not only

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to their own uses but to the wants and uses of the whole economy." Thus it is seen that the object and purpose of the circulation is to supply materials for the building up and support of the wasted tissues and to give life and energy to the structure in which it is found or exists.

The circulation of the blood was discovered by William Harvey in 1620, and although its universal character in some animals is very obscure and cannot on that account be positively asserted to exist in them yet as anatomical investigations proceed new discoveries crown the labour of the investigator tending to substantiate the existence of the circulating fluid even in the simplest of beings. In the higher order of animals two distinct circulations are found each having a heart.

These two circulations are separate and distinct in the perfect adult as are also their hearts, being merely brought together for convenience and economy.

These two circulations are called the greater and the lesser or the systemic and the pulmonary, Each of these systems has a set of arteries and veins of its own and they communicate centrally by the heart but peripherally by the capillaries.

The two systems like mine come into close proximity at the heart yet they do not mix their blood.

The route of the circulation in a human adult is as follows. As the venous blood is being received from different portions of the system by the ascending and descending aorta it is poured by them into the right auricle of the heart, by the contractions of which it is forced through the tricuspid orifice into the right ventricle, from thence it is thrown through the Pulmonary artery,

into the Lungs to be oxygenated or again prepared for the system after which it is collected and conveyed by four pulmonary veins to the left auricle of the heart. thence it passes through the mitral orifice into the left ventricle and by the powerful action of this ventricle is driven through the aorta and its subdivisions throughout the system, to resume the same route successively until death puts an end to the process.

The circulation is chiefly dependent on the Rhythmic action of the heart which organ possesses in an eminent degree the properties of contractility and irritability by which it is easily excited to contraction and relaxation.

This peculiar property belongs to the heart alone and seems to be independent of external and internal stimuli for it has been seen to contract after the connections with the nervous system

had been cut assunder. Neither is this property due to the blood for it is known to continue when emptied of that fluid. Nor yet to atmospheric air for the heart is still found to contract even in a vacuum. The cause of the hearts action then being independent of these various Stimuli it is supposed by some Physiologists to be resident in the heart itself. The exciting cause being as so veiled in obscurity.

Bringing to view the heart of one of the higher animals its two ventricles are seen to contract at the same time, also its auricles, but the contractions of the auricles are not simultaneous with that of the ventricles. Relaxation and dilatation succeed the contractions of the hearts cavities. The auricles have not the propelling power of the ventricles, but act more as receivers of blood. The successive contractions of the left ventricle

sending wave after wave of blood through the ar-
 terial system give rise to the pulse which is
 nothing more than these waves acting on the
 elastic walls of the arteries.

The dilatation of the heart coincides with the
 collapse feet in the arteries. When the blood pas-
 ses from the auricles into the ventricles it is
 prevented from returning by valves which gua-
 rd the auriculo ventricular openings. These
 valves are made to close the passages by the
 action of the ventricles

Thus it is with the ventricles when they begin
 to dilate. the blood is prevented from passing
 back into them by the action of the semilun-
 ar valves placed at the mouths of the
 aorta and pulmonary artery. The ventricular
 dilatation may be divided into two stages.

The first stage is recognized by the hearts

recession from the walls of the chest and it begins immediately after the hearts systole.

The second stage is attended with enlargement of the heart in all directions, and it occurs simultaneously with the auricular contraction.

An interval of repose takes place between these stages of dilatation. The impulse of the heart is caused by its fibres beginning at the base and running in a spiral direction terminating at its apex, so that when contraction takes place the base being fixed its apex is tilted up against the chest in the region of the fifth or sixth rib. At each beat of the heart two sounds are heard following each other in quick succession. These sounds are succeeded by a short repose after which they recur and are again followed by repose. If the time from the beginning of one pulsation to the beginning

of the next be divided into four periods the first sound will be found to occupy the two first periods.

The second sound the third, and fourth period will occupy an interval of repose. The heart's impulse and the systole of the ventricles coincide with the first sound whilst the second sound corresponds with the diastole of the ventricles.

These sounds differ in character, the first being dull and prolonged, the second short and acute. The principal causes of the first sound are found, first in the muscular contractions of the heart, second the passage of blood over the rough internal surfaces of the ventricles third the rush of blood through the narrow orifices of the aorta and pulmonary arteries, fourth and last, the impulse of the heart against the chest.

The cause of the second sound is much plainer than that of the former, and is produced by the

sudden closure of the semilunar valves in the first stage of ventricular dilatation.

The different Cavities of the heart vary slightly in capacity, as do all their walls in thickness.

The right auricle and ventricle being more capacious than the left yet the latter have thicker walls and greater strength which are requisite for driving the blood throughout the system.

Each cavity will contain about two fluid ounces but the ventricles do not discharge quite that amount. The whole amount of blood in the human system is reckoned at about twenty eight pounds to every one hundred and forty.

This amount passes through the heart once in four minutes and through the system about eighteen times an hour. The force with which the heart propels the blood has been variously estimated. Some Physiologists make

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it to equal four pounds six ounces whilst others
compute it at four pounds three ounces or equal to
a column of blood seven and a half feet in height.

The heart of a healthy adult is found to contract abo
ut seventy five times during a minute.. its actions
gradually growing slower, from the beginning to the
end of life.. During a short period after birth this
action ranges from one hundred and forty to one
hundred and thirty beats in a minute and decreasing
as life advances, it ranges in old age from sixty
five to fifty.

As before stated by the contraction of the left ventri
cle the blood is distributed throughout the system
with the exception of the lungs passing from the
arteries through the capillaries into the veins.

In the two latter systems the pulse is lost.

In the proximal arteries the pulse is synchronous
with the hearts beat but in the distal they are somewhat later

The arteries are composed of three coats, an external middle and internal or serous. The external is cellular. The middle is muscular, and the internal as before mentioned serous. The muscular coat possesses the properties of elasticity and contractility by which the interrupted force of the heart is equalized and the quantity of blood to particular organs judiciously regulated. All of the smaller arteries before they become capillaries intermingle and anastomose with each other. The object of which is to supply blood to any part which may have been deprived of it by the compression and obliteration of the vessel leading thereto.

All the arteries and veins in parts not disconnected are united by the capillaries which convey the blood from the minute branches of the arteries to the minute veins. The inter spaces of these minute invisible vessels are filled up by the true substance

of the tissues, The Capillaries measure from the one thousandth to the five thousandths of an inch in diameter, and there are but few if any elementary tissues so small as these vessels are,

Accurate research seems not only to have demonstrated the existence of membranous walls in the capillaries but also a coat with circular fibres as in the arteries.

The Capillary circulation is not entirely dependent on the hearts action, since it is seen to exist in the embryo prior to the formation of the heart,, and it has also been observed in cold blooded animals after their hearts had been taken out.

The arterial and capillary systems having been described, it now remains to speak of the venus system

The veins begin by small trunks which are formed by the union of capillaries, and they convey the blood back to the heart from whence the arteries

brought it. These vessels like arteries have three coats with similar properties, but they are not so fully developed.

The internal serous coat unlike that found in the arteries is gathered into folds called valves which prevent the reflux of blood when these vessels are being pressed upon.

The venous capacity is much greater than that of the arterial, hence its blood flows much slower and more quietly and continuedly. Consequently there is no pulse in the veins as in the arteries whose blood flows in jets or waves.

The venous circulation is chiefly due to the heart's force from behind, and to muscular pressure, it is also assisted by the heart's suction power from before, and by the formation of a partial vacuum caused by the descent of the diaphragm.

The venous blood is charged with carbonaceous

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Materials gathered by the capillaries from the
wasting tissues.

When the venous blood is brought to the Lungs this
deleterious matter or refuse of the system is ex-
changed or neutralized by oxygen which is taken
into the Lungs in the act of inspiration

The Oxygen thus taken in. Coming into close
proximity with the blood purifies and renovates
it, thereby preparing it for the uses of the sys-
tem without which there could be no vitality.