 besides even he, has nowhere taken notice
of the Flexibility or dilatability of Arteries.
Savages speaking of the Dilatability of Arteries
observes with what Weights they are extended, &
with what they are Broke. yet you will find
these not to be in proportion. Within the Bounds
of a force that does not dilate them and does
not Break them ×

Thirdly we are to speak
of the Figure or form of the Arteries; you
consider that in a transverse Section, they are every
where Circular, in opposition to Asclepiades and
Des Cartes, who suppos'd Vessels of different shapes
and adapted to matters of different Figures; I say
they must all assume a Circular Shape. Haller is too minute in hinting that Dr. Pitcairns
circular section might not perhaps always
happen, to be sure if there be a Bony band
we must expect a difference in this Respect.
A transverse section of the longitudinal sinus
of the Brain, has accordingly, a triangular Shape

but that is singular and no where else the case.
We think Arteries are cylindrical. Former Phylosophers, thought it answer'd their purpose
to make them of a Conical Figure, but in
that it makes no odds whether they be so
or not. Anatomists have now agreed pretty
universally to their being Cylindrical, and the
same purposes in Physiology equally arise from
either Figure. Haller is not very clear on this
head. Betwixt any two Branches they are undoubtedly Cylindrical. You may consider them
as a Cone in the Decresence of all their Branches. Haller says §. XXVI. "Ubi vero arteriæ aliquamdiu sine majoribus Ramis sunt, parum
evidenter convergunt, aut omnino nihil quidquam, deinde cylindricæ sunt, vel lentissime diminutæ, ubi capillares vocant, & quocunque ubi
globo patent." You se a sort of hesitation he
is in, in determining this part. But instead
of considering the Arteries as Conical, there is
more application in considering them as an
inversed Cone. In any ramification the capacity
of any two Branches always exceeds that of their

 Trunk; at the same time there are particular exceptions, and the arteries are sometimes manifestly dilated "est ubi dilatari videntur," and always so before they are divided into Branches." paulum latescit. P. XXXVI.

We must now consider the Proportion; as it is constantly varying, I think the particular Proportion is not, even in a gross way, tolerably settled. It is universally agreed to what is asserted in the present P. "Ramorum duorum junctim sumpta Lumina semper majora sunt Trunci Lumine" but that it is so exactly in the proportion of one and a half as Haller thinks, is not so certain. You may consult the Elementa and will find that no two of the measures employd, agree, and I beg you to be aware of rashly giving credit to any of them. There is a doubt if Injection fills them in the same proportion as the Action of the Heart. But supposing this as the Arteries are dilated at their Ramifications, and as these last are frequently a

small variation in the measuring will give
a very difficult Result in the whole Calculation, when you take Numbers that are often to be squared. I shall speak more fully of this in determining how the Velocity of the Blood is affected by it, and shall after have occasion to say what are the Errors of Dr. Martins Measures. When a very moderate velocity of the Bloods Motion is required, we see that the Cavity must be greater; Haller adds "that in the Capilary Arteries the contrary takes place." I can not conceive how he finds out that he takes his observations from the assistance of the Microscope. But if the extreme Arteries are perfectly or nearly cylindrical, every Branch as it is to be united with the preceding Trunk, and to be compard with the ~~Trunk~~ cone from whence that Branch arose it must constantly be greater. I allidge as a matter of demonstration, that it can not be contradicted by Microscopes, therefore it must still be concluded

 that the Size of the Branches is greater than that of their common Trunk. Fourthly with regard to the Course of the Arteries, it is scarce any where in a straight line, but frequently & constantly winding. The Ramifications are also frequent, & the Flexions more numerous where the Ramifications take place. Further the Ramifications are sent off from their respective Trunks at various Angles, most at an acute, few at a right one. none go off at the first at an obtuse Angle tho' their after-Flexion sometimes becomes very obtuse. The larger branches then very generally go off at the smallest angles, and it is only the smaller that go off at right, or nearly at right angles, When two Branches have proceeded from their respective Trunks, there is commonly a Communication, which makes the Anastomoses of Branches, and is most frequent in the small Arteries, and so much so that the destinction of Trunks & Branch among them is extremely difficult. Anastomoses seldom

or never take place in the larger Arteries.
P. XXXVII. "Fines Arteriarum cylindrici aut cylindricis — — — Anastomose fault." Haller says that in all the Membranes that a Network takes place; this is an Idea that he particularly inculcates, and proceeds to the Application in the same Paragraph. But this which is the common state in the Membranes of the Body is not so in the Viscera, and therefore you should compare this with P. XXXX. The Arteries of the Body are very generally double, as Haller observes P. XXXVIII. The Aorta decendens gives out Arteries to either side, which supply Blood to their respective sides only. The question is how far the Arteries of the one side pass over to the other; there are Phenomina affecting one side more than the other that give occasion to this Question. I may say that the Arteries do not pass over from one side to the other, for in Injection one half has been found injected while

100 the other is not much touched. There remains in the course of the Arteries their Universality to be enquired into. Haller in P. XXXV. Arterias Natura tela corpori animali dedit, paucis Membranis exceptis, inquibus nondum sunt odorosa. If that is true there are many parts of the body which our Injections do not reach; and tho' there are not red Arteries seen, yet certain it is that every the smallest part of the Body carries Fluids from the Heart, and therefore no part of the Body is without arteries of some kind or other.

Lect: XX. Dec. 5th

Sixthly, the various Terminations of Arteries is to be spoke of P. XXXIX. and following.

The first is into a Vein in a refluid Situation, or a Branch of an extreme Artery is by an Anastomosis inserted into a Vein already formed thereof. There is another Termination where they pour red Blood either into cellular substance or Cavity as in the

Corpora cavernosa Penis, Clitoridis &c. But 101 as in the Uterus an artery does not terminate in a cavity unless it pours red Blood. Further when these Arteries are branched off into Vessels that carry pellucid Fluids, these Branches have been called ~~have been called~~ sinus lymphatics. But as we are uncertain of a Foundation for a distinction, 'tis better with Haller to call them "Vasa minorum generum".

A fourth Termination is in common to red Arteries and those of minorum Generum, which carry Fluids different from the common Mass, but carry Fluids somewhat different from both of these and are called Organs of Excretion. But between the Arteries and Excretories are the Secretories; this fourth Termination therefore I would call into secretory Vessels, which again will admit of various subdivision, as they pour out Vapour into the various Cavities of the Body or to the Surface of it, But whether this is in the form of Vapour or Liquid relates Com-

102 other Subject. The whole Termination of Arteries may be reduced to these four Heads, the last admiting indeed, of various Subdivisions In P. XXXIV. & XXXV. he answers in the Affirmative, and does not doubt but that Arteries have the third kind of Termination into Vessels of pellucid fluids, and carry fluids thinner than the common Mass. It is not necessary to determine any Figure, but that these are very universally Vessels of the second order, is not to be doubted. Martin has calculated the size of Blood-globules of the first order, but we now question even the Division into the second order. Haller observes that Anatomists & Physiologists are willing to indulge themselves, in supposing that the Division goes to a great Degree of subtility. But in P. LXV. he denies very properly that they go all the Lengths they have been imagined. When we can perceive the red globules, and Wax pressed into Vessels that are ultimate, the secretory & excretory, there is reason to believe that there is no intermediate series

of Vessels. In some the division may go to 103
a second order, in some perhaps to a third, fourth or fifth. Haller has in View the Error Loci of Boerhaave, which will be spoke of in another place.

Veins

The substance of the Veins is remarkably thinner than that of the Arteries, and not so easily divided into layers, or Coats. In most or all of them, at a little distance from the rise are no seperate Layers. In the Veins which terminate in the heart there is evidently a more muscular structure than in the muscular Coats of the Arteries, hence that Portion has been calld the sinus Venosus, & supra Cor — — circumponuntur. Under this thinness & seeming laxity their Muscular coats are more aparent than those of the Arteries. — firmiores, they are too, firmer in Proportion as they recede from the Heart; but in certain Veins, a superior firmness to that of the Arteries does not appear. Facilius — — rumpuntur. Doubt

that we can safely conclude from the morbosa Experimenta; this may be, and I believe there are certain circumstances that dispose them to be speciallarly affected. As to their comparative strength, Varices are more common in the smaller Veins toward the Extremities. It is not but that the proportional strength of Arteries and Veins is as said, but the force will be exerted in the beginnings of Veins and Arteries that tend to rupture. We find the Arteries constantly increasing in density and strength while the Veins continue in their original state and thus perhaps gives occasion to some difference, in the Equilibrium of their Action. But the Experiments on Arteries and Veins are still too few, and donot distinguish betwext flexibility and force of Cohesion. If this were examind we should find the Veins have a superior force of Cohesion with their superior flexibility. The figure

of Veins are much more dilatable than their Veins of the same size. Now what was said with regard to the circular section, general figure &c of Arteries may all be applied to the Veins, but you will remember that I talk of them in repleto canale. Their size is much larger than that of Arteries and their number also greater. The course of the Veins in general is less flexible and winding, and their branches more commonly go off at right angles than those of the Arteries; Anastomoses are also much more frequent in the larger Veins than the large arteries, & their communications on opposite sides much more considerable. The consideration of Valves I leave to Anatomy. There now only remains their various origin to be spoke of; it is of three kinds. First from red Veins Arteries in the two ways mentiond. Secondly from the Vasa minorum generum. and thirdly from Absorbent Vessels; of this there is no doubt.

As to the most considerable absorbents which terminate in the lymphatic Vessels, I need say nothing; nor need I point out how far Baltimore is behind us in this respect as in N.L. —

You know that they do not terminate in the Veins, but take another course by the lymphatics. But it is probable that our late inventors of Lymphatic absorbents, have pushed the matter too far in denying Absorbents of any other kind. It might be expected that I should take notice of the bowels of the Breast especially those of the Abdominal Viscera; but this I refer to the Circulation. —

Lymphatics

That these arise from Absorbents is sufficiently explained; to be referred to the circulation likewise; The

Heart —

itself now only remains, to be spoke of; with regard to it there is room for a great deal of Anatomical discussion; but as it is purely Anatomical; its situation with regard to the Lungs, Diaphragm &c. I don't belong to us

concerning the Heart there is much and very minute Anatomy, and every part of it is usefull in the Pathology. But I shall pass every thing that is not necessary. The Heart is a hollow Viscus, consisting of four Spindazes called its auricles, and ventricles which communicate with each other, beside which the Ventricles communicate with Arteries and the Auricles with Veins. There are valves also which admit the blood from the veins to the auricles & others, which allow it to pass from the auricles to the Ventricles, and others which give it passage from the Ventricules, to the Arteries, but they obstruct its passage in the contrary way. The two Ventricules are applid to each other, tho seperated by a muscular partition. Both Auricles and Ventricules, are surrounded by a Mass of muscular fibres. They in general so surround, the Ventricles and auricles, that they mechanicly diminish the

cavity within, and with the appearance of an equal internal surface; they diminish the cavity altogether, and lastly these fibres are fitted by evident Muscular structure, and they perhaps are endued with a peculiar irritability of which we shall speak hereafter.

Course of the Fluids

This is so inseparably connected with anatomy, that I should think it almost improper to give any description of it in this place, however, I shall do it very briefly. I have said there is a circle, but it is difficult to say where it begins; we shall first take the right Ventricule, which throwsits Blood into the Pulmonary Artery; by this it is distributed to every part of the Lungs, & is returned by the Pulmonary Veins to the left Auricle; from this it passes into the left ventricle, and then to the Aorta, by which it is distributed, to every part of the Body, but the Lungs; from the Extremities of the Aorta it passes into Veins, which run

together as they come towards the Heart and form the Vena cava; from this it is poured into the right Auricle, and by that into the right Ventricle, where we begun. The course thro' the Heart is shewed by the Valves, the disposition of which, admit of no other in sound Bodies. The course in the Arteries being from their beginnings to their extremities, is in some measure proved by their course from the Heart, and still more clearly by ligatures, unless where there are Anastomoses which are rare and uncommon. The same determination of the Arteries, and the same experiments of ligature equally prove, and an additional proof from valves limiting fluids to the Heart and not commonly backwards. Next that the Blood passes from Arteries into Veins is seen by Microscopes, and Injections, which frequently pass into the corresponding veins. The effects of wounds, the Hemorrhages that follow, from small vessels exhausting the whole System, and the transfusion of the blood of one animal

into the Vessels of another while in Life, and often without disturbing the Animal that received it. Another set of experiments, the opening of Vessels and infusing various Liquors, we observed the motion of the Blood. Galen in his large work has stretched his reasonings on this particular, too far, for he supposes the infused matter, to be brought to that part of the system where its effects appear; But it does not go so far, for by being carried to the Heart, brain &c. thro' the Nerves produce effects in parts which it does not properly reach. I shall now only add that I have discribed the course, and given the proofs of what is more ordinary; there are some Phenomina which would make it appear that the motion of the Blood is sometimes retrograde; but this is Localy topical, momentary, and morbid. As to the return of the venious Blood, its motion in the Heads, its being throwne out into the Corpora Cavernosa Penis, its being taken up by absorbents terminating in Lymphatics

and certain peculiarities appearing in the fœtus in utero, all these shall be taken notice of hereafter.

Lect: XXII December 10th.

Having described the ordinary course of the circulation, (which is performed in a continued circle as far as is sufficient here, I have only to add that the blood rests for some short time in the cavity of the Heart, that the motion is performed by Starts, and the order of these is this, the motion of the Auricles and Ventricles is synchronous, with respect to themselves and alternate with regard to each other, that is when the Ventricles are contracted the Auricles are relaxed, and vice versa. But some writers such as Lancisi and Dr. Nichols have observed a very different course in these Alternations, but they are rejected by every other Anatomist Experiments have confirmed that the contractions and relaxations of both the Ventricles are at one and the same time; further it is observed that the Contractions and relaxations are different in point of time, the systole being performed in half the

 time of the Diastole. It is so but whether it is so exact as that we can say the systole takes up one third of the time of the Diastole, and that it happens 60 times in a minute can not be so well ascertaind. I have spoke of the auricles and Ventricles as being considerd in the alternate interruptions and motions of the Blood, but the Sinus Venosi have also their share. It appears pretty plainly that the ~~same~~ Quantity of blood brought to the Heart must frequently stop in the Sinus venosi during the Hearts systole, It is possible that the auricle may contain the Blood, but it is more probable that part of it remains in the Sinus venosi, and therefore the blood is propelld into the Heart partly by the Auricle and partly by the Sinus Venosi. There are specialities regarding the Circulation, that will more properly be considered in another place. I shall speak of the Powers of the Heart and am here to enter into the Doctrines of the

mechanical Physicians; the Iatro-mathematicians as Haller calls them; Their Errors are the most innocent because they are the most easily corrected, and as mathematical Errors are only to be corrected by Mathematics, we must allow it its weight. If I should say that Hallers Experiments are wrong in the power of the heart, yet they have their use in shewing that Borelli was too high in his calculation, and Keil too low in his. No calculation can certainly be depended upon; we must have experiments and of these Halle[s] are the best as yet. In a living Animal he estimated, the Hearts force by the Hight to which its Blood arose. His experiment seems to apply very well; to compare the force of the Heart in a full grown Animal, and his estimate approaches the nearest. But Hallers Conclusion. P. CXXIII in giving the calculation of the Velocity of the Blood ishewing out of the Heart proves Hales's experi-