

I shall now speak of Muscular structure and divide what I am to say upon it into six parts. 1st the particular evidence of Muscular structure. 2^d by their being actually irritable. 3^d by in case I should not be clear, to consider what presumptions arise, from phenomena in the living body. 4th whether the power of the heart is alone sufficient to carry the fluids thro' all the vessels. 5th whether there are not diseases shewing the power of the heart to be ineffectual. 6th the presumption lies in favour of Muscular structure, which is neither for strength nor cohesion. Haller has added that in a variety of experiments there is no irritability in the vessels. Of the two kinds of experiments, to wit the mechanical and chemical, this last can not hold because they act much in the same manner on dead, as on living bodies. Therefore from the application of me-

chanics, are we, to conclude, and Haller and his pupils do conclude from them. But many negatives have not the weight of one affirmative experiment, but it is against all the rules of Logic to draw a general negative from a particular one. Newton made a particular experiment ~~that~~ ^{the} colour into distinct maps of different forms and no mathematician in Europe could imitate the Experiment, till he confirmed N.

While all the rest of Europe refused the fact, yet the negative does at present, and did prevail. Hallers negative experiment however is not to be rested upon. It is difficult to make the experiment on living animals and it would be too much to conclude from experiments on dead; but Haller was deceived by making his experiments after the action of the heart had ceased. W. Ferrius in his Dissertation (see Exper: 8 & 7) produces

136 seemingly very clear and circumstantial
Experiments made before a number of his
friends and some of the most ingenious
professors in Holland, and therefore we must
admit them as a decisive proof of the Inten-
sibility of Asthenia. But further it will be
proper to shew that the Phenomena of the
living body strongly confirm it. The first
principal argument ^{is} drawn from Inflammation: while the Action of the heart remains
the same, the redness and tumor in the part
inflamed, are sufficient proof of an increased
impetus of the blood there. What does this
depend upon? many have long thought that
the obstruction of certain Vessels can produce
it. But take a portion of the body that trans-
mits a certain quantity of fluids, take away
the one half and the Vessels must be more
dilated, swell, and give the red appearance
and throbbing; but this is not sound, inasmuch

as one of two branches being stopped it does not
not follow that all the blood passes thro'
the other. The resistance goes back to the Heart
and is distributed to the rest of the Body. I said
that increase of the quantity of the Blood does
not occasion much harm as all our Vessels
are easily dilatable. But we know also in
fact that obstructions do happen without
Inflammation, so Haller proves that the
vessels carrying the obstructed Blood become
empty all together. But while obstruction
is unfit to account for Inflammation, it
will not when the obstructed part is small
and the Inflammation ^{very} great. In the case
of a thorn thrust under the nail, the In-
flammation often extends to the shoulder
itself. But this leads to another supposi-
tion, that the increased impetus is owing to
stimulus, and that Inflammation is exact-
ly in proportion to the sense of pain, and
therefore stimulus; but such a stimulus cannot

138 have place without Inflammation. There is an adoping, the sensibility of our organs to particulars, and therefore as there is a stimulus in the part and the heart not moved, we must conclude in favour of Irritability. I shall add this may be when their obstruction takes place or not. —

When a coldness and tremor occurs in one Arm or in one leg it is generally followed by considerable heat in the part. This often happens when the heart is not affected, and this is a certain proof of constriction and obstruction. Every other instance of topical ^{affection} is almost a proof of the same thing. When Eruptions happen in the face only we may suspect a particular Disease, but if we find the Arteries of the face are more dilatable, and in so far as the face variously expresses the sentiments of the mind, while the Breast is not affected, these give a proof of irritability. Also Eruption

which I have seen occupy the whole of 139 a limb, or half of the body, as if a line was drawn from the top of the forehead to the extremities, is owing to ~~the~~^a change in the state of irritable fibres. It has been thought that there are palsies which affect particular parts of the Arterial system, it often, when it affects the motion does not disturb the heat or sensibility of the parts. There can be paralytic cases where the vascular system is not affected, but the coats of the Arteries are not affected in the Palsy. I saw a case, where there was loss of motion in one arm, the state of the pulse and warmth remaining in their proper degree while the other was cold, had no pulses, the motion ^{being} entire. Both affections were in some measure transitory, in the space of an hour or two, the heat, colour and Pulse returned, but the same Phenomena of ^{the} ~~the~~ occurred during the life of the gentleman.

120 You can not suppose this sudden coming
and going of the Affection without a peculiar
Irritability of the Vessels. A Palsy
frequently affects one side of the Body and
often by a very sensible Difference between
the sound and diseased Arm. One other
circumstance attends Palsy viz: an Atony
which is most frequent; it is in consequence
of this that the Arterial blood is not dis-
tributed in its usual force and quantity.
It may be said that the Nerves are obstruc-
ted from want of being nourished. Now there
is not only a diminution of the cellular
membrane, but there is also a smaller &
soaker pulse

Lect. XXVI Dec. 16th

Haller in P. XXXII. gives the whole of what
he says upon this Subject. I have shown
that Hallers negative Experiments give no
conclusion. I have rested a great deal upon
the contrary experiments of Mr. Forshuet

but the presumptive proofs of irritability
make very much for it. So I mention
and Inflammation as a proof that the Ac-
tion of the Heart is not increased. I look
not of, topical fevers where the hearts
action is not principally or proportionally
increased. To these may be added Hemor-
rhages which also blushing.
Laquei Nervosi surrounding irritable sphin-
cters and vessels. are quite hypothetical.
on the other hand the examples of Palsy
as examples of an ^{atonia} in the state of the ves-
sels. I mentioned the atrophy here as depend-
ing upon a weaker action of the Vessels. In
the case of Gangrenes, there is a very strong
presumption of Atonia in the Vessels of the
part, the dry Gangrene Nervosa as Sauvages
calls it, where heat, pulse, Motion and sense
are all taken away. There may in some cases
be a putrid ferment or stagnation but not here

152 where there is neither tumor, relaxation nor
flaccidity. It must be in the solid parts.

Gangrenes brought on by cold also if we
are right that cold brings upon the
Nerves even the common case

of gangrenes, where the fluids are greatly
affected, yet these affections spread farther
in the solid. There is a case by D. White
of Aphrodisy in a child where after, for
some days the Pulse had been strong and
full, it became weak in the extremities.

I can not say that this is quite conclusive
as even fullness of the Pulse in some cases
may arise from the Vessels being over-
full. A set of Arguments to be taken in
favour of are, ^{that} Stimuli applied to the fluids
have been reckoned an argument. But the
excretories are irritable, which irritability
may propel the fluids thro' the follicles
connected with them. There is no reason

to suppose that various irritations of the Nerves 153

in general does increase secretion, and by
actuating the whole vessels of the gland:
but it is impossible to say which is the
irritable portion, where it ceases, and the
elastic begins. But I would conclude that
all stimuli and irritations exciting excre-
tions, are owing to the irritable force of the
Arteries. As we see in the case of perspira-
tion, every increased force of the Circulation
should increase that of all the excretions,
but this is not the case. I must conclude that
there is less irritable principle in the large
than the smaller vessels. To finish this
subject there is a reference made to the
Anatomical Nuclei, "That lying in con-
nection with the nerves interrupted the secre-
tion of that part" but I find no such
thing. He adds that the nerves must nec-
essarily concur here but there is no particu-
lar experiment. Now I think from the above

144 If there is not a demonstration there is a strong presumption of the irritability of Arteries. I marked out as the fourth head whether the heart was more or less sufficient for the purposes of Circulation. But I am not to enter here upon all the perplexing discussions of the Patromathematici, because however much they are adorned with the parade of Calculus they are every where Hypothetical. So Senac every where magnifies the motion ascribed to the blood, and vilifies the power of the heart, but in a declamatory manner and made no proper estimate. On the other hand, to avoid the osculation of the small Arteries and so avoid the opinion of D^r White is at much pains to take off the assistance to the heart. Others have assumed a certain power of the heart, and said from that what it must be in a Capillary Vessel; but this too, as it depends upon assuming a certain power of the heart is erroneous. Hales takes it for

low. for the heart in his experiment not only 155 sustains a certain column, but is able to promote it thro all parts of the system. Others, as Haller suppose the heart is equal alone to move the fluids of the body, and that against considerable resistance, which must be a very great force. But that it is so does not appear, as says he when a person falls into a syncope or has been drowned all motion of the heart ceases, and the heart set into motion again moves the whole; but many and repeated contractions of the heart are necessary and that is constantly adding a new momentum. Now Hales's experiments make this applicable to the heart, where he shows that the blood rises to 150 inches, and but a small way at each systole. You will also more plainly perceive the motion of the heart when there is none in the Arteries which is gradually added. In Swinhoeck, apud Van Swieten mention is made of a Bat sleeping and all

1556 its vessels at rest, where by heat at first the action of the heart is restored, oscillations are then perceived in the vessels, and at length the fluids are broke down and the circulation entirely restored. This has disturbed all the Physiologists. But this is only repeated pulsation, which appears to me to be such as takes down the force of a single contraction even lower and renders, perhaps, ^{fields} ~~fields~~ contraction not improbable, and the force to balance the resistance may be sufficient. But as we can not estimate the resistance we can not ascertain this balance.

He says in the Paragraphs mentioned before that the Power that overcomes them is very great; very true: but it is a petitio principii in placing that power in the heart. A very eminent Physiologist has observed the objections just now mentioned. Borrelli has calculated the Resistances to the heart to be 180000. By Stahle it cannot be more than 60. nay it is not equal to the third of that.

But false Calculs are so much employed here that there seems to be no conclusion. The heart at each contraction throws out a certain quantity of blood: suppose $\frac{3}{4}$ the time twice seconds. You can find out that such is the velocity of the blood; this velocity must be retarded by the dilatation of the vessels, and you will find the Motion so prodigiously diminished by the time it reaches the small vessels that it cannot be supposed sufficient to answer the purposes of the Circulation in these parts.

Lect. XXVII. Jul. 17th —

The only important question to a Physician is whether the Circulation is carried on by the Elasticity of the Arteries or Power of the Heart. You will observe I have endeavoured to avoid prejudice in the affair. I mentioned an Argument taken from the Velocity of the Blood, and at the same time a certain proportion of the Arteries. But this however is fairly taken proceeds upon a petitio principii

148 for if you say that the Arteries alone propel the blood,
I imagine that the repeated pulsation of the Heart
increases the course of the blood; and another phi-
losophic principle is that the Heart alone performs
this. What was the Action of the Arteries but
say some, it must be greatly less than the force
of the Heart; but I am persuaded this, which is
a pretty universal opinion, is very far wrong. For
let the motion of the blood during the diastole be
more or less increased, as you please, if the Heart be
a power of percussion, it must accelerate the motion,
therefore I conclude that the Arguments drawn from
the velocity of the blood are inconclusive; and I add
farther, that the fact of the great diminution of the
velocity of the blood is false. But if we take Haller's
own Calculation, we find him right in allowing
that the velocity is greater, vastly than it should be.
If, if I even take Keil's, that will not hold since
we perceive the blood issuing from a small woun-
ded Artery, to be much greater than that Calculation
allows, and even the microscope ^{shows} allows the velocity to be
actually much greater than agrees with any of the Calcula-
tions the you should allow for Description on this way.
Therefore I would say that the blood receives additional

force from repeated pulsations of the Heart and still less
more from the Action of the Arteries. The instan-
ces of Resistance are considerable, the Action takes
place against the contracted force of the Arteries, ~~as~~
against gravity, and considerable external Resistances.
The foot vibrates when one leg is laid over the other,
and by this means you may count the Pulsations of
the Heart. You may hang a weight as great as the
man, on his foot you hang it can bear and you
will still perceive the Pulsation. But this is no more
than a power of percussion; and no pressing power as
Dr. White without proof alleges; and all the Pheno-
mena of the apparent strength of the Heart may be ex-
plained in ^{the same} way. I must observe that the Doctrine
of the Action of the Arteries, from the Heart being
unable without it to propel the blood, is still not
inserted. If the Circulation, as some, says, is carried
on in the diseased state of the Heart, it is a great
Argument for the power of Arteries. We find the
Heart corroded, phaged, affected with mortifica-
tions and abscesses, but what is also against that
reasoning is, that it is not many of these explained
what part of the Heart is affected, whether its mus-
cular part or not. There may be erosions, Ulcers
in the Heart and its muscular part interior; and
where the Muscular Structure has been affected, nobody

180 has said how far the Circulation went on. I am certain that in the state of the Heart described by us, the Circulation could not go on: and therefore this general declamation of his does not apply. It not only proves that the Heart does little, but in many cases does nothing at all; which is too much. In some cases the Ballance of power may be for the Heart, in others, for the Arteries; but there is no conception of the Arteries acting independent of the Heart, when the only Stimulus is received from the Heart. Senae by proving too much proves nothing at all. Some Animals have been mentioned to have existed without Hearts, I find Van Susteren enters into this subject where he treats of wounds in the Heart. Vol. 1. P. 258. He mentions accounts given of many Animals without Hearts, and discusses the matter with this general Conclusion, that the inaccuracy of the Anatomist occasions the opinion of want of Heart in many Animals. He mentions an Edinburgh Rat, taken from our Medical transactions, but still there was an Aneurism in it, which performed the office of the Heart; Susteren concludes, it is not to be admitted that ever there was an Animal of any Rank that could exist without the Heart, or something Analogous to it. There is one other particular which belongs to this subject; the Action of the Arteries

in a diseased state; In which case, those who deny 181 the power of the Heart say the Circulation nevertheless goes on, and they too refer to our Philosophical Transactions, where in a mortification of one leg there was found an organization of the Vessels; there is another given by Gershoer who was present at the amputation of a limb from which no blood flowed, the Patient died, and being opened it was found that the large Artery above the Amputated place was organized, and only for a small way. Also in the same Dissertation an instance is taken from Pampheer of an Amputated incurant; in this case too the Patient died and they found that the Vessels above the Amputated place were organized in a flawed state, that it was thought the Aneurism extended to the Vessels there; but the many organizations of Arteries where the Circulation went on. leads us to lay no stress upon these examples, A partial organization will not imply want of power in the Arteries. A firm sized Tube has been inserted into them, and the Circulation still went on a pulsation being found in the Arteries beyond the Tube. Various Anatomical Dissections are only partial; very rarely entirely circular, and we farther know that in Arteries, Organizations do not occur in the muscular coat. Upon the whole I shall observe that from the Action of the Heart and Arteries nothing very clear is obtained; The irritability of Arteries is established by Gershoer, and the presumption

132 proofs for it are very strong. The Arteries in their contraction may exert a considerably greater force than was lost by the contraction of the Breast and that therefore this power is to be considered as an auxiliary one. What I have been speaking of is chiefly applicable to the larger Arteries. But it may still remain a question what is the base beyond these. An ingenious Physiologist supposes, beyond the portion of beating Arteries, there is a peculiar oscillatory motion propelling the fluids thro' the smaller ones; of these we shall speak at our next meeting.

Lect. XXVIII Decr 18th

The Pulse which occurs in almost all the Arteries, the nature and cause of which I might suppose understood, is explained by Haller in P. CLVIII. The Arteries of a living Body are constantly full; and if an additional quantity is thrown into them by the Heart room must be made for it either by the Dilatation of the Arteries or by the increased Velocity of the Viscous blood. The increased velocity can not take place, because the resistances we spoke of, in what ever Degree they take place, retard the motion of the Blood towards the extremities, therefore the surplus must be provided for by additional auxiliary power in the Arteries. As our judge of the state of the Circulation, and the Power by which it is performed, the Pulse would require a very full consideration. But as it is not to be understood with-

out a previous knowledge of the power employed in 133 promoting the Circulation, and particularly that of respiration, we must postpone the consideration of it till then. The impetus of the Blood increases as it advances from the Heart, and the difference between the anterior and consequent waves, is constantly decreasing; there may then be haste of Arteries without it. It is not determined where it ceases, either by our Eyes or the assistance of Glases, because the pulse disappears in small Arteries, the difference of the Velocity of the Blood has been ascribed to that Physiologists have said that the power of the Heart extended so far, and no further, and have supposed, as Dr. White that there is a peculiar irritability in the small Vessels, he supposes the Humours propelled by a vermicular or oscillatory motion.

In the first place, constant inter omnes that this motion takes place in small Vessels, where there can be no visible proof; and therefore, first the negative experiments so industriously adduced by Haller and his pupils, can not have any effect. Senonchese does observe in several portions of the system no retardation nor alternate subsiding, but that the whole moves on in a stream as if thro' inelastic canals, which is Haller's expression. Haller has been at much pains to show that his observations confirm this, particularly in the cold Animals that the blood moves as