



The image shows the front cover of an antique book. The cover is decorated with marbled paper featuring a repeating pattern of overlapping, semi-circular shapes in shades of red, brown, and yellow, set against a light blue background. The paper shows signs of age, including wear, discoloration, and a vertical crease down the center. A small, dark, rectangular label is affixed to the bottom left corner, containing the number 1283. The book is bound in a dark brown, worn leather spine and corners.

1283

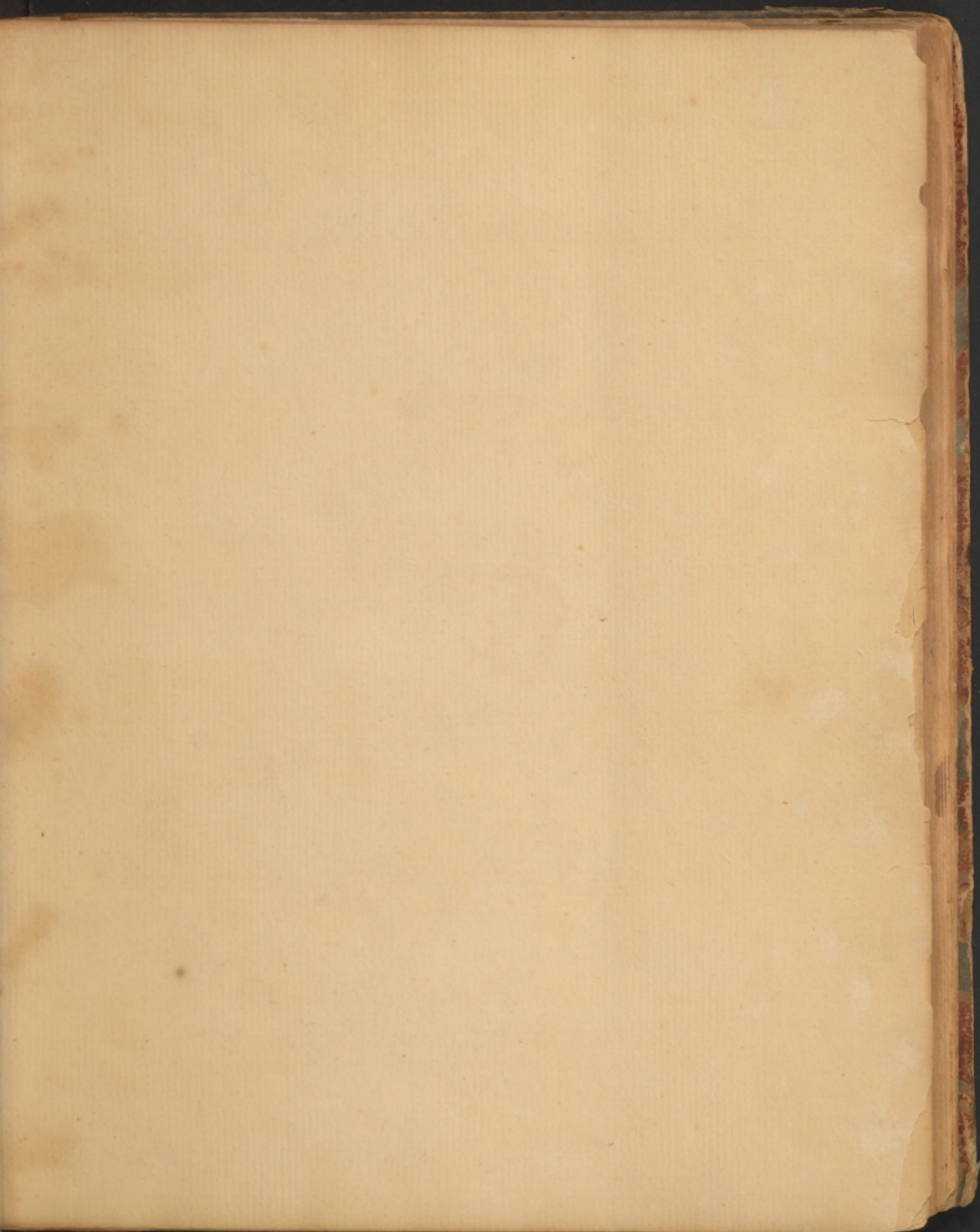
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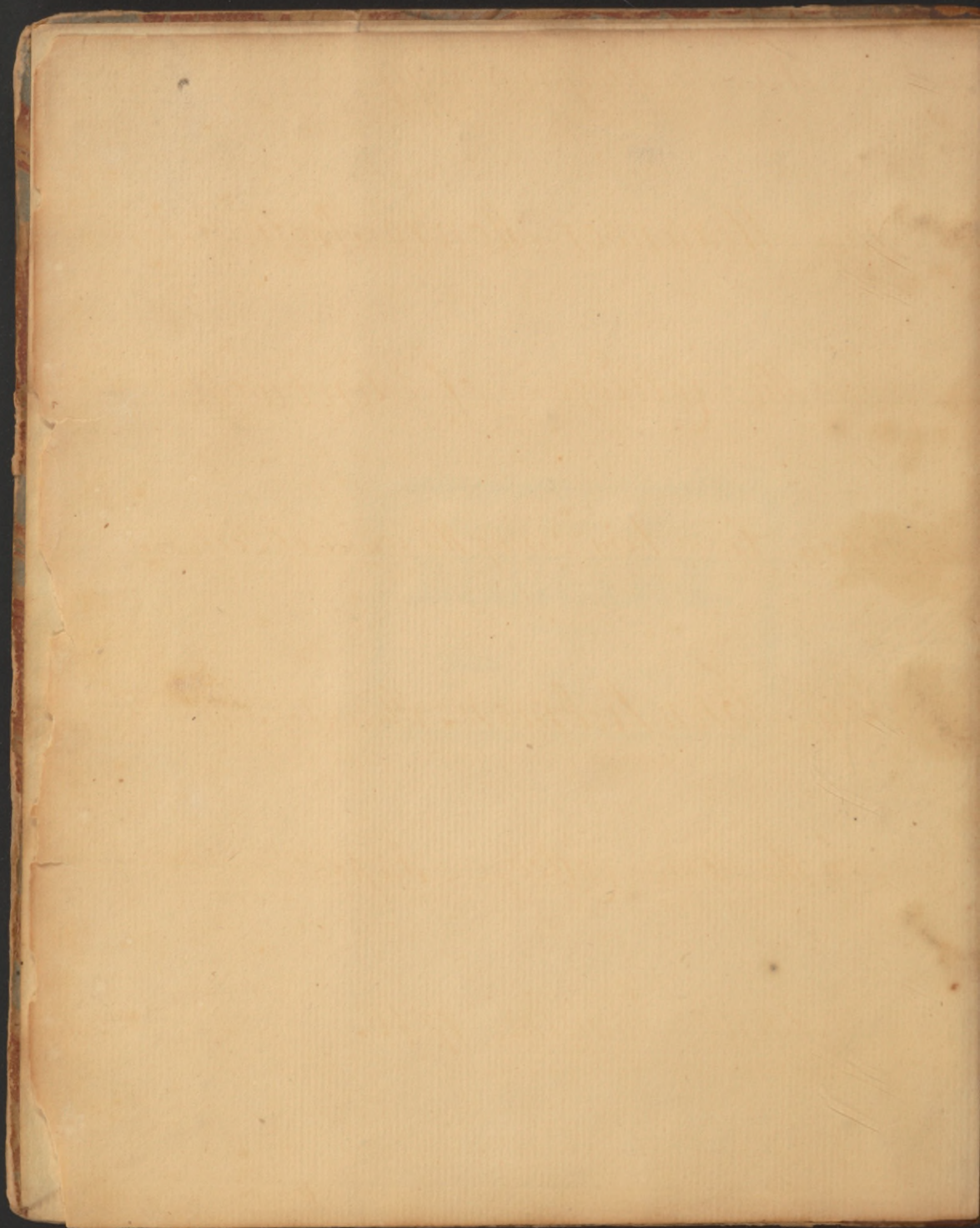
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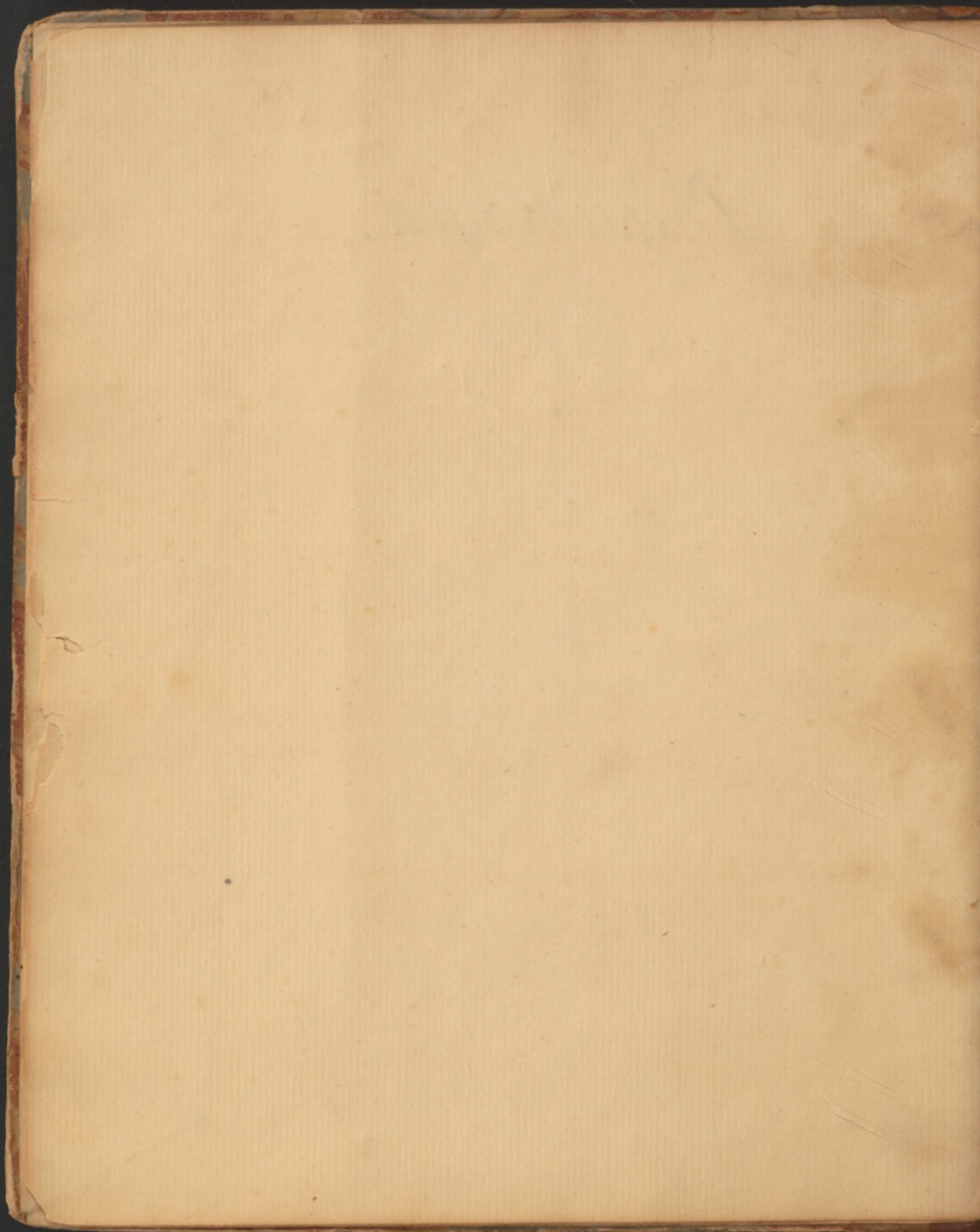
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Physiologia.



The Physiology

By Alexander Monro, Proff: of Anatomy

In the Colledge of Edinburgh

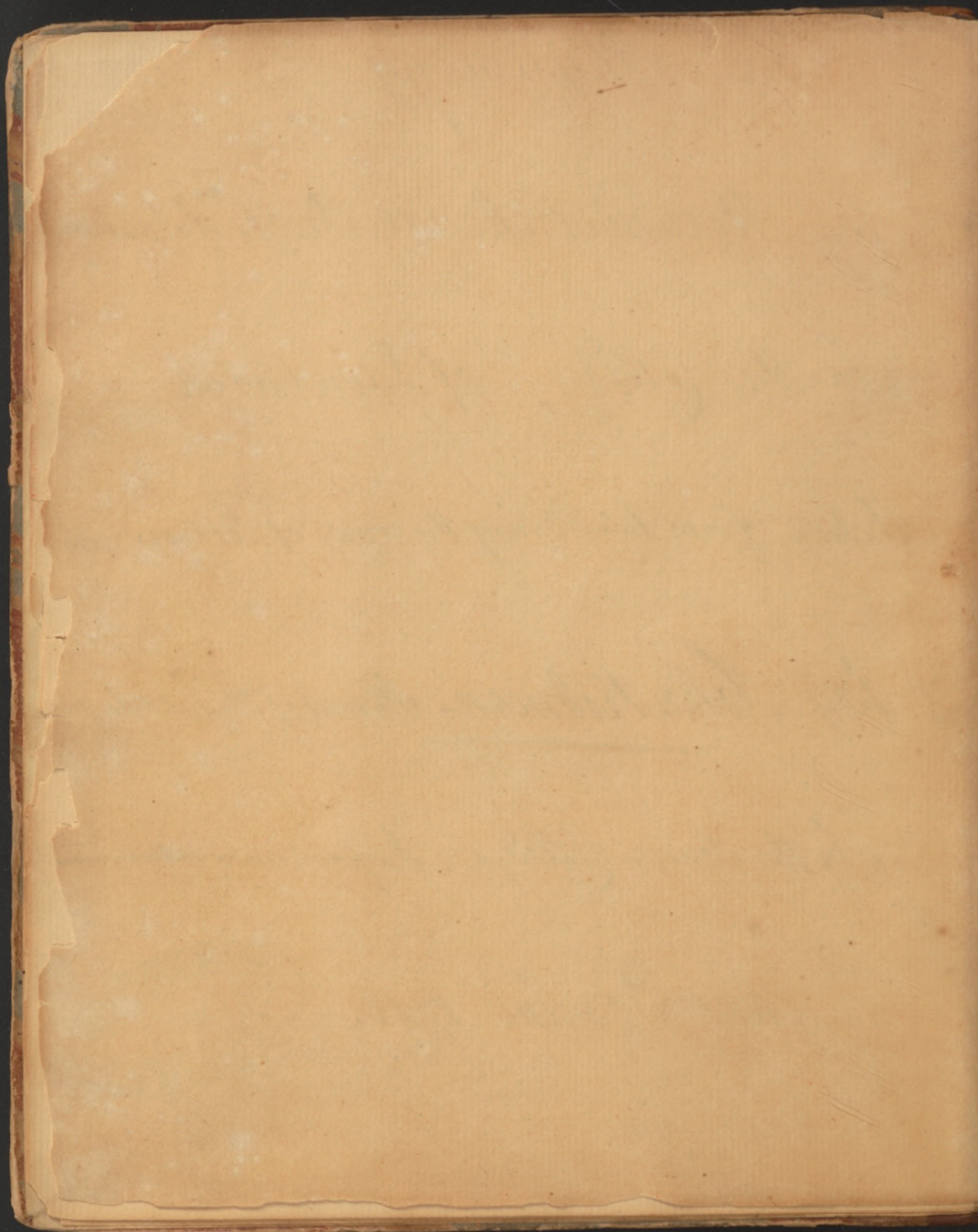
Taken from him during His course of Lectures

By John Redman Student of Physick & Surgery

In the same Colledge. In proprium usum

Anno Domini 1746.





Preface to the Physiology.

Gentlemen.

In giving you an Account of y^e functions of y^e Human Body, & the method by which they are performed, It is not to be expected that I should be very particular; since I only design it as an Introduction to those of you who have not yet attended y^e College of Theory, where these things are explained at a much greater length / And as a Remembrance to those who have attended it.

The method I follow is as near the great Dr. Boerhaave as possible; But as Two men seldom agree in every thing, so I must be leave to differ sometimes from him, and this is no more liberty than I would give to every body.

For the following Treatise I am to take it for granted that you understand the Structure & Situation of y^e parts, and in this short view of y^e Physiology, tho I will follow pretty much y^e same method which Dr Boerhaave has observed in his Institutions, I shall however vary a little, &c. I shall

2.
Preface to y^e Physiology.

I shall bring some things together which seem to be a little dissipated by him. I shall begin wth Tracing the Aliments from their reception into y^e mouth, to their being mixed with y^e blood &c. —

I had once occasion in y^e Comparative Anatomy, to take notice of y^e Different food of different Animals. In Examining that of man, we find the greatest part of it made up of y^e Vegetable kind, and from the Structure of his Teeth Stomach & Intestines, we may safely Infer that Vegetable food was designed for him. The use of flesh seems to have been introduced long after the world began, and to this Day some nations live mostly upon Vegetables. —

The first thing to be considered is Mastication.

Manducation.

For this Action the first thing required is that the mouth be opened, which is done not by the Digastric muscle alone as is generally thought, but by the Os Hyoides being kept firm by the Sternohyoides, Crico-hyoides, & y^e other muscles which serve to pull this bone down; and then the jaw is pulled down by the Genio-hyoidei, Mylohyoidei, Thyrohyoidei, Sternohyoidei, & with y^e assistance of that part of the Digastric muscle which is tied to this bone & y^e under jaw; The muscles of y^e Tongue viz. Hyoglossi, Genioglossi, &c assist much in this affair also; But this is more largely described in the first Vol. of y^e med. Essays Art. 4j. —

The mouth being opened the meat is received betwixt y^e sharp edges of the Dentes Incisores, and is by them divided, This Action is justly enough compared to that of a wedge; since their structure is the same, & consequently their power of dividing a body placed between them will be to y^e resistance arising from the Cohesion of y^e parts of y^e body as their depth is to their Base. As my worthy Colleague M^r Stewart Profs^r of Philosophy has demonstrated of y^e wedge. — The Teeth then are brought together, and the under Jaw pressed against y^e upper by y^e action of y^e eight pair of muscles assigned by Dr Boerhave for that office. Viz.

Of Manducation.

Viz^t The 2 Masseters, 2 Temporal, The Pterigoidei Externi & Interni / tho' the four last seem to have no great hand in it / by the help of these the Underjaw is likewise moved backwards & forwards, & to either side. The Masseter & Pterigoideus Externus help to pull it forwards, The other four viz^t y^e Temporal & Pterigoidei Interni move it backwards; It is moved to either side by a successive action of these muscles. —

The advantage the Teeth have in grinding y^e food is shown in y^e Osteology. —

The morsel being separated by y^e Incisores, is broke to pieces by y^e Canini, w^h pickles are at last thrown by means of y^e Tongue on y^e broad scabrous surface of y^e Dentes Molares there to be sufficiently ground.

These Teeth will act with much more strength on the food than any of y^e others, on account of their nearness to the axis of motion, and therefore when we want to break a Nut or any hard substance, we always thrust it between the Dentes Molares, w^h we at y^e same time press strongly against one another by means of y^e Temporall & masseter muscles, on acct of this violent action of y^e Dentes Molares, they have 3 or 4 different roots to render them more firm & stable. — By y^e Circular motion of y^e Condyles of y^e lower jaw in y^e Glenoid Cavities, the motion of the Inferior dentes molares ag^t y^e upper is so likewise, & it is by this that the grinding of y^e food is effected. The

5 Of Manducation.

The Surface of the Teeth is but small, and therefore it is necessary that the bolus should be kept from slipping off / and excluding the power of y^e Dentes molares / which is done by the Lips (Cheeks & tongue); It is not only proper to y^e Contraction of y^e Buccinator muscles that the food is kept on the surface of these Teeth, by y^e Cheeks being applied to y^e gums & Teeth, for by these acting the two angles of the mouth are pulled asunder, but at this time the Orbicularis Labiorum, or Sphincter oris, whose action is directly opposite to y^e Buccinator acting, the Cheeks come to be close applied to y^e Gums; These two are y^e Principal organs for serving this purpose, perhaps y^e Depressor Labii inferioris, & y^e Elevator Labii Inferioris Cowper may help them a little, but none of y^e rest mentioned by D^r Boerhaave have the least share in this action, for they are so situated y^t they woud rather pull the lips from y^e Gums, E.g. The Zygomatic & Elevator Labii Superioris which do not arise from y^e Gums / as D^r Boerhaave says / they will draw the lips out from the gums; And these muscles concur in this action do it not by any violent but a very gentle Compression. — The Tongue w^{ch} moves itself any way, thrusts y^e food from y^e inside betwixt y^e Dentes molares, while this is doing the Salivary glands being alternately pressed by y^e actions of y^e adjacent muscles, cleave pour out their Liquors more plentifully, thus there is the greatest Secretion of Saliva when its most wanted.

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No Saliva / It's probable / is Excreted but when the jaws are moved, for observe Children who when awake are always salivating, yet when asleep their mouths are always dry. — To me at least it would seem some proof / tho' perhaps but a faint one / of y^e Musculi Mylohyoidei, & Geniohyoidei serving to pull down the Lower jaw, that the Sublingual & Maxillary glands are situated so near them, & consequently are pressed when those muscles act, but an Excretion of Saliva is only necessary in time of mastication, hence also the Parotid glands are situated near y^e mapeter; for as I said before it's probable the Saliva is only poured into y^e mouth when y^e jaws are moved, tho' some have affirmed that it's secreted even in Sleep; but I have observed both old people & Children who when salivated much when awake, yet when asleep I could never see them either swallow it down, nor did it come out of their mouths one of which it must have done had y^e Secretion gone on as when awake; If we consider likewise how dry parched & rigid, all y^e Inside of y^e mouth & fauces becomes upon sleeping wth y^e mouth open, we shall be convinced that there is no Saliva secreted at this time. — As to the Quantity that is ordinarily secreted out of from these glands it is very Considerable; See

7 Of Manducation.

See Med.^l Essays Vol. 2 Art. xij, Viz^t a gentleman wounded in y^e Salivary gland, when he eat was obliged to hold a napkin to y^e wound, w^{ch} would wet thro' several folds but at other times not y^e least moisture appeared.

The Saliva is a thin Limpid Liquor of a Saponaceous nature, the small quantity of salt which goes into its composition seems to be of the nature of Sal Armoniac. - If we consider it merely as a limpid water, we see that it will insinuate itself between the particles of y^e food & loosen their Cohesion; As it is a saponaceous Liquor we shall find it wisely adapted to dissolve & mix with y^e oily & other parts of our food w^{ch} run all in mixture with water; and as it is an animal Liquor (subject to putrefaction) and consequently when taken with y^e food into y^e Stomach more fit for promoting that spontaneous Dissolution & change which it ought to undergo there to be converted into good Chyle. - It would be needless to mention the trifling objections brought by some against this use of y^e Saliva: such as that the saliva is produced from arterial blood, and that this is so far from increasing Digestion that it pallies y^e Appetite and creates Nausea's, & therefore y^e Saliva must be far from increasing Digestion. They

8. of Manducation.

They might as well affirm that because Nuts eat in great quantities occasion a hoarseness & sore throat that therefore the oil expressed from them should have the same effect, tho by the by it is found to be a very good cure for it. There is likewise a root in y^e Indies which is made use of for Bread after the Juice is strongly pressed out of it before that is rank poison. —

The Saliva Consists mostly of water tho it has a little oil & Salt as all our Liquids have so as to make a kind of sapo, and therefore is a proper medium to mix & incorporate the different particles of our food which are either oily saline earthy or watry, So as it dilutes our Aliments, it reduces them to a pulp, and as it is an Animal Juice that has often passed the Circulation, it is more liable to Putrefaction and Capable further to digest or dissolve Animall substances; hence it is an Instrument in Digestion. It is very Subtile & serves to soften & separate the particles of our food which could not be done by the Dentes molares. — Besides this there is a more viscous Liquor separated by y^e Glands of y^e tongue & palate to lubricate y^e passage when y^e food is sufficiently broken & impregnated by y^e Saliva. H.

Of Manducation

It may be said in general that Men & all other Creatures that have blunt Teeth & long Guts are designed originally for Vegetable Diet, & those Creatures on the other hand who have sharp teeth & short Guts are designed for Carnivorous Animals. — In the first the Vegetable food requiring a longer time to digest and have the finer parts strained from it, whereas in y^e latter the Animal food is so ready to putrefy that it does not need such a long removal in y^e Guts to have y^e Chyle strained from it; And the blunt Teeth in y^e former are fitter for grinding y^e Substances in y^e Vegetable food, whereas the sharp Teeth in the latter kind are more fit for tearing the Animal food. —

The food thus sufficiently broke by Manducation, & impregnated wth Saliva the same thing is performed as in making an Emulsion, &c. it becomes of a white Colour, And the particles being more divided by y^e Saliva, the Liquors y^t we drink come to give us a sharper Taste in any Substance than otherwise we should have.

Thus the food is approaching nearer to an Animal Nature or the Nature of Chyle, tho' before it can
Justly

of Manducation

Justly have that name, it must first undergo y^e action of the Stomach & Intestines upon it.

After the food is sufficiently moistend & ground it is prest upon the dorsum of y^e Tongue and the Rugæ of the Palate assist to thrust it into y^e fauces, here also the food by its pressure squeezes the liquor out of the glands situated there and so the passage is made more Slippery, and these liquors tending to an Alcaligeny makes the food approach near to an Animal nature.

The Meat must next be thrust into the Pharynx and from that down y^e Oesophagus into the Stomach, which action is Deglutition.

11 Deglutition

In this Action the first thing to be observed is y^e Amygdalæ & other small glands Situated at the root of y^e Tongue Velum Pendulum Palati &c all designed to furnish liquor for lubricating the passage.

The Bolus then being sufficiently masticated is first taken upon y^e top of y^e tongue which being drawn forward by y^e Genioglossi, and upwards by y^e Styloglossi it is pressed to y^e roof of y^e mouth by these & y^e other Muscles of y^e Tongue, and as this pressure is more at y^e Anterior than y^e posterior parts the bolus is forced backwards, At this time if the Velum pendulum palati was not supported the food would go up into y^e nose, but I think it is prevented by the Muscle which Senglap calls the Tuba nova Val: salve, which may more properly be called Tensor palati by which resistance is made to y^e Tongue that it cant thrust the food into y^e nose, but its determined into y^e narrow fauces; The Root of y^e Tongue being thus brought back, and the Ligaments of y^e Epiglottis relaxed the os Hyoides & Larynx are drawn upwards in a convulsive manner, The Epiglottis is pressed down upon the Rima Glottidis by y^e Bolus, The

of Deglutition

The Glottis also is contracted by its proper muscles, And if Uvula is said to fall down & cover the small hole left uncovered by the Epiglottis and the bolus is determined into the Pharynx. — Dr Boerhaave is much mistaken in ascribing this action to the Velum Pendulum from a false piece of Theory viz^t that the Velum pendulum can sustain the whole weight of the Atmosphere; The way he takes to prove it is this, That when we breathe by the mouth alone, the pressure of y^e Atmosphere is all on one side of the Velum Pendulum, w^{ch} sustains the whole weight of it; But this is a mistake for that the Atmosphere presses as much thro^g y^e nose as mouth is very evident, so that the Velum Pendulum not at all suffers the pressure of y^e Atmosphere because it is equal on both sides of it; If indeed there was a vacuum on the part which is the back of the Velum pendulum I wou^d allow that the Atmosphere did press upon it, but if there was what Resistance could its muscles make to the weight of y^e Atmosphere? For put your hand on y^e mouth of a Receiver, when the air is nearly exhausted, and all the muscles of your arm can't raise it till more air is sent in, so that it's hardly probable that these muscles w^{ch} are so small wou^d sustain such a weight, was there any such wth however there is not.

The

Of Deglutition.

The Uvula is said to be assisted in this action by y^e little Azygos Morgagni pulling it down, but the situation of this muscle is such as makes it evident that it can have no such action, and beside the food pressed back by y^e force of the tongue would easily overcome the Azygos, it being only a very small muscle; again if the Uvula covered a part of y^e Glottis, the bolus must be divided into Two morvells, our drink run in two streams and it would be impossible for such a large body as a Cherry to pass on each side of the Uvula, neither is there any necessity for the Velum pendulum Palati being stretched on the Uvula acting, thus then when y^e food is pressed between the back of the Cricoid Cartilage and the transverse fibres of y^e Pharynx, The Uvula covers the Glottis, The Azygos Morgagni can't assist in this for it makes up part of y^e body of the Uvula itself, and draws it forwards & upwards. — When the bolus has got into the Pharynx [what other times is shut unless to give way to what is voided by y^e Stomach in vomiting] it is dilated by y^e muscles that compose its substance as the Cephalic Pharyngei &c. It then contracts in order to thrust it down, and then is the most laborious part of Deglutition; The Bolus is now lodged betwixt the

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Of Deglutition.

Posterior part of the Cricoid cartilage and the muscles of the Pharynx, so that here are four different ways, if not prevented, that it might go, for it might come back again into the mouth, or slip behind the Velum pendulum into the nose, or into the Trachea or into the Oesophagus, which last is the only way it ought or can go; for the tongue & Larynx being supported by y^e strong action of y^e Digastric & Stylohyoid muscles it can't pass into the mouth, the root of the tongue pressing on the Velum pendulum, and the Uvula being a little raised by the Pterygostaphiline; The Passage into the Larynx is partly shut by the Epiglottis, this is perhaps kept firm by y^e muscles described by Winslow by the name of ThyroEpiglottides, But the Epiglottis notwithstanding the Rim of Glottis entirely some of our food will be in danger of getting back and so falling into the Trachea, but at this time the Uvula falls on the posterior part of the Rim of the Glottis which is not covered by the Epiglottis, and thus that passage is stop'd, so that we cannot breathe, and if we should at this time by laughing breathing or y^e like lift up the Uvula so that the passage is open, some bits of food

Imme

15 Of Deglutition.

Immediately get into the Glottis, and we are at a Cough-
 ing; and if the food be very large or hard that we cannot
 easily Swallow it, we are then in danger of being choaked
 because as long as the food remains there, this Rima is shut
 that we cannot breathe, Thus then the Trachea is also shut
 up and the Bolus must go Qua data porta i.e. down into y^e
 oesophagus, for when the bolus is past the Epiglottis, it
 by its Elasticity is raised a little; Before there was no
 occasion for the Uvula, the Rima being entirely shut
 by the Epiglottis being prest back by y^e bolus, and the
 glottis doing that by its own muscles, but when the La-
 ryna is raised up it applies itself to y^e Uvula, wthout
 any action in it; And it is plain that the Uvula serves
 this purpose because Quadrupeds have no Uvula, but
 the Epiglottis covers the whole Rima; About this time
 then when the food is going into the Pharynx, y^e whole
 Muscles of it & those of the os Hyoides too fall into a
 Convulsion or spasmodic motion or contraction, and there-
 by thrust down the food into the Pharynx; As soon as
 the bolus has got into the Pharynx, the whole muscles
 that were lately in a violent state of contraction, are
 now relaxed, and the passages are all open again.
 After the food has got into the Pharynx from hence
 it

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Of Deglutition.

It is thrust into the Oesophagus being assisted by the spiral fibres in its descent, w^{ch} still follows it & thrusts it down while the longitudinal ones dilate y^e passage below.

This motion by which the food is protruded into y^e Stomach is called Peristaltic, because the Oesophagus moves itself as a worm does by shortning in one place & lengthning in another w^{ch} is performed by undulation from its upper to its lower end in deglutition but vice versa in Vomiting. This motion has been endeavour'd to be accounted for from y^e filaments entering into the Tendonous fibres of the coats, but if this was the reason, then the fibres would be contracted equally and at the same time, & so not make that undulatory motion.

The Inside of the Oesophagus is covered wth glands w^{ch} separate a mucus for lubricating the passage. — The food being still mixed with some small q^{ty} of y^e mucus that is cast out upon y^e Inside of the Gula, w^{ch} mucus being a little diluted wth our drink forms a liquor exactly a kin to the Saliva; from hence the food is carried into the Stomach where is performed Digestion.

17 Digestion.

The food Received into the Stomach undergoes there a considerable Change but by what particular means this Change has been brought about has been a matter of dispute in all ages, Celsus who is thought to have lived in Augustus Cæsar's time gives an account in the preface to his books of all the opinions started before his time, most of which have been since defended by y^e moderns; Some contend that Digestion is brought about by Attrition, The first advances of this was Erasistratus, w^{ch} doctrine was since strenuously maintained by our Countryman Dr Pitcairne who was the first that Introduced mechanical reasoning into Physick in this part of y^e world, and hence he used to call himself an Erasistratean. Others asert its done by Putrefaction; A third sort thought with Hippocrates by heat alone. I need not mention that opinion introduced by Galen of occult qualities or faculties, ^{which is so ridiculous it needs no confutation} If you had asked him or his followers what their Facultas concoctrix was here they stop for they do not understand themselves, The practitioners of this noble way of Reasoning used this pompous way of concealing their Ignorance.

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Of Digestion

After the 13th or about y^e 14th Century Chemy^{ist} came to be much in vogue and was cultivated by Physicians, and they were so fond of it that they looked upon all the parts of our body to be Chemical Laboratories, they would Digestion & all the other ~~Actions~~ of our body performed by certain Menstrua made up of Acids & Alkalies mixt & composing a neutral salt, but they never were so good as to show us either of these Two salts in the Stomach or any other part of the body. — Dr Copleston Harvers in the Philos: Transactions gives his opinion that Digestion is performed by such a mixture as Ethereal oil of Turpentine & oil of Vitriol, but he does not tell us how such liquors can be prepared in the Human body where they are lodged or how they can be any where in y^e Stomach without burning & Destroying the parts that they touch, He gives us an instance, Take says he / Sp^t sulphur, Sp^t C^c, Saliva, flesh & Chyle, mix these together & expose them to a gentle heat, you'll find that this mixture is not acid nor alkaline / and truly no wonder since Sp^t C^c & Sp^t Sulphur make a neutral / let them stand thus for sometime, and you'll find the flesh dissolved into a milky liquor; But how should a Menstruum like this get into the Stomach? — It =

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Of Digestion

It would certainly destroy it; Its true indeed the most part of Fishes digestion is performed by a menstruum but this is not to be applied to us for we find that in our bodies the menstruum is in less quantities or have less acrimony, then certainly it cant have such Effects and only in proportion to its quantity & acrimony are we allowing it a part in digestion. — Several wth Hippocrates will have it done by heat alone, because in winter time he saw that Digestion was greatest supposing then that the heat of y^e body was concentrated and so the Stomach more capable to digest, and according to his supposition the heat in y^e summer is dispersed among the extremities & so the Stomach less capable to digest, but this is a mistake for the heat of the Stomach in summer & winter is much y^e same.

Havers method would be destructive, we have no vessels that could contain such Liquors, nor would any of our juices afford such, We dont know of any in our whole body that are either acid or alkaline except what is immediately furnished by our food, but these are changed altogether before they are mixed with the blood. — Upon examining the Stomach of any living creature, we can see no luctus or Effervescence at all

Of Digestion

Not find any such menstria to digest the food. The officinae w^{ch} they contrived for these menstria were as wild & ridiculous, The spleen was long thought to afford such a menstruum by means of y^e vasa brevia, but this is quite an error, for the vasa brevia serve to carry y^e blood from the spleen in y^e ordinary way of other vessels, and the spleen itself sends all its blood to the Liver. — The truth of the matter is that the Chemists are not very studious to find out whether there be such menstria in y^e Human body, but finding the Effects w^{ch} such liquors produce on y^e food they rashly conclude that digestion must be brought about by these means.

M^r Papin proposed to the Royal Society an Instrument which he would have to be analogous to the Human Stomach, because by ~~exposing~~ it to heat no greater than that of y^e Stomach the hardest substances were dissolved; The Instrument was a strong Iron Pan into which there was a piston so strongly fixed and so close that no air could get in or out; into this he put Ligaments, cartilages, bones, and the hardest substances of animal bodies with a little water, then he stoppt it, and setting it into a gentle heat for some time he reduced the matter to a Jelly, from this he

24 Of Digestion.

concluded that digestion of y^e food in a human stomach was performed by such a heat, but never considered that the vast expansive force of y^e air when rarefied by the heat / seeing none of it could get out / would have broke his pot into a thousand pieces had it not been very strong, It was by this force of y^e air that the separation of these bodies depended, for the included air being rarefied separated y^e parts of y^e matter by expanding so forcibly; Its quite wrong to apply such a machine as this to y^e human stomach; if indeed our stomach was as strong and quite close shut up the application might be just enough, but our stomi: is not so close stopd but some of the air may get out at both orifices, and its not able to resist a great force but is easily burst; for a column of water of no great height can break it to pieces as is shown by D'Hales in his Hydriatics, so that heat as far as it helps to separate in some small degree the parts of our food can only be allowed to have a share in digestion. — After the middle of last Century mathematicall learning came to be much in vogue, and some endeavourd to account for digestion & y^e other actions of y^e human body by a:

22 Of Digestion.

By a Mechanical pressure, amongst whom was Dr Pitcairn he alleges that the force of y^e Stomach was equall to some hundred thousand pounds weights, and Dr Leil [who certainly did it merely to please Pitcairn] by his adding the force of the Diaphragm & Abdominal muscles makes it a good deal more, but it is almost impossible that the Stomach could exert such a force or near it, For M. Pirac in Mem. de l'Acad. for 1702 tells us an Experiment that plainly contradicts this, He gave Corros. mercury to a dog and observing when he was in y^e greatest risus to vomit he thrust his finger into the Dogs stomach thro' a hole made in the Segments & found little or no contraction in it, the Diaphragm indeed was convulsed but not so much as to hurt his finger, and certainly their natural contraction would have been much less, If then there had been such a violent strong force in y^e Stomach as Dr Pitcairn alleges, what would have become of his fingers, sure they would have been crushed, Besides how could worms live in y^e Stomach if that was y^e case? Worms indeed (as Dr Pitcairn observes) have a faculty of shifting their place & shunning the pressure, But to take away all that

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Of Digestion

That can be alledged about such a preasure, how can Currants have a faculty of shifting, ^{which} they cannot be said to do & so elude the force of y^e preasure, and yet they are observed to pass thro' y^e Belly even of y^e Strongest man quite entire, tho' a 2ij weight upon them would crush them to pieces, How comes it then that so many thousands pounds weight are not able to break them? M^r Amian in the Philos.^{ic} Transactions relates the history of an Idiot who swallowed every thing y^e come in his way, when he died his body being opened they found a great many sharp nails, bits of brass, Lead &c. ^{which} had lain perhaps several months in his Stomach notwithstanding it was not the least hurt or wounded which must have been, had the contraction of the Stomach been so great, & y^e preasure so violent as P^rest^r cairn & his followers alledge; But supposing the muscles of the Abdomen Diaphragm & Stomach had all the Power which they ascribe to them, they have not near the weight he assigns them; I weighed the whole muscles ^{of y^e abdomen} of a man six foot high, who was hanged here in his full vigor, and tho' I put in the Tendons & all together yet they did not weigh near so much as he says, I also weighed the Stomach ^{tho'} with all its membranes abt it, yet it fell short of his weight, so

that

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of Digestion

So that if one would allow his Conclusions to be just, yet his premises are false, and much more so in an ordinary person, since they were so much above what I found in a man so big. Pitcairn weighed y^e whole when he should agreeable to y^e Contraction he assigns have weighed the muscular Coats only, w^{ch} Coats are the smallest part of it, besides his weight is by half greater than any ordinary Stomach weighs; such a proof, sure as he assigns would certainly not only create intolerable pain but pound all y^e viscera of y^e Abdomen into a Jelly, neither would the tender Embryo ever be allowed to come to maturity; In short the Calculation was built on a very bad foundation; The method by which the D^r computed the force of the flexor Pollicis (on which Computation the Calculation was made) any one who Examines that thing will find it to be a very erroneous one; Beside his supposing the absolute force of muscles to be according to their weight, under the Calculation still more erroneous, For y^e Stomach & muscles being put into a pair of scales wth y^e flexor pollicis, he inferred that as many times as they exceeded it in weight so many times they exceeded it in its supposed force; But

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of Digestion

But it is the number of fibres or thickness of a muscle not its weight or length that constitute its strength; - I can see no necessity for such a supposition as if the obstacle to be overcome was invincible.

Again some will not allow the stomach to have any contraction at all but this is contradicted by Autopsia or ocular demonstration; however its pressure is very mild and gentle, & it is a little assisted by y^e motion of the Diaphragm. — Others again would

have Digestion performed by y^e putrefaction or fermentation of y^e food in the stomach; But that the Spontaneous Changes which the food undergoes in the stomach never proceed so far in a sound state as to produce an Acid or an Alkali {the Effects of fermentation & putrefaction} appears from an examination of its Contents which were never found to be so far changed tho' they might be tending one of these ways. — In short there have been

different opinions advanced about this action in all ages, according to y^e prevailing Philosophy of the Times And y^e Defect of them all seems to have been that they would have that to be brought about by one particular Cause w^{ch} is really owing to many or at least to a combination of many Causes. The

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The most probable way by which Digestion is performed is this; We suppose the stomach to be a Vas Clausum exposed to a gentle heat as is that of an Animal body; having a gentle easy contraction from its muscular fibres, and having its contents perpetually conques-
sated by y^e action of y^e Diaphragm & abdominal mus-
cles, & in some measure by y^e pulsation of y^e aorta in
its back part, and that of y^e Coliac & Lienteric arte-
ries | tho' y^e pulsation of an artery is so small that if laid
bare is scarce perceived, and therefore can have little or no
Effect in Digestion | While the air contained in
the alimentary particles being rarefied by y^e heat
of y^e place, divides these particles by its elastic spring
as we find by y^e Belchings which come so frequently
from y^e Stomach; Digestion is still further promoted
by y^e Liquor flowing into y^e Stomach, not violent
Acid menstrua but bland saponaceous liquors
I mean the Saliva, and the Liquor Gastricus secreted
by its proper Glands, & our drink w^{ch} macerates our food
& makes it give way more easily and mix y^e oily & aqueous
parts together and bring it nearer an animal nature
at the same time this action is assisted by y^e natural
Corruption that all bodies are liable to, &c. Animals
to

Of Digestion

^{Some of y^e Vegetables} Animals to Putrefy & turn alkaline, ^{most} Vegetables to
 ferment & turn ^{alkaliphent or} acid, Oils to turn rancid &c, The
 Natural Tendency to Corruption w^{ch} our food has when
 contained in a warm place like y^e Stomach, will very
 much further Digestion, Not that they will actually
 turn alkaline Acid or Rancid, but that that intestine
 motion by which this Change is brought about in y^e Stom-
 ach will be begun there; so many Different Causes
 concur in Digestion, And certainly D^r Boerhaave
 has been very much in y^e right to join them all toge-
 ther since not one of them singly seems equal to
 the Task. — The Digested & more fluid part
 of y^e food is at last drove thro' y^e Pylorus in to y^e Duo-
 duum, the rest abides some longer time till further
 divided & fit to be thrown out; However the Chyle
 is not yet prepared, the food requires yet further to
 pass ~~before~~ thro' y^e Intestines mesentery & Thoracic
 duct before it deserves that name; And as here it recei-
 ves its full perfection I shall consider this process under
 the name of Chylification.

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Tho' the Chyle is first formed in the Stomach yet before its mixture with the blood it undergoes many Changes which are called Chylification

The Chyle is not perfected nor prepared to enter of mass of blood before it passes thro' y^e Intestines mesenterij &c. — At its Egress out of the Stomach it's generally of a greyish Colour, In its passage thro' the Duodenum the Succus Pancreaticus ^{which} is much of the same nature as the Saliva & the Bile (which is more salt & Saponaceous, Its oily & saline parts being greater in proportion to its watery parts) are mixed with it. — There are two sorts of bile viz^t Hepatic & Cystic, The first is a mild sort of saponaceous liquor, The Cystic is an Intense viscous alkaline bitter more yellow & Saponaceous than y^e other, sometimes it's morbidly cases it's perfectly alkaline, and that it is naturally alkalescent is evident by its resolving coagulated blood, or resolving coagulated milk in calves, for after the milk passes this place it's never found coagulated whereas when it's in the fourth stomach it is so acid by y^e coagulation that it is used always to Curdle other milk this being what is called the Rennet. The

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Of Chylification

The Hepatic Bile is continually poured into the Duodenum, whereas the Cystic is only poured in when the Gall bladder is pressed upon by y^e Stomach, and its necessary that the Cystic Bile should not always be poured in too large quantities when the guts are empty, lest by stimulating them too much it should occasion bilious Cholera, Cholera morbus &c. - when the Stomach is empty & the Duodenum, the orifice of the Ductus Communis Choleochochus is shut so that no Bile can pass into the Intestines but the bile coming from the Liver by y^e Hepatic Duct is regurgitated back into the Gall bladder by y^e Cystic duct, and this is the way this bladder is filled. But when the stomach is full & consequently y^e Duodenum the orifice is opened, and the Gall pressed out of y^e bladder & Liver into the Intestines so that it is pressed out when it is most wanted.

Its use is to stimulate gently the Intestines and to keep up the peristaltic motion, and hinder the Rarification of y^e Air contained in them, hence when it is either wanting or Insipid it causes a Tympanites, by the guts not being stimulated to contraction, while the Air in them is continually enlarging their cavity.

Besides

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Besides in common wth y^e Hepatic it dilates y^e Chyle, blends its watry & oily parts together and makes it more miscible wth y^e blood; Thus it is that the Aliments of what colour soever when taken in are always changed into a milky one. — That the Chyle may be still more diluted the Extremities of the meseraic Arteries are continually pouring a liquor into the Guts. — The Chyle is promoted forward by the Peristaltic motion of the Guts, which is thought by Dillarton as you may see Med. & Phys. Vol. 1 Art. 12. to depend upon the alternate pressure that the nerves^{as} serve the Guts & other Viscera of y^e Abdomen receive from the action of y^e Diaphragm, for since these nerves pass thro' a hole in y^e Diaphragm, during the contraction of this muscle their Influence on the Guts must be destroyed because the Spirits are denied a passage thro' them by this pressure, so that this vermicular motion is only performed when the Diaphragm is Relaxed. — The Chyle then being pressed forwards & mist by this action, is a little retarded in its passage thro' the Intestines by the Valvulae Conniventes in order that the thinner parts of it may be received into the open orifices of the Lacteal & meseraic veins; but then here a dispute arises whether this be done by a mechanical pressure that y^e Chyle suffers or by that attractive power or whatever

you'll

You'll call it that Capillary Tubes have, called absorption, & by which all vegetables are nourished: I think it is done by absorption, But how absorption is performed by a Capillary Tube, {E.G. Take a Sugar loaf ^{end} the one of which being put into any liquor the whole loaf will by & by be wet provided there be as much liquor as to do it / is not yet fully determined by Philosophers for if it were by any Mechanical force we could certainly Imitate it, and yet no force whatever applied to the Intestines can make even water pass from them into the Lacteals. - In a dead body by losing their necessary Rigidity & Energy they loose also their absorptive power; They perhaps hang pendulous into the Gutts their Labia Collapse & Close their orifices like so many valves so that no liquor can be forced into them. — This Absorption is increased by any aromatic or Stimulating particles in our food, thus it is that pepper mustard &c like promote digestion, w^{ch} they seem to do by Constringing a little the orifices of the Lacteals, for the smaller & bore of a Capillary Tube is the more strongly does it absorb; But tho' this Constringing the vessels to a certain pitch may be of considerable service, yet if carried too far will have quite different effects as we learn from the opera =

Operation of many poisons particularly of the mineral kind / as Mercur. Corrosiv., Arsenic &c. The Chyle having entered the vasa Lactea proceeds thro' them to the glandular vasa of the mesentery and is diluted wth the lymph secreted there, w^{ch} accompanies it from thence to the Receptaculum Chyli, where all the Chyle is collected & most of the Lymph secreted below the Diaphragm, from hence it ascends by the Thoracic duct generally toward the left subclavian vein behind w^{ch} it mounts till it be a little above it, then turning downwards enters the vein & is mixed with the mass of blood, while its entry is facilitated by the Lymph poured into it from the Cervical glands at the top of the arch w^{ch} it makes. The other part of the Chyle which is too gross &c is protruded into the great gutts in order to be excreted, tho' it does not all go this way, the finer parts of it being taken up by the mesarian veins, That the mesenteric veins do perform this office is plain from birds who have no lacteals, but have all their Chyle taken up this way; Thus M^r Du Hamell in *histoire de l'Acad. des Sciences* tells us that he pressed the food into the mesenteries of a crane: Besides M^r Cowpers Experiment of injecting water. And M^r

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M^r Duverney^s of blowingⁱⁿ air thro' the Mesenteries and thereby distending the Intestines, sufficiently prove that their small orifices open here; Several too have been for a long time kept alive & nourished by Glysters merely by the nutritious particles being received by the Mesenteric veins & carried into the blood, for in y^e great Intestines there are no Lacteals, and the Injected liquors could not get into the small ones by reason of y^e Valvulae Tulpae; Spirits likewise injected this way produce the same Effects as when taken in by y^e mouth, M^r Homberg Informs us in Mem: de l'Acad: des Scienc: for 1701 that upon giving Sp^t vin: or Aq^u vite^m wth a little Camphire in it by way of glyster, the patient soon found the Taste of it in his mouth, ^{made manifest} & was intoxicated by it, And D^r Stubbbs of Londⁿ found that Sp^ts thrown up by y^e Anus would make a person drunk sooner than when taken by y^e mouth. By y^e Absorption of y^e Mesenteries in y^e Small guts the sudden effects of Cordials are accounted for by some, D^r Boerhaave acc^t for y^e Refreshment arising from y^e Food which is eat after a long abstinence, He says, Hinc Cito Instauratio Languidarum ex Inedia virium dum Subtilissimus Humor Receptus fistulis venosis excipientibus ubique in ore oesophago Ventricula hiantibus in venas Lymphaticas se evacuantibus, hinc brevi in

venas

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Venas sanguinis Immissus indeq; cito ope Arteris in omnes corporis partes distributus subito Collapsas repleat
 Instit: 87-5 — But in my opinion they might as soon pass thro' the Lacteals &c. — All that can be of service for y^e nutrition of y^e Body being taken up by y^e Lacteals & Meseraics, the more gross parts descend towards y^e Anus; Its descent is helped by y^e motion of the Intestines which is increased by y^e acrimony of y^e matter, Its passage is Lubricated by y^e mucus secreted by y^e glands in y^e inner coats of y^e Intestines & particularly in y^e Great sack of y^e Colon &c. The faeces being got down to y^e Anus begin to stimulate y^e rectum by their acrimony & quantity, at last the Sphincter ani being relaxed and y^e Extremity of y^e Rectum dilated by y^e Levatores ani, while y^e Diaphragm & abdominal muscles act strongly it is expelled out of the body —

The Meseraic Veins carry the grosser parts of y^e Chyle into y^e Vena Portarum (this is pretty plain from Mr Cowpers Experiment of injecting quicksilver into y^e meseraic Arteries and making it pass into y^e Lacteals) The guts have no proper Lymphatics save the Lacteals themselves but the Lacteals have Lymph poured into them by

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by the Surface of the Guts from the mesenteric Arteries, and the Chyle is still more diluted with Lymph in the Glandulae vasa & in y^e Receptaculum Chyli, where all the Lymphatics from y^e Inferior Extremities and the Abdomen Terminate, where the Chyle is more ultimately blended, and then it mounts upward in the Ductus Thoracicus assisted in its ascent by the valves & y^e alternate pressure of the Diaphragm, & pulsation of y^e Aorta, receiving in its passage Lymph from all the Contained parts of y^e Thorax, thus all the Ingesta advance nearer to putrefaction on out of y^e gth of animal Liquors mixed with them. —

The Chyle enters the Subclavian vein (at which there is a valve to hinder its return) but very slowly & in very small proportion to any given quantity of Blood, for supposing the Chyle to move in the Thoracic Duct wth a velocity equal to that which moves in y^e veins (w^{ch} it certainly does not) then the Quantity of Chyle to y^e Quantity of blood in y^e Sinus Venosus will be as the area of the Transverse section of the Thoracic duct to the sum of the Areas of y^e transverse sections of all y^e veins.

As

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The Sudden Effects of Cordials seems rather owing to y^e Stimulus given to the nerves in y^e same manner as when Cold water revives a person when fainting.

The gross part of y^e Chyle lies some time in y^e great sack of y^e Colon in great quantity, and wou'd be apt to turn hard & uneasy did it not get a great q^{ty} of mucus to keep it soft & fluid, which mucus is kept as in a Reservoir in the Appendix Vermiformis, w^{ch} by some is called I though improperly / the Gut Cocum. — When the Faeces are too long retained they give a very strong alkalescent quality to y^e Chyle, so as to irritate y^e Solids & Cause a fever.

The Diaphragm & Abdominal muscles have some share in y^e Expulsion of y^e Faeces, tho' very little, for we see when one in Costiveness calls there to assist this action how little they do. — The white Colour of y^e Chyle seems principally to be owing to y^e Liquors mixt with it in y^e Duodenum, for m^r Musgrae injected a blue tincture into y^e beginning of y^e Duodenum, and afterwards found that the Chyle was perfectly white, but when he injected it below y^e Entry of y^e Gut's ducts, it entered y^e Lacteals still coloured. — The Chyle never enters the Lacteals of y^e same nature as the aliments were of when taken in at y^e mouth, unless when they are taken in very large Quantities.

Quantities or are very difficultly changed, as Sea Salt & all strong alkalies as onions &c which are found in y^e milk of Nurses without much change. —

Of Sanguification & Circulation of the Blood

The Chyle is in its progress more & more changed into an Animal nature by the Animalized liquors that are mixt with it, so that at its entry it makes no Chymical effort or union wth y^e blood, for we see woman's milk tho' it has undergone one Circulation retains still something of the nature of the Alimento, so that if the food was of y^e aciscent kind the milk inclines likewise to be acid.

From the Subclavian Vein the Chyle is carried into y^e Vena Cava from thence into the right Auricle of y^e Heart and from thence into the right Ventricle where it suffers a great Conguassation from the Carnea Columna and has its fluidity much increased, It is thrown out from hence into the Pulmonary Artery, and by the
Rota=

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Rotation of the particles about their axis & their mutual collisions their Spherical figure is formed. In the branches of y^e pulmonary artery ^{which are dispersed} on the vesicles of the lungs they undergo the strong alternate pressure of y^e air, and are still more compacted & rendered specifically heavier. The particles which have a strong attraction to one another being yet more compressed, while those that but a slight cohesion are driven closer together, hence it is likewise that it seems to get its red colour, but by the action of y^e heart upon it its particles are made more dense & compact, first in the Auricles by y^e Carnea Columna dispersed in its substance (in y^e same way as Butchers by stirring y^e blood of a slaughtered animal hinder it from growing into gross lumps) this blending is still greater in the right ventricle which is much stronger & has more Carnea Columna, hence the red colour of the blood may be accounted for: for if the pressure be diminished & the blood suffered to rest, we find one Red Globule fall into six smaller ones / viz^t Serum, and become of a pale yellowish colour and these again into still more pellucid particles called Lymphs: At the same time every particle when it is thrown out of the heart has a rotation round its own axis as projected Bodies have, whence their Spherical figure; for this

H. C.

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Reason viz^t the Blood being more compacted by passing thro' the Lungs, the Left Auricle is made ^{up} than the right tho' the same quantity of blood is contained in them because in the left it is more dense & specifically heavier.

The heart has alternate motions of Contractions & Dilations; The Systole & Diastole of the two Auricles, & two Arteries is synchronous, so are likewise the two Ventricles, but while the Auricles are contracted the ventricles are dilated & vice versa, or their motions are Achronous.

The blood brought from the several parts of y^e body collected in the vena cava enters the right sinus Venosus and dilates it, It is from thence by the contraction of y^e Auricle expelled into the ^{right} Ventricle, from thence its thrown into the pulmonary artery, the valvula Tricuspides hindring its return, By y^e Pulmonary veins it returns into the left sinus venosus & Auricle from thence its thrown into y^e left ventricle and then by its systole into the Aorta (while the valvula mitralis hinder it from returning back to the Auricle). From the extreme branches of the aorta it returns back to the vena cava and so to the right auricle to go the same road as before.

But I need not now a days to insist upon this Theme since it is universally allowed

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That the blood circulates thro' the body may be proved a great many ways but perhaps the most convincing is the viewing its motion by y^e help of a microscope in the transparent parts of animals.

That the Systole & Diastole of the Auricles & Arteries is Synchronous, And that of y^e Ventricles & Auricles Asynchronous, & that each of y^e Ventricles is synchronous is fully proved by experiments made on Animals opened alive, and was never denied by any one who allowed of the Circulation since Harveys time, till of late Dr Nichols contradicts this in his Syllabus Anatomicus but Autopsia shows his reasoning to be false, and as he has advanced no proofs of his opinion it need not be regarded, for this see Med. Essay Vol: 4th

While the Arteries are contracted the veins are dilated & vice versa. The stronger the heart the less blood it contains, but throws out the more & vice versa. The force wth w^{ch} the blood is thrown into y^e larger vessels in the contraction of y^e heart & dilatation of y^e Arteries Borelli makes it equal to abt 1000 w, M^r Keill only abt 15 ounces. Both are in the wrong. M^r Hales calculation is the most exact, and is founded upon experiments made by fixing glass tubes into the large Arteries of animals and observing to what height the blood was capax

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Capable of driving the liquor in the Tube. For by this means he might pretty exactly know y^e force of y^e contraction of the heart w^{ch} he makes equal to 114 ^{lb} wt in the larger Animals, and reckons it abt 52 in man. The Arteries at y^e time of the contraction of the heart as well as at all other times are perfectly full of blood. That the heart fills the whole Arterial System at every Systole, and that at every subsequent Systole of the Arteries it should be all expelled is a mistake w^{ch} the younger Physiologists have been apt to fall into and which has been defended by some authors; That it is otherwise is easily proved from observing the blood flowing from a wounded Artery, where tho' it does not move uniformly nor describes the same parabola, but now is thrown to a greater distance, now again to a smaller, yet it moves continually & does not cease between each greatest Jet, but if the part be kept steady forms a kind of Ellipsis in the place where it falls on the floor, whose largest diameter points towards the artery, and whose farther end was formed when the stream was largest, the nearer end when it was least, The common engine for extinguishing fire when wrought by unequal forces on each side, ^{suppose 5 to 2} will give you a pretty Idea of it; This exactly resembles the

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The greater Contraction of the Heart and the weaker natural one of the Arteries; Besides if the Arteries were not full when the heart contracted but had before entirely emptied themselves by their Systole it would be impossible for the Heart to fill them again in its Systole, for its impossible for a muscle w^{ch} contains not above $\frac{1}{4}$ of blood to fill entirely by its contraction all the Arteries w^{ch} are capable of containing 50 times as much; If the Arteries were not full at every Systole of the Heart, their pulses would not be entirely synchronous, since the blood must take a longer time in going to the extremities than the parts nearer to the heart, But if we lay our hand on our breast we'll find the pulsation there to be in the same moment of time as in the arm or leg, for the Arteries being consider as full, the heart in its Systole distends them wth a superadded quantity of blood, and the shock made by this is felt at the very extremest Arteries at the same time that it was made in the Aorta, for in a Tube full of Liquor or in a solid body as a stick, &c. a motion imprinted at one end is instantly felt at the other. This distension of the Arteries is not so great as is generally imagined; it would indeed be greater

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Greater were the Arteries close at their extremities, but as the Blood finds a passage into the veins it is very much diminished, You will perhaps be surprised to hear that the Dilatation of the Arteries ^{wh} you would think so Considerable by feeling the pulse with y^e finger, is yet scarcely perceptible to y^e Eye as you may be convinced by laying bare the large Arteries of a living Animal, for the diffusion is not equal to the Quantity of blood thrown out of the heart, as we must always deduce all that went from the Arteries to the veins at the same time. When the blood then is propelled from the heart its motion is communicated to that contained in the smaller Branches but with a very much diminished velocity since it flows from a narrower Canal to a wider, in moving from the Aorta thro' its Branches, for it is found to hold universally true that the Conjoint Capacities of all the branches arising from a Trunk are greater than the transverse Area of the Trunk, For the Aorta & its Branches are so far from resembling a cone as some have imagined whose Base was next to the heart, & apex at its extremities, that the contrary is demonstrably True, VIZ that they really resemble a cone but whose Base is in y^e Sanguine Capillary Vessels

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Vessels or Branches & Apex at the Aorta / tho it cant be properly be called apex since it is a truncated Cone whose apex is supposed to be cut off / the Velocity therefore in such an inverted Cone must continually decrease so that in the extreme Branches of the aorta it will be so much less than in the Aorta as the Area of the transverse section of the Aorta is less than the Areas of the Transverse sections of the extreme Branches; The friction against the Sides of the small Branches still more diminish the Velocity, one should wonder therefore that ~~Dr~~ Jurin & a great many others should maintain that the motion is quicker in the Branches than in the Trunk; Their Mistake has been owing to their considering the Arteries as Conical Canals gradually growing smaller (and certainly if that was the Case the Stream would be quicker) or from an Error in a very obvious Experiment viz viewing in the smaller Vessels spread on the Diaphanous parts of Animals the motion of the Blood ⁱⁿ a microscope, and observing its apparent quickness without considering that if Velocity is magnified by the microscope as well as the vessels, so that if the Vessels had their diameter increased 100 times, the Velocity would be increased 100 times likewise. In the veins indeed the Velocity increases from

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From the Branches toward the Trunk both because the surface to which the fluid is applied & consequently of friction decreases, but besides it moves from a broader Canal (I mean all the branches taken together) to a narrower viz^t the Two Vena Cavae, For it is a general Rule both in the Arteries & Veins that the Velocity of the blood is *ceteris paribus* reciprocally as their capacities, hence in the Arteries the Circulation is growing continually more & more languid while in of Veins its continually increasing. There is a question which is pretty much overlooked by our Physiologists and not as yet cleared up by Physiology - i.e. why there should not be a pulsation of the veins? It is commonly answered to this that the force of the heart is lost before it reaches them, & likewise that their Coats are considerably weaker than those of the Arteries. If we apply any force to the Blood in of veins equal to of Contraction of of heart we shall find an evident pulsation in them, Thus in opening a vein the Blood moves in an equal Stream, whereas if of person grasps any thing alternately in his hands it flows out like Arterial Blood of Saltum, the reason of which is the alternate pressure of the muscles upon of Veins But this is not all, How comes it that the stopping the

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The Stopping the blood flowing from the Vena Cava into the right Auricle by the subsequent contraction of the Auricle does not cause a pulsation. Since this alternate Resistance made to the returning blood ought to give it a shock and cause a sort of Retrograde pulsation in the Veins as the alternate propelling force of the Ventricles cause a progressive one in the Arteries. I shall endeavour to Clear this up a little; If we carefully observe the pulsation of an Artery with our finger we shall find that the time of its Diastole (which is Synchronous to the Systole of the heart) is only about half as long as the Systole or when it ~~when it~~ draws itself away from our finger, (at which time the heart is in its Diastole) and therefore the Systole is twice as great as the Diastole. Let then the Systole of the Auricles & Arteries (which are Synchronous) be expressed by the time 2, and their Diastole by the time 1. The Systole of the Heart or contraction of its Ventricles, will be rightly expressed by the time 1 and its Diastole by the time 2. The Ventricles therefore will be twice as long in filling as they are in emptying. Again If we examine the proportion between the right Auricle & Ventricle, we'll find their Capacities to be pretty near in proportion of 3 to 1, The Ventricle containing 3 parts of what the Auricle will contain but 1, Now the Blood in the Vena Cava coming to the right Auricle in an equal Stream and sending

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Sending equall quantities in Equall times, When the Ventricle contracts in the time 1 the blood in the veins meets with no resistance but flows into the empty Auricle and fills it with the quantity 1, when the Aorta is relaxed or in its Diastole the Auricle Contracts in the time 2 and sends its quantity 1 to the Ventricle w^{ch} it cannot fill, so that the Vena Cava in this time 2 pours in y^e q^{ty} 4 which with y^e q^{ty} 1 in it before makes up the required q^{ty} 3, so that the blood in the veins never meets with a stop here w^{ch} might occasion a pulsation as long as these proportions hold, But if they be by any means altered there comes to be a considerable odds, As E.g. from a polypus Concretion in the right Ventricle or any other cause whereever the blood be denied a free passage out of the Auricle, a pulsation of the Veins will be produced, an Instance of which we have related by m^r Homberg in mem: de l'Acad: des Sciences, and I have observed it in the Jugular veins abstracted from what the Carotid Arteries might have done; I own indeed that in y^e left side the proportion between the Auricle & Ventricle is not the same wth that here assigned for the right, But then we cannot know whether there is any pulsation in the veins of the Lungs or not on a^ct of the difficulty of making an accurate experiment on them because of their continual motion and their

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collapsing as soon as the Thorax is opened. When the blood is in the Ventricles and these are Contracting there is a small quantity poured out into their cavity by the Coronary Arteries from the substance of the heart; This is done least the Ventricle should be in danger of being Burst by the Contraction. When the Ventricle contract the Blood is hindered to regurgitate into the Auricles on y^e right side by the Valvule Tricuspides on the left by the mitralis. These valves do not clasp close to the substance of y^e ventricle by reason of the Carnea Columna, and so the blood gets in between the the ventricle & Valve & elevates the Valves and so stops up the passage into the Auricle. The blood is hindered to get back out of the Arteries into the Ventricles by the Valvule Semilunares.

It is not easy to determine whether the heart is Elongated or shortened in the Contraction of the Ventricles, for at the very time of its Systole its Apex strikes against the Ribs. — Harvey relates a fine opportunity he had of seeing the heart Contract in a young gentleman who has an Ulcer in his Breast some of the ribs having been broke and the Ulcer turning fallow left a large opening there w^{ch} the Dr says the Heart strike

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Strike against the ribs when it contracts, but notwithstanding this the Heart may be shortened in its contractions, for as the Heart is situated in the Thorax suspended by its proper vessels in the pericardium when the arteries there are turgid the blood rushes into the Auricles and arteries makes it strike against the side by lifting it up, for it would seem to be rather the force of the contraction of the large vessels that makes it strike against the Breast by its rising up, as its own would rather appear to bring it back, for Suppose y^e heart to be shortened in its contraction $\frac{1}{4}$ of an inch, the Auricles & arteries seem to be stretched $\frac{1}{4}$ of an inch the Heart may be really shortened in its Systole. —

By all the Trials I could make I am apt to think the Heart is shortened tho' very inconsiderably, and a Priori one should think it ought to be so, for the Tendinous fibres being at the base of the heart the Apex should be drawn up towards these See med.^e Essays Vol. 4.th —

As its no easy matter to Determine how much blood is sent from the Heart into the Arteries, and how much the Veins return I shall pass by that Question and go on to

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To a Phenomenon w^{ch} has puzzled some and perhaps has been the occasion of supposing that the Arteries emptied themselves at every pulse, What I mean is, How it comes about that the Arteries are generally found empty in a dead body? First they will be emptier in a Dead than a live Animal because the Blood in a living Animal is very much Rarefied & takes up more space, Besides the Blood will not cease to move thro' the Arteries Immediately upon the ceasing of the motion of the heart, It will like all other Bodies retain the motion last impressed as we see in a water machine where the water will continue to move thro' a pipe (in a Horizontal position) for sometime after the Impelling force has ceased to act, this is further assisted by the contractile force of the Arteries (which have nothing now to Resist them but a fluid which easily gives way) with force is more increased by y^e Cold, By these means their liquors will be drove forwards into the Capillaries from whence the veins will receive them.

I shall scarce enter into the dispute about animal heat whether it arises from the friction of the circulating fluids against the sides of the Canalls
and

The Bloods Circulation

And against each other, or whether from that Intestine motion of the particles of our fluids we always must accompany that Spontaneous food which Vegetable food must undergo in order to acquire an Animal Nature, & Animal food still further to be Animalized, Both seem to have an hand in it. —————

The Velocity of the Blood during the Systole of the heart is to its velocity during the Systole of the Artery, as the force of the heart to the force of the Artery.

I do not know of any experiment which can prove the heat of our bodies to be produced by the attrition of the Solids & fluids together, If you apply a Thermometer to water that has fallen from a high precipice upon rocks, & consequently has suffered a violent Collision (as in a watermill you wont find it all warmer than it was before the fall; In fermenting wine indeed, and in churned milk there is a heat produced, but then there is a change made in the Constitution of the parts, and then indeed that heat will be produced; And as in our bodies there is always a Tendency to putrefaction w^{ch} is in a good measure produced by motion, and as Putrefaction is always attended with heat, we may hence conclude that motion or
the

Of Languification &c

The Attrition of our Solids is the cause tho' not the immediate Cause of heat, hence the greatest heat is when the greatest motion is, & that is in the large Vessels, tho' indeed it cannot be exactly known whether the Tendency to Putrefaction is the Cause or Effect of heat, they seeming (as may be guessed) to act mutually wth one another so that the one cannot be said to be the cause of the other tho' they depend much upon one another.

Some Alledge that the blood would be in danger of becoming too hot by frequent Circulations and that the Lungs serve as a Refrigeratory to it; But its evident that the blood is driven with greater impetuosity thro' the Lungs, and if you apply a Thermometer to the left Ventricle & to the right you'll find the heat as great in the one as y^e other.

Before we proceed to discourse of Perspiration & the action of the Lungs It will not be improper to observe again to you that always the further the blood be from the heart the slower is its motion, so that in the small Capillaries the force of y^e heart seems to be entirely lost, and y^e blood is returned to the Heart by the Veins (which are only the extreme Arteries reflected Back) by its being as it were absorbed by them, the force of the Heart being so small as to do no more than to hinder the blood from stagnating in these parts, & to determine the blood to them.

Of Respiration and the Action of the Lungs.

Respiration & the Office of the Lungs have so much to do with one another that I shall consider them both together, tho' Dr Boerhaave puts them at a very great distance for what reason I can't tell.

It has been in all ages reckoned a difficult matter & question, by what means the air rushes into the Lungs and is forced out of them again, and how this action when once begun should be continued after during life whether sleeping or waking without our being conscious of it.

To any account of Respiration yet given there have been unanswerable objections made; Dr Marten in Med. Essay Vol. 1st has started difficulties to all the different Hypotheses, and endeavours to give what he himself calls an imperfect act of Respiration in which he insists mostly on the action of the Diaphragm, But it has been found that the action of the Diaphragm may be wanting yet the animal respire, as it is in great measure in women with child, & Hydrophical people, and Mr Lower in the Philos. Transactions mentions one whose Phrenick Nerves were compressed, yet he continued to respire much in the same manner as broken winded horses do, that in Inspiration the abdomen became plain or more concave and in expiration Convex. — It's impossible to act for Respiration in Dr Boerhaaves way, his account of the

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Of Respiration and

The Lungs is not just, for the transverse sections of the
cellule of the Lungs are never circular, but rather like those
of an honey Comb, and how can it be otherwise seeing they
are not only surrounded with a membrane but also contain-
ed in a cavity which will not allow them to expand not
near to their full extent and so they must press upon one ano-
ther; By D Boerhaave's way of reasoning viz if they be
circular, the blood should have a free passage thro' the lungs
when the vessels are most distended, and thus when we
have once inspired, we should never again expire.

If ^{vessels of the Lungs} they are applied to one another by straight lines, the
greatest compression of the blood will be when they are most
distended wth air, & when the air is thrust out again and they
in a collapsed state; It is only in the interval of these two
conditions the blood can freely pass, D Hook tells us
of a very good experiment which at first seems to contradict
this viz He laid open the Thorax of a Dog, and with a
pair of Bellows he distended the Lungs alternately wth air
and thus the Dog lived a considerable time, then wth two
pair of Bellows he making a continual blowing in of
air, distending the lungs very violently and keeping them
so distended a long time yet the blood still passed; then he made
the Lungs collapse as in expiration by pressing them wth his hands
and cutting a piece off the Lungs the blood ran freely out.

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The Action of the Lungs

To answer this objection raised from the first experiment, we must consider that the Lungs wanted the Compression of the containing parts of the Thorax which makes a resistance to the Bloods passage, And for the 2^d part the blood might still flow out of the large vessels which are never quite emptied of blood, but the Capillaries only are.

D^r Boerhave also forgot something w^{ch} he should have related such as a muscle becomes weaker by contraction but stronger by being stretched, this circumstance may be of use to us afterwards, And also that the Inspiratory organs are much stronger than the Expiratory.

The Lungs too have a Contractile power but not superior to the Compression of the Atmosphere as may be seen by placing the Lungs of an animal into a receiver so as to shut out the Air from the external surface of them, and fixing the Trachea out so that if Air may have access to it, it will easily overcome their Contractile power & distend them. In a fetus the Larynx is pulled up by its proper muscles and all the parts of the neck are huddled together so that the air could as little get into the Trachea as the Liquor Amnii into the Oesophagus, And the Inspiratory organs wanting the Assistance of the Atmosphere, come to be overpowered by the Expiratory, assisted by the pressure of the external air, and so the Child never

Never Breathes in the Uterus, but when the Child is born its
 head being raised, its neck stretched out, its Larynx pulled
 while the Epiglottis by its natural elasticity rises up and
 all the muscles of the Thorax are set in action by natu-
 ral instinct [if you please] The External air finding
 then an empty space rushes violently into it and pressing
 the external surface of the Lungs next to the Pleura, the
 Inspiratory organs which are naturally stronger come to pre-
 vail over the expiratory, but then the Diaphragm and in-
 tercostal muscles by contracting become weaker while
 the Abdominal muscles and Cartilages of the ribs by being
 stretched endeavour to recover themselves, and in short the
 Inspiratory become weaker while the expiratory become
 stronger, and thus they are brought very near an equilibri-
 um and a very small force will turn the Balance to the
 expiratory, Now the air within the vesicles of the Lungs
 being rarefied by the Heat presses upon the pulmonary
 vessels hence less Blood getting into the left Ventricle
 and Aorta, and consequently less is sent thro' all the body,
 but the Inspiratory organs being in action can receive
 none while the expiratory have what is sufficient
 for their contraction already within them, hence the
 Expiratory assisted by the elasticity of the Cartilages of

of the Ribs produce the action of Expiration in which the air having a narrow passage by the Glottis makes it concave outwardly, when the Lungs are collapsing the Blood passes thro' them and so comes to the Inspiratory organs, but when they are too much collapsed the Blood is again stopped and so the same causes take place as to the expiratory, as formerly to the inspiratory, Inspiration must again follow in which the air finding but a slow passage thro' the glottis the weight of the external air makes the pleura concave externally. ———

The Lungs are always contiguous to the pleura tho' Morgagni denies it & gives an experiment to support his opinion, but tho' I am far from doubting his fidelity or his endeavours to do the experiment right, yet he has certainly some way or other cut the pleura, and then the Lungs must necessarily collapse, for I have made this experiment too and always found them contiguous both in Inspiration & Expiration, the experiment is carefully to dissect off the Interostal muscles, and then to avoid cutting the pleura which is easily done in a Dog seeing there is always some fat betwixt these muscles
and

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And Pleura, and when you have done look thro' the pleura and the motion of the Lungs are visible, they will always be found close to the Pleura if the experiment has been made right; How can it be otherwise since the generality of adult bodies tho' they have never labour'd under a pleurisy have their Lungs strongly attached to the pleura, and how should this happen if they were not contiguous? Besides I think this might be proven a priori, for if the Lungs be not contiguous to the pleura there must be either a vacuum or some air contained between them, if there is a vacuum why doth not the External air rushing into the for ^{Nepels} press the Lungs to the pleura? It cannot be answered their Contractility hinders this & makes a resistance to the air, for this same contractility should also hinder them to rise into a great bulk when the Sternum is taken off; In the next place the air cant be contained betwixt them else it would be a counterbalance to the air contain'd within the Lungs, and so hinder Inspiration, See more of this in med. & pays by D. Martin.

We come now to the use of y^e Lungs which is to divide & break the particles of the blood that had made any Cohesions when circulating in the Veins that

The Action of the Lungs

That also they may be small enough, compact & dense to circulate thro' the body again. The Lungs greatly promote Sanguification and the Condensation of the Globules by the attrition they undergo in them, and consequently give it that redness. That great redness of the face &c. caused by holding the breath is owing to the pressure of the Atmosphere on one side and the force of the Respiratory organs on the other. The Density & compactness of the particles may give much of the red colour to the blood, some small proof of this may be brought from Fishes where the red globules are only to be found in their Bronchia (commonly called their gills) which they only have intended for & instead of Lungs & lie at their necks, as also in that glandular substance to be found at the head of their ^{which they can lessen or increase at pleasure} Air Bag. And about their heart all these places being considerably prest upon by the air. — All this is brought about by the pressure that the Blood suffers in passing thro' the Lungs when the vesicles are distended with air, but whether any air enters into the blood thro' y^e Lungs is something hard to determine, that there is air in y^e blood is very clear but in a sound state it does not act as air. Air

Of Respiration And

Air gets into the blood by the Lactals wth y^e Chyle
 but it is in so small quantity, and so mixt with y^e blood
 as not to be able to exert its properties in a sound state;
 This is evinced in an experiment in which I assisted M^r
 Stewart Professor of Nat^l Philos:; We cut a large piece
 of the Vena Cava inferior, and of the Carotid Artery before
 it divides after letting them be well filled wth blood & tying
 them, then we threw these vessels into the water which we
 before had prepared by y^e help of thermometer of the same
 heat as the blood of a living animal and out of which
 we had exhausted all the air least that in the water should
 keep up an equilibrium wth that in y^e blood and so hinder
 this to act & distend the vessels, and they immediately
 sink then we put the vessels with the water into a
 receiver and exhausted the air and leaving it thus for
 a good while, we found that this blood did expand itself
 very considerably and not till the mercurial gage had risen
 itself a great way; The blood did not rise in the artery
 till the mercury had risen to 22 inches, and in the vein till
 15 inches; This experiment proves that the air in our blood
 cannot be brought to act but with great difficulty, and
 when it does it produces the worst effects as in people ex-
 hausted after Hemorrhages from large wounds instances of w^{ch}
 I have seen, and M^r Petit relates several of the same kind. But

The Action of the Lungs

But the Question is how comes this air into our blood, some will have it to get in by the lungs, to prove this Mr Mery gave in a Scheme to the Royal Acad: of Sciences shewing that he injected air into the trachea Arteria and made it pass by the Pulmonary vein, and to avoid any objection he alleges the air after some Circulations is thrown out by the pulmonary Artery, but Mr Bullfincher says that the air which Mr Mery alleged to get into the pulmonary vein was there before, but from experiments its certain or however very probable that something I call it what you will Pabulum vite that Acidum vagum of Isaac Newton so necessary to the nourishment of fire, and after this has passed thro' the fire and been consumed by it / makes the air useless & even fatal to animals, as has been proved by their being killed when they have received air that has come thro' the Red hot barrell of a gun; Besides the presence of y^e air is necessary to our well being, The Lungs are pervious so as not to contain the air but let it pass thro' them in a dead animall which is prevented in a living one by the mucus and their adhering to the pleura. — Tho' this air in the blood is not the Elastic particles / for an Animal is presently killed by having the air injected into the veins so as to circulate with y^e blood yet it is something of y^e nature of air, and that it really is I doubt will never be demonstrated.

Of the Voice

The voice is formed by different apertures & Tension of the Glottis, being assisted in this by the Cavity of the mouth & nose resounding the notes like so many Violins, as is evident by the Trembling we feel in our nose when we speak so that some words or letters are formed by y^e Glottis some by the Tongue & some by the Lips. See that Chapter in Keils Anatomy concerning the Larynx.

Of Glandular Secretion

The way how Glandular secretion is performed seems not to be so well agreed on as could be wished; From the time of Malpighius to Ruysch, the Malpighian scheme was universally agreed on; He defined a Gland to be a small folliculus or sac composed of two membranes, one the sides of which the blood vessels ran, the laterall branches of which deposit the secreted Liquor to be carried off by y^e secretory duct, the remaining part of the blood being brought back by a proper vein; This was agreed on by every one till Ruysch opposed it: He would not allow the secretion to be performed by means of an Intermediate Folliculus otherwise he does not differ
much

of Glandular Secretion.

Much from Malpighius, only he would have the excretory duct to be a continuation of the small lateral branches.

All that can be said on either side the Question is done in Boerhaave's elegant Epistle to Ruysch in defence of the Malpighian scheme, and Ruysch's answer to it, and Mr Heister's letter on the same subject. — We should consider Mr Boerhaave as a person of the most polite letters and Mr Ruysch as a mere mechanic. If I may be allowed the term I which necessarily must be of some disadvantage to the latter, should one unacquainted with this read his answer. The Arguments of Malpighius are then

In morbid cases such as obstructions of y^e liver &c these little sacculi or bags are frequently seen wth the naked eye, To this Mr Ruysch answers that the small conoid or cylindrical vesicles might be formed into pellicles by an obstruction; Again in some preparations (say Malpighius followers) these sacculi may be distinctly seen, as by boiling the Brain the Cortical part seems to be composed of small Spherule, as also in luxuriant excreescences of y^e Brain, and wounds of y^e head these sacs are also sometimes seen.

There are also Two
cases

There are also two Cases related in Mem: de l'Acad: for 1684 & 1705 by M^r Littre which favour the Malpighian scheme, one of a man in perfect health who was accidentally Killed, and in whose Liver were prosecuted a good number of the ^{branches of} Vena Portarum to their terminating in those folliculi, and a branch of the Vena Cava arising from the Sac wth a branch of the porus Biliaris coming from each Bag. The other is of a Child who had its ureters grown together so that the Kidney was greatly swelled, and he could with the naked eye see the folliculi and the secretory coming from them and ending in the papillæ Uriniferæ which he demonstrated to the members of y^e Academy. Another Argument in favor of such folliculi is that a great many secreted Liquors change their consistence (as y^e Semen Bile & not &c) and become thicker, in order to which there must be some Reservoir where they may lodge and when y^e thinner parts may be dissipated or absorbed, now it is not so easy to know how this is performed if the gland were made as Ruysch would have it.

Ruysch's chief answer to the Malpighian scheme is that he could never see such folliculi or Sacs in a sound body and that his injections could never fill these Sacs. — D^r

D^r Boerhave answers to this that his Injections were not subtle enough, and that he is in the wrong to Imagine that his injections were capable of penetrating the smallest vessels, if so it would return to the veins which it does not, and besides this very manner he took to find them out would destroy them infallibly by distending the vessels so with his injections; Its true that Liquor injected by the Ductus Hepaticus come out by the Vena Cava & Porta whence it would seem that there is a passage or plain continuation of the Excretory with these vessels so that its not easy to determine which is right. X Tho' it would appear that

Malpighius notions take place for the most part, yet his followers have carried it too far when they wont allow any liquor in the body to be separated without the Intervention of a folliculus, for it is certain that what Daily flies off by the skin is not secured by the glandulae millares, In some parts of the skin there are indeed glands as the armpits &c but then they separate a Liquor different from the ordinary perspiration.

This Bag then is the most simple kind of Gland / The glands are distinguished into two kinds (Conglobate & Conglomerate) when all the excretories unite & form a large one the Gland is said to be Conglobate, when several of these are found together they are called Conglomerate Vide Keils Anat. on of Glands There is still a considerable difficulty about the manner how so many different liquors are separated from one & that in appearance a pretty Homogeneous fluid viz^t the Blood,
The

66 of Glandular

The old notion was that all the secretory vessels had such & such pores so disposed as to admit such & such liquors of particular figures, some spheres some angular particles &c and since our Canals are flexible tubes and of a cylindrical or conoid figure they will admit all particles whose size are less than their diameter. But this doctrine of theirs is at large confuted by our Countryman Dr Pitcairn in his dissertation de Circulatione sanguinis & vase minima. The Chymists again observing a Liquor so different to the blood to be secreted from the Blood some would have it to be done by their Effervescence, and seeing from the mixture of two bodies a Tertium Quid is produced, But its needless to have recourse to such shifts as these, seeing our liquids may undergo very considerable Changes from the mechanical force of the Circulation, by which they may in some Cases be made more compact & dense, in others more diluted &c by which means a vast variety of Combinations may be produced. Dr Keil in his chapter of the glands gives an account of the most common way of Glandular secretion now performed as its thought now a days which is that the Blood is thrown to the secretory organs in some places straight, in others by hooked or

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Secretion.

Of Serpentine windings or canals in some at a greater distance ~~into~~ others at a less from the Heart, and by vessels of different diameters according to the Liquors to be secreted, In morbid cases of some kind where the pores are preternaturally dilated we find the blood separated

The vessels that are capable of making any secretion must be smaller than those that admit the red globules so that if the finest liquors are to be secreted or excreted then the Canals are only of that wideness to admit this liquor, and none the diameter of whose particles is larger, If a liquor whose particles are a 2^d or a 3^d largeness in their diameter, then only those with those of the first size can pass thro' the secreting organ whose diameter must be no larger than to admit these, and lest that the first size should be in too great a quantity there are some of the smallest going off from the sides of the excretory to take up & carry it ~~up~~ into the blood again thus the Semen Bile & not are very thin when separated as may be seen by irritating the nose, for instead of not there comes away only a thin Lymph, so that to have the liquor in any thickness you please, it may only lie the longer in the gland to have the finer parts of it ^{or left} taken up by small veins which are more in number as

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of Glandular

As their liquor to be secreted is more or less thin.

But then there is a considerable objection to this way of reasoning about the secretion &c. Why does the Liver of a Child separate the same liquor as that of a man? for one should think if a Childs liver separated Bile then its vessels being considerably enlarged it should in some years transmit red blood. But the force of this objection is taken away, if we consider that the velocity of the blood is prodigiously diminished in the small branches (as may be seen in an artery of the bigness of a silk thread having no contraction at all in which the blood runs in a constant & uniform stream) so that the velocity of the blood in the extreme branches of the mesenteries is to its velocity ~~of~~ in the Aorta as 100 to 1

The Velocity is also diminished in the extreme branches by the compression of the neighbouring parts, and by the attraction that the Liquids have to the sides of the Canals insomuch that the heart does not propel the liquids in the smallest Capillary tubes, but they are propelled forwards by the same Law as all liquids are propelled in

Secretion

In Capillary tubes viz^t by Absorption or any other name you please to call it, only the Succeeding liquors as it were an obstruction a tergo determine the liquor which way it should go. - Now if this Liquor is determined by y^e way above mentioned, and the contraction of the heart and Arteries have no Effect the most remote vessels must always remain the same in their diameters in a man as in a Child, in the largest as in y^e Smallest Animall. The Capillaries are smaller in an Adult than in a Child as is plain by injections which can be pushed much further in a Child than they can in a man. When the blood circulates wth great velocity all its parts seem of an Homogeneous nature and not able to separate from one another, But when the blood motion is scarcely perceivable viz^t in the Capillaries there the parts of it will have sufficient time to separate from each other, and then secretion will be performed; so that it is performed where the Circulation is very slow, & cannot be where it is great. Some suppose a different way which they think less liable to objections i-e that at our first Creation there is a particular liquor
im:

Of Glandular Secretion.

Implanted in each particular gland, after which that gland will receive no other liquor, And as we see by dipping a piece of grey paper in oil it becomes incapable of receiving water, &c. contra, this they would have analogous to the glands. This was first advanced by Mr Leibnitz & Bernoulli and improved by Mr Winslow who supposes that its internal coat or Tunica Villosa of the very small arteries almost filled up their cavity and that it was the very small processes of this Duvet (as he calls it) were first saturated with the proper liquor and received it into their Cavities. To this we need only answer that there is no such Antipathy betwixt any of our Liquors for that they are all of a saponaceous nature, and have been once mixt and will be easily mixt again with the least agitation, & that all of them are intimately mixt wth one another; Besides the Villous coat in a sound state is firmly tied down to its muscular the Intervening cellular coat being inconsiderable except in a morbid state and the Duvet not to be observed till after maceration in warm water. Thus much for the glands in general and the method how secretion is performed. We come now to speak of the secretion of particular glands and first of the secretion of ~~the~~ ^{the} brain =

Of The Secretion of the Brain.

The Head gets its Blood in the most direct way from y^e heart as the orifices of the Carotid Arteries are most directly opposed to the action of the left Ventricle of y^e heart and so far as that Law will take place in Hydraulicks, the finest & most solid parts of the Blood will get thither, If our Canals were made of wood Iron & such like this Rule might take place but it must be considered that our Canals are flexible & Elastic & in their Systole will intimately Blend the blood and throw off the most visious least moveable part that is apt to stick to their sides, Besides they have a motion from their Center to their Circumference communicated to them And also when the Arteries contract are driven from the Circumference to the Center; As the Internal & External Carotids divide at a very small angle there must be very little difference in their Blood, but if there is any that Law obtains the finest must go to the external, but without assuming any thing in this the Blood in a man has no great way to go, In some Brutes indeed it has a great way to go, but this is recompensed by y^e Course downwards which it has in them. — As it is necessary the Blood lose some of its Velocity before it enters the Brain, considering what fine tender Canals it has to pass thro, lest it should otherwise destroy some of them, the Carotid Artery makes several Turns as it enters, & within the Skull. The

Secretion of the Brain

The Eye is served by the Internal Carotid, The External indeed has as pure blood at first, but as there are secretions of fine liquors made from it in its passage, it comes to have more gross Blood in it hence not so proper for the Eye.

The finest & most subtle injections we can make, can go no further than the Cortical part of the Brain, In a natural state there are no red Globules of Blood in Cortex and when we separate the Dura mater we see nothing but very fine Vessels, except sometimes a vein which runs a good way not into the substance of the Brain but between the Circumvolutions of the Cortex. — The Cortex of the Brain seems mostly to be composed of fluids, for when it is dried, it shrivells up almost to nothing, In it there are an Infinite number of small Bladders heaped together in clusters into each of which enters an artery, a vein, & Excretory duct goes out hence it would appear that it serves for separating a Liquor like as other glands. The Nerves seem to consist of the Medullary part of the Cerebrum, Cerebellum and Medulla Spinalis prolonged, and in all probability contain a fluid, yet that is denied by many because it was never seen, but it must be very fine for the Brain and nerves have very little solid in them as is seen by drying them. Dr Morgan pretends if there was a fluid it would be subjected to our senses, But I would ask him if a fly had no Juices since they are not demonstrable to a naked Eye.

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Secretion of the Brain

D^r Porterfield in Med: Essays Vol: 4th has demonstrated that the nervous Fibres of the Retina must be an innumerable number of times smaller than a hair, otherwise we could not see objects distinctly as we do, But they may be much smaller for ought we know; How fine then must this fluid be? But there are some objections to a fluid having the force to perform several functions, but as the motion here must be exceeding small & slow the parts of y^e fluid have a very small cohesion, otherwise it would be impossible but the force wth which they attract one another & y^e sides of the canal would overcome the propelling force, which is here as in other Capillary Tubes only the obstacle a Tergo (as it is said elsewhere) hinders the Regurgitation and determines the Course of the fluid. But to show how great a force a small quantity of fluid will have, take a piece of wood dry it very well at the fire then expose it to a foggy air, & lay as much weight upon it as you will, and in a short time it will raise it; or take a piece of whip cord ~~it will~~ do y^e same, and it will raise a weight of any heaviness provided it be not as much as will break the cord suspended to it. The story of Pope Sixtus y^e raising a large pyramid by wetting the ropes in water is so well known that need not mention it. Thus the force which the Liquidum Nervosum exerts on the villi of the Muscles must be very great
Thus

Thus we may only suppose the nervous fluid to be weak, and as Liquid as common water which from w^t is said before / is capable to penetrate even the hardest substances, even gold itself as was found by making an experiment of a globe of gold and filling it wth water, then cementing it together and putting it into a press the water ^{was} found to have penetrated thro' the substance of the Gold. Water then being composed of such a number of firm solid particles / altho' there are a great number of interstices betwixt them as is known by its lightness / is capable of such penetration. So that we may suppose the Liquidum Nervorum to be such a fluid composed of such hard ^{or firm} particles but in y^e mean time having a great number of pores. The Nerves cannot act by their Elasticity / as some will have it / for by an experiment of D^r Stewart it is found that they have less Elasticity than any vessels in the body, and any that they have is owing to the Dura mater which form a coat to them, for the Strings of y^e Cauda Equina do not shrivel up when cut, and besides this way of reasoning for the nerves acting by their Elasticity is attended with so many objections that its favourers cannot answer for which reason it ought to be rejected. Let us ask them what is the reason that after any nerve has been tied & stroked down with ones hand once or twice the muscles that it serves should act no longer unless the Ligature be either tied further up or removed entirely? This experiment is

Secretion of the Brain.

Inclasp'd by M^r Monro in his Treatise of the Nerves annexed to his osteology, it was done by Bohn, Pitcairn, himself and many others, And Besides all the Nerves are deprived of their coats before they are capable to give sensations which if they acted by their Elasticity would considerably hinder it. The Fluid in the nerves cannot be acid or alkaline else it would destroy them, Its canals and they cannot contract by the explosion of it, if so there must be some liquor or other mist with it in some particular places to set it on fire. If I may so speak otherwise it would be continually exploding within its own Canals and it is plain that such an explosion would be without the reach of our Command. The Nerves then act thus, They are supposed to be Canals full of Liquor, when they have any object applied to them, the Liquor is hindered to flow so freely as it did before which resistance will be found at the Fountain head or origin of the nerves and as Reaction is equal to action will have the same Effect as if there made, seeing all objects act by a plain mechanical impulse or pressure as may be seen in Monro's Treatise above mentioned. The Brain then serves for separating the Liquidum nervosum from the Blood in the same manner as other glands do and this Secretion is exceedingly slow. - From what has been said it appears that all the parts of the Brain serve for the same use, and that the

Pro:

Secretion of the Brain.

Protuberances of it come from the fibres collected in bundles more in one place than another, for instance the Tubus Arterialis is nothing else than a Bundle formed by the conjunction of the *Truncus Medullæ oblongatæ* and *processus medullares cerebri*. The Cavities in the Cerebrum are to allow it to receive a greater quantity of Liquors at one time than another th without doing any harm, hence the Nerves coming from the Brain at sometimes furnish only a very small quantity of Spirits, whereas the Cerebellum which has no Cavities propels its Spirits in a constant continuall equal stream. Yet these Gentlemen who will have the nerves to act by their vibratory motions, will allow no other use to the Brain than Separating a liquor to keep these Chords moist & in a constant capability of action, but this way being attended wth so many almost incompatible difficulties, it is now rejected by the most part of Physiologists.

And yet others have gone a greater length in asserting that the Brain was not altogether necessary for life, because there are some instances of Children & some brutes born either without Brains altogether or whose Brains were putrefied or a hard irregular Lump of flesh. But to this it may be answered that these animals never lived above a day or two after their Birth, and that one that had the Lump of flesh ^{had}

Secretion of the Brain & of Sleep &c
 had a Secretion performed / altho not in the ordinary
 way / that supplied the nerves with a liquor. —

An Acc^t of Sleep how Caused &c —

cts a too great Inanition or Emptiness of y^e Vessells especi-
 ally the Nerves, may when there is not enough of fluid to
 serve the Muscles occasion Sleep, so too great a fullness
 of y^e vessels when the small nervous fibres are pressed upon
 by the distended vessels may also occasion Sleep.

Seeing Sleep may be called the time of recruiting the
 Body worn out by the days Exercise, how comes it to pass
 that the vital functions are still exercised in Sleep?
 This may be answered if we consider that the Anterior part
 of y^e Brain or Brain itself has large Cavities in it which
 Cavities or Ventricles may be filled with nervous Juice
 and so there may be some Store of it laid up for the days
 waste, and consequently the flux of that Juice must
 be none or very inconsiderable during Sleep. And as the
 most part of the nerves designed for muscular motion
 come out of the Brain itself (so since there is no flux
 of Fluids there can be no action of these muscles, but
 seeing there are no Cavities in the Cerebellum, and the
 nerves that serve for the vital functions come from it,
 as

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Of Sleep how caused &c

As soon as the separation of spirits is made they are sent to these parts, hence it is that they do not fail during sleep; And as the muscles in general have no motion during sleep so do all the secretions become less, &c. There is no Saliva secreted during sleep for as soon as one awakes he finds his mouth dry & parched (especially if he sleeps with open mouth) But as soon as the Jaws are opened & a little moved the separation of Saliva begins to Increase. All the other secretions are diminished during sleep except that of Insensible perspiration which is Independent of the action of the Nerves / as is easily known by observation.

We come now to consider the use of those organs that serve (tho' not immediately) the Cyclopoetic viscera, and the first of them is the,

Omentum Its secretion use &c.

This membrane lies upon and serves the upper part of the Viscera of the Abdomen, so as not to allow itself to come further down than the navel in y^e Human Subject, tho' it does otherwise in Brutes. The principal use of y^e omentum seems to be in the first place to have a thin oily lubricating liquor speeded out of its glands by y^e action of

Omentum its Secretion Use &c -

Of the abdominal muscles and to grease & keep the guts in a fit capacity for performing their peristaltic motion, this is seen evidently by y^e Surface of the guts being as it were all greased over after death, and it needs not come further down than the Navell in the Human subject because of our erect posture, and the reading y^t that the oily matter has to fall down, . If it came down to the Os pubis / ~~the base~~ as in Brutes the horizontal posture of whose bodies require it / we should be continually labouring under an Epiphloecle, which they are exempted from. The next use of the Gland seems to be its subserviency to the Liver for as there is no passage to carry this oil out out of the body, so it is continually taken up by the Absorbent veins of the Mesentery & gradually mixt wth the Blood to be thrown into the Vena portarum, and assists considerably in making up that Saponaceous oleaginous Liquor the Chyle: But it is not carried to the Vena Portarum in that direct manner and in so great quantity as Malpighius would have it by his Ductus adiposi, for there are no such ducts to be seen so if it were carried in such a direct way and all in a mass it would scarce mix with the Blood at all in the Liver

Omentum its Secretion Use &c

seeing it is such an oily mixture, But as it is gradually taken up and mixed with the blood in small quantity, it comes to be sufficiently blended with it before it arrive at y^e Liver. When there is any Animal who has no Omentum there is always something to supply its place, thus there are a great many fatty cells about y^e Stomach in Birds and a great deal of oil in y^e Liver of fishes. —

Of the Liver & Spleen

The Liver separates one of the Sharpest Liquors in the whole body, and the Blood which goes for its secretion undergoes a considerable & particular preparation, it being the only blood in the whole body that has undergone a complete Circulation before it comes to the Secerning organ, for it comes to the Vena portarum after it has returned back by the veins from serving all the other viscera of the Abdomen. As it receives a great part of its blood from the Spleen I shall first treat of it. It has been matter of dispute in all ages what change the Blood undergoes in y^e Spleen and what was the particular use of this viscus, and indeed it is no great wonder considering its texture and insensibility, so that it has been sometimes swelled to a

(Con=

Of the Spleen its use &c

Considerable bulk / from obstructions / without the least pain, and it has been cut out without any seeming inconvenience for some time. It is now generally agreed upon to be subservient to the Liver. When the four Galenical Humours prevailed the Spleen was thought to be the seat of one viz^t Atrabilis, but it seems very improper for that office since it contains the most fluid blood in the whole body. The Chemists again would have it to be the seat of their digesting menstruum which say they it sends into the Stomach by the Vasa Brevia, whereas those Vasa do really carry back y^e blood from the left side of the Stomach to the splenic vein. — Since the Circulation of the Blood has been found out there have been a great many uses assigned to the Spleen The Chymists would have it to send a fermenting liquor to the Stomach, or to precipitate the Bile from y^e Blood and so render its secretion more easy, But such fermentive are not in y^e body, if they were they would burst y^e tender substance of the Spleen. Mr Richard Blackmore maintains that it some how or other serves for generation, for says he all the parts of y^e body are either usefull to the Individual or for the propagation of the

Of the Spleen its use &c

The Species, But the Spleen is of no use to the Individual therefore says he it must serve for serve for generation. But it is easy to see his Syllogism is is lame in y^e minor proposition, for it does not necessarily follow that because he knew no use the Spleen served for y^e Individual that therefore it should have none, What made him think it was of no service to y^e individual was that Animals lived when it was cut out, but they turned more salacious, which would rather seem to prove that the spleen was an hindrance to Venery, But this depends on a greater Quantity of blood being sent by y^e Spermatic Arteries and consequently more seed separated; they likewise become more voracious a greater quantity of blood being sent to the Stomach, and so more Liquor gastricus being secreted, upon which a good digestion depends, but both these were only temporary. Those who have carried the experiment far enough as Mr Peyer have found that tho' the Animal was in pretty good health for a while, yet if it was long kept its Liver began to turn Bigger, harder, and its Biliary ducts to be obstructed, till at last it wasted and died in a Year or two, The same has also happened when the Spleen has been in a morbid state.

Of the Spleen its Use &c

Tho' all agree that the Spleen is subservient to Liver yet they differ among themselves which way or in what manner it is so, Mr Cowper in Drakes Anatomy fancies that it serves for accelerating the motion of the blood in the Vena portarum, but a small artery sent out directly from the Aorta would have done this much better, on the contrary all imaginary care seems to be taken to diminish the Velocity of y^e blood, for y^e Arteries divide into very small branches w^h are spread in the small cells of y^e Spleen where it is almost entirely out of y^e Laws of y^e Circulation. Spilatti who was one of the first mechanical writers in the Physiology and Keil who seems mostly to have taken it from him, These two agree that y^e use of y^e Spleen is to retard the blood, but they differ about the design of this, for Spilatti & Bellini wou^d have it retarded that its parts might recede from one another, and so the secretion of y^e Bile be more easy, for say they the greater the Velocity of y^e Blood, the more will its parts be compacted together & c contra, But Keil wou^d have the blood retarded that its particles might attract one another more strongly and so the Bilious particles
which

Of the Spleen its use &c

Which do not easily combine, may have time to unite
 He to support his notions observed that if blood when stag-
 nated or Extravasated went into gummy Lumps. Vide
 Keil's Anatomy Page 79 — This
 Conjecture of ^{the} Doctors is pretty & ingenious enough, but
 if we consider that nature always takes the easiest
 nearest & plainest way in all her operations, this Opinion
 will prove as little satisfactory as the rest; For in y^e
 first place why is there any more blood sent into the
 Celiac Artery than is sufficient for nourishing the
 Stomach, Intestines omentum & mesentery? The Doct^{rs}
 answer would no doubt be, that out of a quantity of
 blood sufficient to nourish these parts, there would not
 be so much bile secreted as nature requires, and therefore
 what is more than sufficient for their nourishment is
 sent by y^e Ramus Splenicus into the Spleen, & thence by
 the Vena portarum into the Liver, But granting all
 this there does not seem any necessity for a particular
 Viscus for this purpose, seeing that if the Intestines
 had but been made a little longer than they are
 they would have taken a sufficient quantity of
 blood to nourish them and to secrete a proper quantity
 of Bile besides. — Mr DuRoi from observing
 an empty Space near the Spleen in the Abdomen of a

Of the Spleen its Use &c

A dead body, the proportional greater largeness of its Blood Vessels, and its Structure somewhat Analogous to that of the Penis (without considering that the empty space was owing to the air not being vacuified in a dead body as in a living animal) concludes that the Spleen was subject to Inflations like a Bellows without telling us how it is thus moved or to what purpose. — Some Dr Boerhaaves opinion seems most probable viz^t that the Spleen being exposed to the alternate Action of the Diaphragm, and abdominal muscles the blood in it, in some measure, suffers the same change as in the Lungs, for by this Conguassation the Blood is rendered thinner and finer, its oils more rancid, its Salts more Volatile, and all its principals more exalted, and since the Blood which is sent by y^e Vena portarum from the Chylopoetic organs has been robbed of its Lymph and finer parts, & so will be too thick & gross for the Secretion of y^e bile, it by being mixt wth the Blood [which is more fluid] from the Spleen w^{ch} consists of exalted & consequently Acid particles is rendered more proper for the Secretion of so Acid a liquor as the Bile is; This seems to be in some degree confirmed by y^e Situation of y^e Spleen not only in ones but also in

Of the Spleen its Use &c

In other Animalls, All the Quadrupeds have it either tied to the Diaphragm, or the place where the abdominal muscles have the strongest action ^{wh} is a little below the Diaphragm, The fowls have it placed at y^e side of their Air bags, so that it is very much comprised by the contained air, All Fishes have it lying upon their Air or Swimming bags, so that these Features as well as men have it so placed as to be subjected to an alternate pressure ^{wh} is no small confirmation of this Doctrine. As the Spleen has no great motions to perform nor is endued with any quick sense, and yet has a very remarkable number of nerves distributed thro' its substance, Its probable their use may be to pour into the Blood their subtile fluid. —

Of the Vile

The Vena Portarum besides the blood from the Spleen receives also the returning blood from y^e Stomach Guts Mesentery & omentum ^{wh} Laffar is said before gives a great deal of oil, Seeing if it were not taken up by y^e absorbent veins it would turn Rancid & destructive being so much exposed to the heat of the Abdominal Vif-

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Of the Bile How Secreted &c

Viscera and its one of the Chief Ingredients in y^e Bile; This Blood then from all these parts being mixt in the Vena Portarum makes one of the fittest liquors for separating the Bile, which is done much after y^e same manner as in other Glands. The next Question is Whence comes the Bile that is poured into & found in y^e Vesica Fellea? Whether does it Regurgitate into it by the Ductus Communis or does it come into the Gall bladder by Communicating Canals from the Porus Biliaris or substance of the Liver by what is called Ductus Hepato Cysticus, or is it separated by glands on the coat of y^e Gall bladder. Truly I think that it may come more ways than one, the Rings indeed of the Ductus Cysticus hinder a solid body such as a probe to pass either up or down, but they do not hinder liquors to pass either way And I do not see why the Bile may not regurgitate into the Vesica if any compression is applied to y^e orifice of the Ductus Choledochus in y^e Duodenum.

Of the Ductus Hepato Cystici

Which Morgagni absolutely denies, Winslow only says he saw it in an ox, But M^r Perault bestows

Of the Bile how Secreted & of the Gall bladder

A whole treatise particularly upon them, M Bohn in the Leipzig Transactions for y^e years 1682 & 83 & M DuVerney Jun^r in mem: de l'acad: des Sciences both describe them, as also Bianchi in his Historia Hepatis, but if it come either of these ways there is a great change made of it here, for besides the Absorption which happens to all liquors contained in Cavities and by which the thinner parts being taken up, the remainder is more thick & viscous, I say besides this it undergoes a considerable change by the Heat of y^e Place for this makes it more bitter and acid; Some say there are glands on the inside of y^e Coat of y^e Gall bladder, which separate a liquor of y^e same kind as that w^{ch} lines y^e Meatus Auditorius externus, and to this liquor they attribute y^e Difference of y^e Bile in y^e Liver & Gall bladder, I own indeed that the Crumen I saw when it is a little diluted wth water is exactly like Bile But these glands must be first proved & demonstrated on y^e Gall bladder before they are assumed; In fishes the Gall bladder is not contiguous to y^e Liver, and the Bile would have a very disadvantageous course up the Ductus communis, so that it must either be sent by some Canalls thicker that are too small to be seen or it must be

Be secured in some of the Coats of the Vesica fellea;
 The gall bladder is so placed as to be squeezed when the Sto-
 mach is full so that there is the greatest quantity separa-
 ted & sent out when most wanted. Its use was shown
 when speaking of Digestion & Chylification. —

Kidneys how they Secrete &c

As to the Kidneys their Secretion is made Much the
 Common way only we should observe Urine undergoes
 a considerable change after it is secreted, before it is
 thrown out, for it is not near so high coloured, acid
 or so strong smelted at first but as the thinner parts
 are absorbed from it in its passage through y Ureters
 and more so during its stay in the Bladder, the Olea-
 ginous Saline & Earthy parts shew themselves more
 a proof of this I had occasion to see in my own practice
 A Gentleman had an Ulcer in his Kidney which I
 ventured to open, at every dropping the Urine, after
 wiping away the pus, came out by itself newly se-
 creted, I gathered some of this Urine in a tea cup & com-
 pared it wth some which he evacuated from his bladder
 and

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Kidneys how they secrete. &c

And found them to differ greatly both in colour, taste & smell, That from his Bladder consisting of more Saline, earthy & oleaginous parts, being rendered more exalted & high coloured, the finer parts of it having been absorbed again to mix with y^e mass of Blood.

M^r Morin Affirms that all the Urine does not come by the Kidneys, but that most part of it must come directly from the Stomach to y^e Bladder, for says he Mineral waters pass much sooner by Urine after they are drank, than its possible they could do if they went thro' the Lacteals and so underwent the whole Course of the Circulation, But certainly this Experiment has not been accurately made, for he has been induced to think this by observing that after two or three Draughts, they were observed to Urine after every Draught, which he has imagined was owing to y^e Draught taken immediately before, but he should have made them empty their Bladder after y^e first Draught, and then observed how long time they took to pass this, w^{ch} is certainly considerable, tho' not so long as some have imagined seeing the motion of most of our fluids is so rapid; Upon drinking of Mineral waters or any diureticks the Pulse is always more full & frequent, w^{ch} is a proof that they are mixt wth y^e blood.

M^r Morgan in his Philos. Principi: of Medicine says y^e same
 thing to prove which he says he hung up the whole
 viscera of a new killed Animal, and poured water into
 the Stomach and found it in the bladder after a short
 time, But this is absolutely false & M^r Morgan being
 sensible that it would be denied him dropt it in the 2^d
 Edit:ⁿ of his book, He tells us that he tied up y^e Ureter
 of a dog & sewed up his abdomen, yet found the Urine
 in his Bladder after a short time, But this is also false
 as the other; There may indeed be a little liquor found
 in the bladder, but this is only the muilage of the
 glands for defending the coats of y^e Bladder from the
 acrimony of the Urine, and Eustachius (who can't
 be said to be concerned on either side of y^e Question)
 absolutely tells us / & so it is / that if you tie the Ureters
 there can be no Urine found in the Bladder, but the
 Ureter will swell betwixt the Ligature & Kidney and
 collapse betwixt it & y^e bladder. At last the Doct^r falls
 upon ^{way} a way for accounting for it, for seeing D^r Boerhaave
 in his preface to the Auctores de morbo Gallie affirm-
 ing that all the parts of y^e body are connected by a
 Cellular Membrane whose Cells communicate wth one
 another, thought he this would serve his purpose very
 well for the water might get into y^e Cellular substance
 of

Of the stomach, and since this cellular substance has communication all the way at last it gets into the bladder. But in y^e first place how should it get into the cellular substance of y^e stomach? For the Tunica Villosa is in its way, and then the strong muscular coat of the stomach compresses the cellular substance makes it collapse and so hinders any thing to pass by it; but besides how should a watry liquor pass thro' so much oil as is contained in the cellular membrane every where? Sometimes then y^e Secretion of urine is stop'd so the Evacuation must be made another way. There is an acct of a boy in the Philosophical Transactions who never pass'd his urine the common way but while he lived aboard under a continual Diarrhea, I wish the history had been accurately made & Related, and that it had been shown whether the Kidney sent the secreted liquor to the Intestinal Glands by particular Canalls, or whether it was secreted by y^e Glands of y^e Intestines. Some under a suppression of urine have been found to vomit up something like it. The urine is protruded much in y^e same way as y^e feces by a gradual Relaxation of y^e Sphincter Vesicæ and action of y^e Detrusor Urinæ, and by determining the force of y^e Diaphragm & abdominal muscles to act on y^e Bladder. —

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Of Perspiration

The Skin has an immense number of Exhalant Vessels disposed on its Surface, carrying off a matter from the Body which would prove extremely hurtful if detain'd. This is called the *materia perspirabilis* and may be render'd visible in the Summer time on a White wall coming from the head of a person standing a foot or two distance when the Sun shines. The Quantity of this in Italy was found to be very great, but it is much less in Britain, as we learn from Dr Keil's observations, But the difference betwixt if Two would probably have come out less, could it be determin'd what quantity of Air the Absorbent Vessels of y^e Skin take up which certainly must be more in the moist air of Britain, than in Italy.

When this Evacuation is made in a greater Quantity than can fly off readily it is called Sweat, This was generally said to be done not only by y^e above mention'd exhalant vessels or Extremities of the small arteries, but by particular glands called *miliares* lying immediately under the Skin upon the fat, But the Existence of these Glands can hardly be demonstrat'd, what is taken for them being only morbid Tumors; All the Phenomena of Sweat are easily accounted for upon supposition of y^e same organs serving for both; Thus upon using violent Exercise The

The motion of the blood is increased, and the materia perspirabilis makes its way out in great Quantities, & so relaxes the vessels as to admit y^e grosser particles of Sweat; In fainting or the like, the Extremities of y^e vessels lose their Contractile power by which they retain their liquors and so these flow out in great quantities.

On Muscular Action

This is a Subject which has given as much play to peoples Luxuriant fancies as any other, and indeed it is as difficult a Subject as any in the Physiology.

A Muscle is a Bundle of fleshy fibres closely connected by cellular fibrills, its Extremities consists of y^e same fibrills more closely joined & compacted, which is also more Elastic but cannot Contract, This is called its Tendon.

The Arteries which are sent into the Muscles divide into innumerable small branches, and it is to the blood in the Artery & Vein that y^e Red colour of y^e Muscles is owing
(but

(But red blood is not absolutely necessary for the action of a muscle, for we see some fishes whose muscles are quite white ~~white~~ & yet act) Leuwenhoek in the Philos. Transactions for 1720, has demonstrated that a red globule of blood must be divided into 64 parts before it can enter into the small Ramifications of Arteries before contraction of a muscle, What we take th our naked eye to be a single fibre, when viewed th an ordinary microscope appears to be composed of a great number of fibres, and thro' a better one each of these single fibres appear to be composed of a great number of smaller ones, so that we do not know how infinite the Division of a fibre may be, Thus when we trace an Artery or Nerve very accurately ^{in a muscle}, one would imagine its substance to be quite composed of such nerves or arteries, the fibres being connected by cellular membranes in wth there is a little oil, are also joined by transverse fibrils, — All muscles have a natural Contraction independent of y^e will of y^e creature, this does not depend entirely on their Elasticity, otherwise it would not take place in a dead animal, less than a living one which it does. The natural contraction ^{is}

Is greater than from the Elasticity, and the Voluntary again as far greater than the natural. When the Arteries that go to any muscle are tied that muscle loses its contractility (tho' it may retain a little of it for some time) unless the muscle has an Artery somewhere else, or anastomosing branches from some other Artery. And herein seems to have been Mr Brown Langrish's mistake, when he affirms that he tied of Carotid Arteries and the muscles of y^e Head still retained their action hence he concluded that the artery was not necessary to Muscular action, but he forgot to tie the Vertebral Arteries w^{ch} also serve these muscles; He was guilty of y^e same mistake about the Crural Artery, as he forgot to tie the posterior Crural or Muscular Artery, Nay he allows that in some Experiments that he made when the blood was entirely intercepted that the motion was lost. The Tying of a vein also destroys the action of a muscle, but in this case it turns thicker & redder, whereas when the Arteries were tied it became pale & flabby. If the Nerve be tied or cut the Muscle also loses its action; Mr Duvernay tied the 8th pair of Nerves in a dog, yet the Heart in
some

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On Muscular Action.

Some measure retained its action, because it was supplied a little by the Intercostals, - Some will affirm that a muscle is always shorter when it acts, but I deny that this always happens, for when we bend our body forwards the Trunk of y^e body is supported by the muscles on its back part, and it is plain that these muscles are then longer than when they do not act at all, In y^e same manner while we support any weight wth our hands, while our Arms are stretched out this is done by y^e Biceps Flexor Cubiti tho' it is in this longer than when it is in a paralytic state. This motion can be communicated to any muscle Instantaneously at pleasure; There are no experiments to prove that a muscle is increased in Bulk while it contracts, If any one immerses his arm in a vessel of water and then make all the muscles of y^e arm Contract, he will not find the water rise a bit But this Experiment proves nothing & is very defective, for notwithstanding y^e water does not rise the Muscles that act may be increased in bulk, for it is impossible to make Antagonist muscles Contract at

At the same time, unless one is seized wth some convulsive motion or contraction, in that can indeed opposite muscles may act at once, and then if an hand was put into water we might certainly know whether the muscles increase in bulk or no when in action but else we cannot know, because the muscles that act may indeed increase but then the opposite muscles w^{ch} are now relaxed may be diminished in bulk as much, and so the water may not rise; But perhaps this Experiment has not been done wth caution and care eno^g, Some alledge that the water decreases, & perhaps this may happen if the Absorbent vessels of the Skin do absorb fast, so that bathing in warm water any part of our body sometimes thins the blood so much as to give the Urine a watry Colour & Consistence. When a muscle contracts it becomes harder whiter & firmer. Considering the smallness of the proper muscular fibres and the subtilty of Liguors contained in them, we should not asigne any properties to them but what are grounded on Reason, First Some have advanced that the Action of a muscle comes from the mixture of an acid & an Alkali in the blood (viz^t the blood & Spirits) but this Opinion ^{does}

Does not need much computation, for we know that there are neither Acid nor alkali in the blood in a natural sound state; Secondly Others again would have it brought about by some Explosive force or expanded Air or some such thing, but this action could not be at our Command.

D^r Keil & Bernoulli have fallen upon another method of accounting for it, By supposing every globule of blood to contain a small particle of Air, which is hindered to expand by y^e Shell of blood that Encloses it. Bernoulli supposes that

by the Influx of the Nervous juice into the muscles, the Spicula that are in it break y^e Shell of blood, and so the air gets free & expanding itself contracts the Muscle. D^r Keil supposes that the Influx of the animal spirits causes the attraction of y^e blood to these to become greater than the attraction of its parts among themselves and thus the air gets free; But without desiring them to prove that there are pointed Spicula in the nervous juice, or y^e greater attraction &c. Only Consider this, How does the Action of a muscle cease so instantaneously? Perhaps it will be answered that new liquors are sent in, but How can either the expanded air get out or the new liquors get in while the

The Muscle is in Contraction. — Thirdly
 Dan: Bernoulli Son of y^e former & member of the
 Petersburg society supposes the Nerves to be twisted in
 a spiral manner round the Villi of the muscles w^{ch} is
 nothing but the continuation of small arteries & veins
 so that when the nerves are filled wth spirits they grasp
 close to y^e muscular villi & hinder the liquors to pass
 and so as it were the cylindrical villi is inflated and
 made more capacious in its transverse diameter while
 it shortens the same way as a piece of gut distended
 wth air has its diameter increased by tying bits of thread
 here & there, The Nerves says he by their Elasticity
 occasion the natural contraction, and he calculated
 the ^{q^{ty}} nervous fluid requisite for this contraction w^{ch} he
 makes but very small, And likewise what length of its
 fibres the muscle Contracts making it about $\frac{1}{12}$; But
 in the first place he must ~~first~~ prove this mechanism
 and secondly the Ligature is by no means strong en^{ough}
 for this Resistance, If the same fluids still remain in
 the muscle, How comes it that in its action it shoud
 be of a white colour? M^r De Molieres in
 the Acad: des Sciences 1723 has an opinion much
 akin to this, He imagins the muscular Villus to be
 formed much in y^e manner of a Zig Zag, and the Nerve

And Artery to be fixed to the Angle of the Villus
 And that when the nerve is filled with liquor its transverse
 diameter being enlarged it becomes shorter and draws the
 Angles of y^e villi nearer to one another & sometimes all
 the Villi of y^e muscle ~~of y^e muscle~~ shorter, but this is
 as much as to say the motion of the muscle is made by
 its Villi ^{pulling} following yet these Villi do not in y^e least
 contribute to it. But these opinions are just as pre-
 carious as y^e others, since neither these Gentlemen nor others
 for them have had the good luck to discover these spiral ner-
 vous fibrille running round the muscular fibres, so that
 instead of real ones they may justly be reckoned ima-
 ginary. To me Dr Boerhaave's Opinion seems the most
 simple, but most probable & satisfactory, tho' it is liable
 (from some Phenomena w^{ch} cannot easily be solved by it
 nor yet can they by any other yet invented) to some ob-
 jections, He tells us the Brain ^{is still} separating a quan-
 tity of Liquor w^{ch} has the same properties as Lymph
 only that it is much thinner, finer, more limpid, sub-
 tile, less compressible and having a much less cohesion
 of its particles, the motion of this liquor is very subtle
 & slow, the Heart having no effect on it, and there being
 nothing near to disturb this secretion, it is equal &
 constant, All other glands are placed near some moving
 forces w^{ch} makes their secretion greater at some parti-
 cular

On Muscular Motion

Particular times, whereas this is much in y^e same state with other glands in a fetus the only thing that has any effect upon it is our soul, whose modus operandi we are utter strangers to, This Liquor then is sent into the Villi of all the muscles by y^e Nerves which open into the sides of y^e Small arteries, or else y^e Small arteries open into the sides of y^e nerves no matter which, and as it meets wth y^e blood flowing in the arteries in an equal stream for as has been before mentioned the force of the heart is lost in y^e Capillary arteries, The natural contraction will then be according to the force wth which this liquor is moved or to the quantity sent in, Now the Liquor being sent into the muscular villi equally occasions a natural contraction of all y^e muscles of y^e body, w^{ch} is equal ^{exactly} to that of their Antagonists being destroyed, that muscle contracts & keeps the Limb it belongs to always in y^e same state of flexion or extension untill a power equall to the Contraction of y^e destroyed Antagonist be applied.

Supposing then the Villus of a muscle to be a small nerve with arteries opening into its sides, or e contra, tho^o the natural contraction be but small, we at the command of our will can determine a greater quantity of liquor to flow into y^e villus and thus when its length cannot be increased its transverse Diameter is stretched and thus the muscle is contracted, and this contraction will be in proportion to y^e force wth w^{ch} the liquids are propelled.

The

The Reason why a muscle becomes pale in its contraction is because the red globules of blood are squeezed from betwixt y^e fibres by compression.

This way of Reasoning tho' liable to some objections (yet not near so many as any of those other opinions I mentioned before) for instance it may be asked how the Heart should exert so great a force, since the Animal spirits flow in to wth so little force, and one should think it would communicate only as much force as it receives and thus the Heart contracting wth a force proportioned to the small momentum of y^e fluid it receives from y^e Nerves, why does it not send the blood to the brain in less quantity &c thus less animal spirits to be separated consequently its next contraction weaker, & so on untill its strength entirely decays. But to answer this we need only prove that the Liquidum Nervosum (notwithstanding the small momentum it has) does exert a force superior to any mechanical one, this will easily appear if we consider what was said before how such a prodigious weight will be raised by a piece of dry'd wood wet, or whip Cord when moistend with plain water, Now this fluid of our Nerves is capable of producing greater Effects than any other as it can move more easily & insinuate itself into y^e pores of any body and pass out of them again as its parts have

Have an infinitely less cohesion with one another among themselves than any other liquors have, w^{ch} we can subject to our Senses. There is also another objection to Dr Boerhaave's Doctrine viz^t That the muscles are Capable of motion after death &c. The Heart of an El^l for a fetus / taken out of its body will continue to act for some time, and even some hours after will be found Capable of action again if you breath on it, Prick it wth a pin, or pour warm water upon it. In Answer to this objection we must consider that tho the Impulse from the Brain has ceased yet the fluids are still going on in y^e nerves (especially in an El^l's heart, seeing the Circulation of their blood is slow, and consequently the secretion & propulsion of the Animal spirits also slow) in y^e same way as the Lacteals of a dog w^{ch} immediately after death will be greatly distended with Chyle yet in a few hours become quite empty, so the fluids of y^e nerves may still go on to fill the villi of the muscles after the impulse from the Brain has ceased, indeed if red blood were necessary to the action or contraction of a muscle, that must certainly cease in the space of two hours after for by that time the red blood is coagulated; But as I said before the Red blood is not necessary to the contraction of a muscle, But why should it act by the pricking of a pin &c? There must be somewhat ascribed here,
 But

On Muscular Action.

But from experience we find that stimulating substances Heat and do Cause a contraction wherever they are applied. We also find that we naturally without the mind being conscious of it go into an accustomed Habit &c. by accustoming ourselves to one particular posture we naturally fall into it without any kind of reflection, to this seems to be owing the custom of turning both our Eyes one way, Besides this warm water & the breath act in a mechanical way, for the heat may rarify the fluids & make them more active; But tho' we are so ignorant of y^e souls way of operating upon the body & e Contra, yet we see that they have a mutual Sympathy with one another e.g. Any person that has a member Amputated will complain for a while of that same member giving him pain (tho' it be away) w^h argues that the soul has a care of all the parts of y^e body, and that tho' such a part be not existing yet the Idea of pain formerly gave to the soul is still represented in a lively manner to the mind, and that the person must Complain tho' he afterwards chide himself for his folly as he calls it, so if we argue on the other side that the body has a care for the soul if I may so express it and when the soul is gone the body shivers after the same manner as if it were still remaining, but we are so ignorant of this wonder full mutual Sympathy of the soul & body th^t that it may be said in this we know nothing save our own ignorance.

We

We must consider that the nerves going from y^e Brain to any muscle are always quite full of their liquors so that whatever force is applied to one end of them will be instantaneously communicated to the other just as e.g. a Pipe that is full of water, whatever force is made at one end, you will immediately see it communicated to the other be it ever so long. In this manner I would endeavour to acc^t for the action of Muscles, But how the will has such a Command of the Animal Spirits to make them exert so great a force on y^e muscles is I believe beyond the reach of human understanding; Man indeed is a noble Creature, and it is almost Incredible to what a prodigious extent his Intellectual all faculties may increase by improvement but still they are limited and it has been the will of y^e wise Creator that some of y^e Secrets of nature should be and are concealed from y^e Eyes of mortals.

Of the Senses.

It will be scarce necessary to say much upon These, since they are so largely treated of by a great many Authors. We shall only say in general that Sensation is brought about by an impulse and thro' the Remora occasioned by this impulse to the fluid of y^e nerves is immediately felt at the fountain head. But here we must stop we can go no further, the Brain is more matter and sensible of nothing, and the manner how the soul acts upon it, probably we shall be for ever strangers to.

It is very probable that all sensations are occasioned by a mechanical pressure, its very plain that y^e Sense of Touching is produced by such a pressure. Again The Sensation of Smelling is the same way for the odoriferous particles must be carried forcibly by y^e rapid motion of the air, thro' the organ And the Solid substance which gives the Sensation of Taste must sometimes be pressed upon the palate by the Tongue, before the Tongue can be sensible of y^e taste.

The Rays of Light collected in a focus will drive away a piece of paper or any such light substance held gently between y^e fingers; And

Of Sensation

And Sound will shake all the cords that are in the same harmony in proportion to the sounding one.

The Sensation of Touching is the most simple of any, The Tangible quality must be applied to the Papille nervosa wth that force w^{ch} is able to overcome the Cuticle, if we meet a firm resistance we judge the body to be hard, If there are a great many Irritations given to the papille we have y^e Idea of a Rugged or unequall body. The Sensation of

Smelling & Tasting differ very little from that of Touching, Both the Sapid & odoriferous bodies must be applied to the papille of the Tongue & membrane of the nose, Both of them must be moistend wth a liquor, And that Mucus in the nose

the odoriferous particles so that we are sensible of a very odoriferous body sometime after the body itself is removed. These two Senses have so strong a Sympathy wth each other that if you stop your nose (and at y^e same time close your eyes) you shall not be able to distinguish the Taste of bodies unless very acrid. All substances deprived of oil as Sal. Tart., Sal. E. &c. are very acrid upon y^e Tongue
and

Of Smelling & Tasting &c

And have nothing but a biting taste, whereas those bodies that have oil affect the Tongue in a different manner, for the Salt is enabled to act wth more violence being carried along (as in a Vehicle) wth the subtle oil that those bodies have, and I think the only proper object of taste is some such subtle oil, some Spiritus rectior (as we cannot however define); but bodies that have none of this are tasteless or Insipid. —

Light contains the seven Cardinal ^{natural} Colours, from a mixture of which all other Colours are produced; What we call a Red a Blue Colour &c are only in reality a certain disposition the parts of such a body have to Reflect such & such Colours of Rays, What reflects none we call black, What equally reflects all is White; The motion of this light is not instantaneous but by any experiment we can make by objects on this our earth we may consider it as such, tho by observing the Satellites of Jupiter which dont appear within five or six minutes of the time they ought by Calculations, we may judge that Light has a progressive motion, wth however is exceedingly rapid. —

The

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Of Light & Colours

The Rays of Light that fall on opaque bodies are reflected, and the Angle of Reflection is always equal to y^e Angle of Incidence, If they fall on pellucid bodies (as our Eyes) they are refracted and that in different Directions according to the densities of the mediums they pass thro^u; for the more dense medium they are refracted nearer to the perpendicular or converge as they call it, If they come from a dense medium into one more rare, they are refracted from y^e perpendicular, or nearer to a Horizontal, or Diverge. Now when the Rays of Light arrive from a rare medium viz^t y^e Air to one more dense viz^t the Aqueous humour of y^e Eye they are converged and this is still increased by the Crystalline Humour, And the Vitreous humour can be so compressed as to be near the same thickness wth the Crystalline, or it may be so much thinner And the Rays of light may either pass on to meet wth the Focus directly, or they may be diverged And thus they can be accommodated to the different distances of the object, assisted by y^e Crystalline humour being pulled further backward or forward, & perhaps altered in its convexity by y^e processus Ciliares, which are fixt into the Coat of y^e Crystalline Humour, so that when the Ciliary Circle is

Is dilated the Crystalline Humour will be brought nearer the Pupille & vice versa, Thus each point of the object comes to have its correspondent point on y^e Retina as may be seen by taking off y^e coats from y^e bottom of the Eye of an ox, and y^e Image of a candle held before y^e Eye will be directly painted on a piece of paper held at the bottom of the Eye. For your further Information about y^e sense of seeing, consult D^r Porterfield in Med. Essays Vol. 2 where this Function of y^e Eye is demonstratively & accurately treated.

Of the Ear & Sound.

The use of the parts of the Ear are so little known to us that we can say little about them But it is now agreed on by all that Sound is the Trembling motion of the air from the Sonorous Body, which motion is a kind of Intestine motion in the particles of y^e Air, so as to communicate the ^{Impulse to y^e} Fibres of the Tympanum's membrane that are in the Harmony in proportion ^{to}

112 Of the Ear &

With the sound coming from the Sonorous body which moves the air coming in y^e Cavity of the Ear so as to make all the Small bones there move & Communicate the Sound to the Nerve, which before it be Capable of any kind of Sensation must be deprived of its Coats. The use of the External Air is to Collect the Rays of Sound as we see by those who have it Cutt off who can hear very little without something to supply its place. For Hearing Consult Valsalva de Aure Humano, .

Of the Seed &c

The Testicles of the male Serve for preparing that thick white liquor the seed in which when viewed in a microscope we see an Infinite number of small Animalcules like Tadpoles. If this liquor is not separated there is a considerable change made in the whole body, as we see in all Animals that have been castrated; Perhaps this comes from the want of something which should be absorbed from the Testicles into the Blood; There has been a considerable dispute whether the Animalcules be originally in the Testicles or are separated from the blood, perhaps the Ani=

Of the Seed how Prepared & Ejected

perhaps the Animalcule in Semine is as it is in the Testicle and the thick glutinous liquor may be a Vehicle to it. When this liquor is to be Ejected, The Erectores Muscles press & twin of the Penis close to the os Pubis, hinders the refluxent blood to pass while more is still brought by the Artery; by this means the Cellules of y^e Corpora Caverosa Penis are distended, At the same time the Levatores Ani draw the Intestinum Rectum nearer y^e Bladder & consequently ^{comp}press what lies between them viz^t the Vesiculae Seminales, Prostate Gland & Corpus Caverosum Urethrae; and thus the Glans (which is nothing but a continuation of the Corpus Caverosum Urethrae) reflected back upon y^e Extremity of that of y^e Penis) is filled & swells; Thus the Penis is Ejected that it may be the more easily introduced into the Vagina of the Female, and convey the Seed which has now a free passage thro^o y^e Urethra, it being made straight & freed of its wrinkles by y^e distension of its Corpus Caverosum. In this Action all the muscles are convulsed, & there is a greater derivation of Blood & Spirits to these parts. Before we consider what the Female contributes to generation, we must consider a Phenomenon which has very much puzzled Physiologists

Of the Menstrual Flux.

Small Ages to Act for, I mean the Menstrual Flux which is a Periodical Evacuation of Blood from the Uterus, or Vagina according to some, every 21-24 or 28 days or Lunar Month ^{tho} it has got its name from six greater or lesser Quantities according to the different Constitutions, In women who live Regularly & are of a good Constitution, this Evacuation begins at y^e age of Puberty and continues till near 50 for the most part pretty regularly every month.

When the Menses first appear the Mammas turn larger & a little harder, Pains are felt thro' the whole body but especially in the thighs with a great tension & weight in y^e Hypogastric Region, She has a reaching to vomit, gripes in her Belly & sometimes a Diarrhea, her Colours is pale & yellowish for ordinary and she has but a small q^{ty} of them at first, Perhaps they come in great quantity at one time and then don't appear again for some months after. If this Evacuation be stop'd the whole Constitution is in danger, and all kinds of Diseases may be brought on When old age approaches it gradually wears off in the same manner as it came on, sometimes ^{tho} very bad Symptoms. There is a dispute whether the Menstrual Blood comes from the Uterus or Vagina; 'Tis true Both are capable to give it ~~the~~ a passage, their structure being much alike but in a sound ma-

Natural State ^{of women not in Child} it certainly comes from the Uterus
 M^r Litz in Mem de Acad. &c tells us that in some
 women he dissected ^{who died} while their menses were upon them
 he found the blood coming plainly from the Uterus
 And in a Child which I saw with Prolapsus Uteri the
 vessels of y^e Womb were so much stretched as to al-
 low red blood to pass. Those who affirm it to come
 by y^e Vagina have probably seen some instances
 of it as in a woman with Child, or y^e Cavity of y^e Womb any
 way filled up, but these are extraordinary Cases. I
 myself have seen them flow from y^e Vagina during y^e whole
 time pregnancy. It is a much more difficult Question
 to determine, How this Evacuation comes to be at such
 regular Periods; This as well as all other Physio-
 logical questions has been accounted for according to
 the prevailing Philosophy of y^e times. The Chemists
 would have it brought about by their Effluvia &c
 when the Planets were said to have a great Influence
 over y^e several parts & functions of our Body, then the
 Moon was said to preside over this Evacuation, But
 we see that it comes indifferently at all times of the
 moon, So that of y^e same family, not any two per-
 sons shall have it at y^e same time. All these
 doctrines have been long ago exploded, And since
 the

The Introduction of Mechanical reasoning it has been more justly ascribed to a Plethora. It is certain that women are so formed as to prepare more blood than what is sufficient for y^e nourishment of their Bodies, and this superfluous blood will be accumulated when they cease to grow, w^{ch} is abt y^e time the menses appear. This Blood must have an exit out of y^e body, and indeed by distending y^e vessels will force its own passage, and that rather at the uterus than any other part, where y^e blood is sent in greater quantity in proportion to the bulk of y^e part, where it gravitates in a large column, and has its ascent impeded in y^e veins by its gravity without any valves to support it, and where the vessels most easily yield.

Before we go further it will be necessary to explain what we mean by a Plethora, since there are diff^t notions about it, and many seem to mistake y^e true meaning of y^e word.

All vessels then may be more or less stretched wthout any disorder happening, and there are two fixt points beyond which the vessels can neither be filled nor emptied without a Plethora in one case, & an Inanition in the other; These two points are diff^t in diff^t persons and

And vary at diff^t times in y^e same person, so
 when we speak of the Tone of y^e Vessels of ~~any~~
 person we only mean what it is at present not what
 it has been or may be. A Plethora then is merely
 Relative and Quoad vires vaporum, Not depending
 on y^e Sole Consideration of y^e Quantity of fluids con-
 tained within the Vessels, but in the proportion
 between y^e Quantity of & y^e Strength or Resistance
 of y^e Vessels w^h contain it; So that a person may la-
 bour under a Plethora in this Relative sense of the
 word tho he should not have any great Quantity of
 blood, while another person of y^e very same size, but
 strong & Rigid vessels would with this small q^t of blood
 labour under an Inanition; Thus then Any Quantity
 of fluids w^h is able to distend the Vessels beyond their
 tone is call'd a Plethora, w^h makes them inactive
 and so loose their Elasticity till some Stimulus be ap-
 plied or they be emptied; Thus both in Plethora and
 Inanition there must be slowness of Pulse; But in
 the first case it is full & hard and the Artery seems to
 be as a Cord. The Reason why women should be lia-
 -ble to a Plethora, Dr Friend very well accounts for
 from

From their Sedentary life, And Sanctonius assures
 us that on this Acc^t they Perspire less, And that such Men
 as lead an Effeminate life have some such Analogous
 Evacuation either by Urine, the Hemorrhoids or a Di-
 =arhea &c. And I have known several who had such
 Periodical Evacuations & could exactly foretell when
 they would happen. - Some Relying on D^r Keils
 Authority (who says he tryed the same Experiment on
 himself but it did not hold) suspect Sanctonius to have
 wrote this on a preconceived piece of Theory; But D^r
 Keils way of living differs widely from that of Sanctonius
 The D^r was perpetually rambling up & down the Country
 being much hurried wth Business, and the paulo plus
 potus frequently came in & disturbed his calculations
 I do not wonder the same thing did not happen to him
 on y^e contrary Sanctonius lived a Recluse Effeminate
 life, and was certainly a much fitter person for making
 experiments upon of this nature, and no doubt faith-
 fully relates what he observed, And I think his Autho-
 rity in this case much more to be depended on than Keils.
 When a Plethora is caused The Blood (as I said before)
 will press where there is the least Resistance, and
 Con=

consequently will be determined to the Uterus first & then to y^e Mammas, hence Women know the Approach of their menses by the weight in the Belly & hardness in the Mammas; The momentum of the blood gradually dilating the orifices of y^e small exhalant vessels within the Uterus, The thinner parts will only flow thro' first till the orifices be so far dilated, as to transmit ^{as soon as y^e blood is freed from its plethoric state} red blood, after which they will gradually contract so as to transmit thinner & thinner parts till at last they only give a passage to the subtle fluid which they before exhaled into its cavity. Dr Friend tho' he

has wrote very well on the rest has Erred in supposing a Rupture of the Vessels of the Uterus, for if this were the Case, they must cicatrize after every time they were broke, and in a short time the womb would become ^{so} callous that it would be impossible for the force of the blood to break thro' them; on the other hand I myself have seen y^e open orifices of y^e vessels at which this evacuation was made in y^e Uterus of women who have died with their menses upon them. Some object against this doctrine of Plethora, that women Reduced to a shadow by a Pthisis Pulmonalis or any other lingering disease still have their menses regularly; Now say they there can be

be no Plethora here, so that Doctrines is false; But this
 Question depends upon the Definition of a Plethora, for I
 affirm in this very case there is a Plethora, for it is always
 Quoad Vires vasorum, and here not only the quantity of fluids
 are diminished but the vessels are proportionally weaker
 have less Elasticity and so a less quantity of fluid is able to
 overcome their Elasticity. I have seen from a very great
 laxity of y^e vessels Colliquatione menstrua where the patient
 was almost exhausted: even here was a plethora since
 the q^{ty} of fluids was too great for y^e Strength of the Solids.
 In a healthy woman perhaps 30 of Blood will scarce
 render her Plethorick, whereas if she is reduced low by
 any Chronic disease ^{it} may & will make her Plethoric.
 Again some observe that Bleeding in y^e Interval does
 not stop the menses, and so they make this an objection
 to their being occasioned by a Plethora: For say they if
 there was a pound of Blood to be evacuated by y^e Uterus,
 then by taking away 80℥. in y^e interval of y^e evacuation
 there should be only half evacuated by y^e Uterus the next
 time; Yet we see that this makes no alteration, But had
 they considered how soon this blood is recruited, they would
 not have thought the objection of much moment.

Sanctus

Sanctorius affirms that after bleeding Perspiration is diminished, and y^e quantity taken in by y^e absorbent vessels increased for some days till the body comes to the same weight it was before, And S^r Keil in his *Mediciniæ Staticæ* proves that Blood let out is soon made up again, And tho' the menses are stopped by very great Evacuations, yet they are not always, for y^e Blood stagnating while there was a plethora in y^e uterine sinusses, is not affected by these Evacuations but still distends y^e vessels, and with a small additional force will break them; Bleeding is frequently used wth success to bring on this Evacuation, but this only happens when the Quantity of Fluids are so much augmented as to distend the vessels so much beyond their tone, that they loose their Elasticity, and cant propel them with a sufficient Velocity or Impetus against the uterine vessels, for the Momentum of y^e Blood depends upon its quantity & Velocity; Tho' there be therefore a great Quantity, yet if it moves with a very little Velocity, its momentum will be but small, But if by decreasing y^e Quantity, I restore y^e vessels to their due Spring & increase y^e Velocity, I increase the Momentum likewise; For y^e Quantity in this case tho' somewhat less & its Velocity taken together shall be greater than the quantity in the former case / tho' larger / wth its little or no Velocity for

for the Velocity added very much overballances the Quantity taken away. Therefore when there are signs of a very great Plethora, as a pain in the head, heaviness over y^e whole body, uneasiness on any kind of motion, as when upon moving the hand or fingers a stiffness is felt, a Tension & swelling of y^e Eye balls a slow tho hard strong pulse, in this case bleeding is absolutely necessary, for it has been found that when these Symptoms oppressed a woman, & blood has been taken away, the menses have burst forth in y^e an hours time after the operation, tho' it ought not to be practised unless y^e above mentioned plethoric Symptoms Indicate it. Some object against a Plethora that there are women who have a constant Millium from y^e Uterus, But this arises from y^e great laxity of y^e vessels & thinness of y^e blood. In short the most part of y^e objections brought against a plethora after a thorough & particular examination of every Circumstance seem to Confirm it. Some stand up for a partial Plethora, that is they woud have y^e Vessels of y^e Uterus to be plethoric & no others; But whena got the Uterus the blood? Why say they from the Aorta descendens; The Aorta then either had it to spare or had it not, if it had it, certainly there must be

Be a Plethora, if it had it not then there was an inattribution and there can be no mention made of the sinuses of the womb being filled with blood to occasion the menstrual flux, for according to that Doctrine if the menses once when the body & womb have come to their time, that flux would never be again, seeing the blood had no further to penetrate into these Sinuses. The Quantity of blood ~~the~~ Evacuated is not easy to be ascertained as it comes but by drops; The Ancients assigned too large a quantity when they made it 20 oz. and others have erred as much on y^e other side; perhaps 5 or 6 oz is y^e Standard. There may be a kind of secretion of it and so it may not only be the Quantity but also y^e Quality that offends, for we see that men who have a periodical discharge of Urine, analogous to this of women. The Urine evacuated is always turbid as well as in large quantity. We come next to the final cause of y^e menses. If the female had no more fluids than what were barely sufficient for the nourishment of her own body, when she was wth child she would not have enough for y^e nourishment of y^e fetus and therefore nature has supplied her wth a superfluency, which is of y^e greatest service in the time of gestation, for the Quantity of this fluid evacuated during pregnancy decreases in proportion as the

Of the Menstrual Flux.

The fetus increases, and when that is large eno^r to take it all, it ceases to flow entirely till after y^e birth. I need scarcely mention y^e Common opinion that the menstrual blood is of a Poisonous nature, But it by no means differs from other blood, except that it may tend a little to Putrefaction & loose of its mildness when it has been a while out of y^e vessels; Tho' indeed one might imagine that nature makes use of this way to free herself from some noxious particles, on observing the bad Consequences that follow its obstruction even tho' there have been large evacuations made another way.

Of Generation

It is now agreed upon by most Physiologists, that the Female contains the proper Nidus for y^e Embrio, whose first Rudiments it receives from the male and nourishes it till it be able to bear the Injuries of the Atmosphere, for no Conception is formed without y^e Assistance of y^e male, whose Seed by proper instrument is thrown in as far as the Uterus where it has been found after dissection. Puych relates two Cases of women whom he opened who were killed immediately after Coition in whose Uterus the male seed was found, if we take his word for it, for we have no more to depend on seeing he did not put it to a Tryall by viewing it with a Microscope, w^{ch} he ought to have done & then he could have exactly told y^t that Glairy substance which he called seed was really so or not. But the seed goes still further, for the Ovum has been found impregnated in y^e ovarium, & sometimes the Embrio has been found in the Tube Fallopiana, And Extrauterine Fetus have been found adhering to the parts of y^e Abdomen, by all which it appears that y^e Seed has its influence upon the Ovum while it is in the ovarium, For the Tube Fallopiana change their Situation considerably, turn round & grasp the ovarium close with their fimbriated edges, and taking hold of the impregnated Ovulum gradually bring it down to the Uterus as has been

Been found in disputing bodies after a fruitfull Copulation, whether or no this is the ordinary way is Uncertain. If the Ovum is too large or if it meets wth any resistance in the Tuba it may fasten & grow there; Again if the Coats of the ovarium are too thick to allow y^e Ovulum to get out & fall down the Fallopian Tube easily, then the Impregnation may grow in the ovarium, or if the Tuba lets go its hold before the ovum is quite Separated from the ovarium and leaves it hanging by a small Peduncle & this soon giving way, the Ovulum falls down into the Abdomen and there grows to the first part it meets with. And thus are extrauterine foetus produced. In all these cases (and all have been observed) the Mother must inevitably perish. —

The Human Ova are small round Bodies surrounded wth a yellow substance much like the yolk of a Hens Egg, They are all covered with a Plexus of vessels or a vascular membrane. In Bodies shortly after conception we can observe in y^e ovarium a small calia or cup out of which the impregnated ovum had dropt, These calices you may remember from the Comparative Anatomy in Hens are so remarkable that we can tell precisely how many Eggs she has laid. By what power Impregnation is brought about & carried on is a Question not easily determined; If to the Ancients I should tell you it was done by a plastic power, I

I believe I had as good tell you nothing. But the Chief Question is, whether the Rudiments of y^e Embrio are originally contained in the Father & transmitted from him to y^e Mother, or whether they were implanted in y^e organs of y^e mother & made to grow by a subtle vivifying aura from the male. As soon as the little Embrio can be subjected to our senses, either in y^e Larina of y^e Chick, or Embrio of Viviparous Animals it appears not unlike the Animalcules in Semine masculino, But as it were undergoing some change, so that the common Opinion is, that one of the Animalcules going up the Tuba Fallopiana enters one of y^e Oviducts, or meets wth one of them already in the uterus, That in the former case the Impregnated ovum is carried down into y^e Womb by y^e Tuba where it encreases & is nourished till it be fit for Exclusion. But there are Objections brought against this acc^t. And first, It is asked whence comes it that as so many Animalcules enter y^e Womb at one Position, yet only one fœtus, Two, or very rarely three are formed? This Question has some difficulty in it; But without Enquiring into y^e Reasons w^{ch} determin'd our ~~determin'd our~~ Creator, and w^{ch} are far beyond our reach, we may suppose that the same thing holds here, as in Vegetables, for how many

Many seeds grow upon one Tree plant or shrub wth never come up when sown, There may be a great number of Animal-
 -cules thrown into y^e womb, and but one Imbric produced
 by reason of the Tube Fallopiana denying a passage to
 any more than one at a time. It is likewise objected
 How happens it that the Mule should have y^e form
 properties &c of y^e horse & Ass joined, whereas if the
 Imbric was produced from y^e Animalcule in y^e male
 seed it should have entirely the form of y^e Father, But
 this Objection is taken off by considering what a great
 change the Nourishment makes in Animals, so that a
 Lamb [its said] nursed by a goat, instead of a soft woolly
 Fleece shall have a hair bristly covering like a goats, if
 after Birth such such a change can be brought upon an ^{Animal}
 what vastly greater Change is it capable off while in the
 womb & susceptible of any impressions from the Im-
 -aginations of y^e Mother, Hence we see that as Children
 are so very apt to take after their nurse, How absolute-
 -ly necessary it is that every Mother should nurse her
 own Child if she has any desire it should be like her.
 Another objection relating to this doctrine, & not ea-
 -sily solved is this, if the Animal preexisted in y^e male
 Sperm, whence comes the Secundines which have com-
 -municating Canals going from them to the fetus. This

This is indeed the objection that is by far the most difficult to remove, but it may be attempted after y^e following manner. When the Animalcule has got into one ovula so as to Impregnate it, it is carried down to the womb by y^e Tuba Fallopiana, where the Membranes that it gets when coming down the Tuba forms the Membranes of y^e fetus, but indeed the Animalcule is so small when in the Male Sperm that it cant be known whether it has the Tunus umbilicalis sticking to it or not, but we may suppose it has, w^{ch} spreading its vessels join with those on y^e membranes of y^e Ovary and thus the Placenta comes to be formed, while y^e coats of y^e Impregnated Ovary distended make up the Membranes of y^e fetus, while the fetus thus contained within its Membranes has its fluids circulating by the Vasa Umbilicalia upon y^e placenta. The Placenta begins to adhere to the Uterus & especially at that part of it to wit the fundus. Where Krupsk has observed the largest blood vessels are placed, here there is a communication made between the mother & y^e Embrio, her blood being sent ~~by~~ into y^e Umbilical Veins of y^e fetus and returned by its Umbilical Arteries. Another Opinion relating to Generation is that the Animalcule was formed in the ovarium of y^e female; This is liable to much greater Objections, as

As, why does it never come to perfection, if it has all things necessary for its life? Surely if this was the case there would be some one history or other of a child being brought into y^e world without the mother having any intercourse wth a man, But since the Creation such a thing has never happened, Perhaps it may be said that it was dead & was only set in motion by the subtil Aura Seminalis of the Male Sperm, But if it was dead it would have no Circulation & so Corrupt. — Seeing therefore there are no liquors in our Body that have such Animalcules swimming in them unless exposed to the air, & so they take up the seeds of Animals from the air, as the thickish substance sticking on the Teeth has a great number of such Animalcules in it; And seeing these Animalcules die when a person has the Lues Venerea, and at such a time the Person is not prolific, & since the Liquors dont appear till the Age of Puberty, I say considering all these things, we may conclude that these Animalcules are men & women in fieri, tho' by reason of the subtilty of y^e parts we can't solve all difficulties as they are not subjected to our senses, And the Animalcular doctrine is liable to fewer Objections than any other.

Of all that I am Capable to say about the Nutrition of the fetus in utero is in the 2^d Vol. of y^e med. Essays which Consult at leisure.

On the Circulation of the Blood in Fetus &c

The Blood being brought from the Uterine Arteries of the mother into the Umbilical Vein of y^e fetus by y^e Placenta, It is thrown into the Capsula Glissoniana in y^e Liver and intimately blended with the blood in the Vena Portarum, While a part of it is immediately transmitted to the Cava by y^e Ductus Venosus & Carried to y^e heart, That Received into the Vena Portarum Circulates thro^u the Liver is received by y^e extreme branches of the Vena Cava and likewise Carried to y^e heart, and received into the right Auricle, a part of it is immediately sent to y^e left Auricle by the Foramen Ovale while y^e other part goes the usual way as in adults viz^t into y^e right Ventricle from whence it is drove to the Pulmonary Artery, but does not all go thro^u the Lungs, for the greatest share of this is sent into the Aorta Descendens by the Canalis Arteriosus, The Remainder circulates thro^u y^e Lungs, & Coming back into the left Auricle by y^e Pulmonary vein it there meets with the Blood brought thither by the foramen ovale and is with it sent into the left Ventricle by which it is driven wth y^e blood from the Canalis Arteriosus thro^u y^e whole body by y^e Aorta. The great design of this mechanism is that the whole mass of Blood might not be obliged to pass thro^u y^e Collapsed Lungs of the Fetus, but

But might get another more direct passage into the Aorta, This was universally agreed upon from Harveys time to the end of the last Century when Mr. Merz violently opposed it, He would not allow that the foramen ovale was to cause a less quantity of Blood to enter the Pulmonary Artery by its allowing it a passage into y^e left Auricle, but that on the contrary it transmitted the blood from y^e left Auricle into y^e right, his chief reason for advancing this is, because he observed y^e Pulmonary Artery larger in a fetus than the Aorta and hence concluding that it contains more liquors, he could not imagine how it could receive them, was then such a great quantity transmitted thro' y^e foramen ovale without entering it. Du Verney disputes y^e fact with him and says that upon measuring both y^e Arteries he found the Aorta largest, Sauvry & Vicupens agree with Du Verney in this, Besides according to this scheme the right Ventricle ought to be the largest which sure no body will affirm, And if it can be found that the Pulmonary artery may be as large if not larger than the Aorta without containing more blood then I think Mr. Merz objections are answered, Now supposing the thickness of y^e coats of the Arteries proportionable to y^e force exerted by

By the Respective Ventricles, yet y^e blood in y^e Aorta
 meets wth a less resistance than that in y^e Pulmona-
 ry Artery which has not only the collapsed lungs
 to pass thro' but also to overcome the resistance wth
 which the blood in y^e Aorta presses from y^e axis to
 y^e sides of y^e Canals & so the Reaction of y^e fluids in
 y^e Canals is greater in y^e Pulmonary Artery, con-
 sequently its fibres will be more stretched. Again
 McIlery might have been led into y^e mistake by
 injecting wax into both the Arteries for the right
 plain that the Pulmonary Artery having y^e wea-
 kest coats would be most stretched, or even tho' he did
 not inject y^e Arteries the Aorta having y^e greatest
 Elasticity would contract most & appear less capacious
 Those that wrote against Mr Meny founded their
 Arguments mostly on this, That y^e Arteria Pulmonalis
 was less than the Aorta, Mr Winslow in a paper
 given in to Acad: des Sciences endeavours to reconcile
 these two opinions by affirming that y^e foramen Ova-
 le will allow y^e blood to pass either way, and thus E-
 qual quantities are transmitted into both Ventricles
 for says he if you put the foramen Ovale (in water)
 in its most natural situation by shaking y^e heart you'll
 see that it will allow fluids to pass either way, This
 Paper of Mr Winslows is severely Criticised by

By M^r Robault the present professor of Anat.^y at Turin
 in a paper which he sent to y^e Acad.; w^{ch} they would not in-
 sert; M^r Winslow wrote an answer to this w^{ch} was inser-
 ted. M^r Robault having been a scholar of M^r Mer-
 strongly defends his Masters opinion, building principal-
 ly on the appearance of some dried preparations, w^{ch}
 M^r Winslow will by no means allow to be any proof.
 I own I would rather join wth y^e Common opinion, for
 the greater largeness of y^e Pulmonary Artery, if it be lar-
 ger, signifies nothing, since it may be more stret-
 ched than y^e Aorta & so larger without transmitting
 any more blood; And if we should allow either of
 the foregoing opinions, we should have y^e right Ven-
 tricle vastly more Capacious than y^e left, For
 Supposing the foramen ovale Capable of trans-
 mitting $\frac{1}{3}$ of y^e mass of blood in any given time
 and y^e Canalis Arteriosus in y^e same time as much
 Then according to Merys opinion you'd find that y^e
 whole mass of blood being driven from y^e right
 ventricle into y^e Pulmonary Artery, $\frac{1}{3}$ would pass
 would pass by y^e Canalis Arteriosus into y^e Aorta
 all y^e Remainder would circulate thro' y^e Lungs
 & Return into y^e left Auricle, of which $\frac{1}{3}$ or $\frac{1}{3}$
 of the whole mass would be transmitted by y^e fora-
 men ovale into y^e right Auricle the remaining $\frac{1}{3}$ will

Will go into the left ventricle and be thence expelled
 into the Aorta, w^h with $\frac{1}{3}$ sent into $\frac{1}{3}$ of Aorta De-
 scendens by $\frac{1}{3}$ of Canalis Arteriosus, make $\frac{2}{3}$ of $\frac{1}{3}$ whole
 mass circulating thro' $\frac{1}{3}$ of Body w^h $\frac{2}{3}$ are returned to
~~of right~~ $\frac{1}{3}$ of right Auricle, and there meeting with
 $\frac{1}{3}$ from the foramen ovale go together into $\frac{1}{3}$ of right
 Ventricle to circulate as before, so that from this Act
 the whole mass is received & expelled by $\frac{1}{3}$ of right Ven-
 tricle and only $\frac{1}{3}$ by $\frac{1}{3}$ of left. How comes it then that
 the right Ventricle is not thrice as large as $\frac{1}{3}$ of left?
 M^r Winslows Opinion that the foramen ovale trans-
 mits equal Quantities either way comes to $\frac{1}{3}$ of something
 as if there was no foramen at all, so that needs not be
 regarded in $\frac{1}{3}$ of Calculation at all; The whole mass
 according to this plan is thrown from $\frac{1}{3}$ of right Auricle
 into $\frac{1}{3}$ of right Ventricle and thence into $\frac{1}{3}$ of Pulmo-
 nary Artery, then $\frac{1}{3}$ of $\frac{1}{3}$ whole is sent by $\frac{1}{3}$ of Canalis
 Arteriosus into $\frac{1}{3}$ of Aorta, the other two thirds are trans-
 mitted thro' $\frac{1}{3}$ of Lungs, & returned by $\frac{1}{3}$ of pulmonary
 Vein to $\frac{1}{3}$ of left Auricle & Ventricle to be thence dis-
 tributed thro' $\frac{1}{3}$ of whole body, w^h with $\frac{1}{3}$ of $\frac{1}{3}$ sent
 by the Canalis Arteriosus is returned by $\frac{1}{3}$ of circulation to
 the right Ventricle to undergo the same Course as
 before, so that the right Ventricle expels $\frac{1}{3}$ of whole mass

And the left but $\frac{2}{3}$. Why then is not the right Ventricle larger than the left by $\frac{1}{3}$? —

But if wth y^e common opinion we suppose the Foramen Ovale to convey the blood from the right Auricle to y^e left. Then $\frac{1}{3}$ from y^e right Auricle to y^e left, & so into y^e left Ventricle, and the other $\frac{2}{3}$ are sent by y^e right Ventricle into y^e Pulmonary Artery, thence one half goes into y^e Aorta by y^e Canalis Arteriosus, the other half returns by y^e Pulmonary Vein into y^e left Auricle & Ventricle and together with that brought from y^e right Auricle by y^e foramen Ovale is driven into y^e Aorta when it meets wth that from the Canalis Arteriosus, then y^e whole mass is returned into y^e right Auricle, so that $\frac{2}{3}$ are expelled by each Ventricle & so they come to be pretty much of y^e same dimensions; Thus the blood is driven thro' y^e Placenta by y^e conjoint force of both Ventricles, by means of y^e branches that come from y^e fetus's Alices & go to y^e placenta. You see all this time that I have taken no notice that a greater q.^{ty} of blood is brought to y^e fetus than it sends back by y^e umbilical Arteries, this still argues for y^e common & best opinion there being the greater necessity for such a passage the more the quantity of blood is increased.

Dr Nichols Lecturer of Anatomy at Oxford
says that the blood of y^e Cava Inferior of a fetus is
more fit for nutrition, Muscular motion & Subtile
Secretions than that of y^e Superior Because it Con-
sists of y^e blood newly sent from the Mother, partly
of y^e blood newly defecated in the Liver, & of what
comes from the Iliacs & Emulgents. But how this
Blood should come to be so fit for subtile secretions
I really cannot understand, for its certain that by much
the greatest part of y^e blood in the Umbilical Vein con-
sists of what was sent out by y^e ^{immediately} Umbilical Arteries of
the fetus, and but a very small part from y^e mother
and how y^e blood should be defecated in y^e Liver by a
subtile secretion being made from it is still a great
mystery, and how the Iliacs & Emulgents should
contain so fine a blood is I must own very strange
seeing that it is now generally agreed on that the
blood returning from y^e Kidneys is so very thick
by the thin secretion of Urine being made from it
that the Glandula Renales separate a liquor for di-
luting it. He next affirms that the Ascending &
Descending Aorta are Anchronous to each other, but
this wise piece of Theory is sufficiently destroyed by
observing that the Temporal & Umbilical Arteries
beat at the same time. The great Design he has
in-

In all these Apertions is to make y^e fine blood in y^e Vena
 Cava Inferior be sent into y^e Superior Branches of y^e Aorta
 w^{ch} he does in this manner Viz^t He makes the subtle
 Blood in y^e Cava Inferior come to y^e right Sinus Lowen-
 = anus, at the time the Auricle is Contracted so that it passes
 directly by y^e left Foramen Ovale to y^e left Auricle & thence
 into the left Ventricle, but says he it Cannot then pass into
 the Aorta Descendens w^{ch} is at this Time Contracted, & there-
 fore will go into the Superior Branches ~~branches~~ of y^e Aorta
 now in its Diastole, & be thus Carried to y^e head & by the
 Coronary Arteries to y^e Substance of y^e heart. This Blood
 returning by y^e Cava Superior goes directly into y^e right
 Auricle, some part of it being Thence sent directly
 thro' y^e Pulmonary vessels into the left Auricle to be
 mixed with the blood from the Cava Inferior, the Rest
 being sent by y^e Canalis Arteriosus into y^e Aorta descen-
 dens & not mixed with y^e blood in y^e Ascendens on pur-
 pose says he that only the gross viscus blood may be sent
 by y^e Umbilical Arteries to the mother; But if this was
 the case there must be no blood in y^e Aorta betwixt the
 place where y^e Ascending branches go off and where
 the Canalis Arteriosus enters; Besides this thick gross
 blood w^{ch} y^e Doct.^r sends to y^e mother is in fact y^e finest
 & Purest in y^e Whole body having been diluted wth Lymph
 w^{ch} it has rec^d. from the Pectusculum chyli, gland.
 Thyroideus

Thymus & Thyroidea &c. But this is only a specimen
of the Doct:^r Theory which is not only contradictory to the
received principles in the Animal Economy but also to
the most known Anatomical facts so that its needless
to Insist any further on it, Since y^e Doct:^r has been
himself at the Pains to make everyone sentence con-
tradict another to as good Purpose as any one could
have done it for him, And it seems to be so absurd a
piece of Theory that its wonderful how it would
ever have been conceived by any one. But to
proceed to our Subject. — It has been disputed
whether there is a Sac belonging to y^e Human fetus
for containing its Urine, as is the Alantoid of Brutes
This dispute cannot be easily determined, seeing the
opportunity of dissecting women 5th Child is so rare,
but in two whom I opened, I must own I could find no
such membrane, tho' assisted by my colleague Dr
Stclair who is not only a good Theorist but also
accurate Practical Anatomist. One would think that
there certainly must be an Human Alantoid since
there is the same necessity for it as in y^e brute fetus
And a Posteriori there are some observations that seem
to confirm its existence e.g. Of some people who having
the Urethra stopped evacuated y^e Urine by y^e navell
& without this Conduit it must have fallen into y^e Cavity of the
abdomen. again.

Again in Child birth there comes away two diff. kinds of waters ^{wh} seem to be the Urine & y^e Liquor Amnion; Besides Dr Hales & M^r Litter have given into the Society of London & Paris Dried Preparations of y^e Human Alantoid, so that it would be hard to Deny its existence since some of the best Anatomists have Admouced it, & since it is highly reasonable that Nature should provide a Receptacle for the Urine of a Human fetus as well as of any other Animall.

The Posture of y^e fetus in the womb is such as we naturally fall into when asleep and is owing to the Advantage some particular Muscles have over their Antagonists either by y^e Situation of their parts the Angles of their Insertions, their greater Natural strength or the Levers they act with. When the fetus has had its full time in y^e Uterus, the Contents of its Intestines begin to turn Acid, & Stimulate y^e parts, and make it uneasy, and being weary of its confinement it begins to bounce & kick about, The Irritation given by this to the womb makes its fibres contract, and draws the neighbouring parts by consent into contraction likewise, While y^e Child itself is making efforts to get out by Spurning with its feet against the fundus Uteri (in a natural birth) and pushing its head against y^e Uteri at last it breaks the membranes and y^e waters come out & Lubricate & Relax y^e passage wh before was entirely shut.

Shut up by a glutinous sort of substance, till at last it opens it and the Child by y^e throws of the mother particularly y^e action of the Abdominal Muscles, comes thro' y^e Vagina into the world. — Formerly shewed you how Respiration was a necessary consequence of y^e trachea being raised and the Trachea exposed to y^e pressure of y^e Atmosphere; Then whenever the Child inspires the Pressure is taken off from the Pulmonary Artery and the Blood passes thro' them more easily than by the Canalis Arteriosus w^{ch} therefore must grow together, for the Blood at any time meets with a greater resistance in the Canalis Arteriosus from the blood in the Aorta pressing against the sides, and now that resistance is increased, for in the fetus only $\frac{1}{3}$ of the mass comes out of each Ventricle but now the whole mass passes thro' each of them, a greater quantity of Blood coming from y^e Lungs (into y^e left Ventricle) by y^e pulmonary vein, and having its Velocity much increased by y^e action of y^e Lungs will strongly press against the foramen of the Foramen Ovale & stop the former passage of y^e blood from the right to the left auricle by making it grow to the sides of y^e foramen. No more Blood being sent by the Umbilical vein it grows together & is afterwards called by y^e name of Ligamentum Rotundum Hepatis; Less blood being received into the Capsula Glissoniana, it will have less force to keep open the ductus Venosus especially as its sides are more & more compressed by the

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Of The Nourishment, Increase,

The Visera Abdominalia in Inspiration, it therefore grows together, Thus you see that all these Changes are produced from y^e Expansion of y^e Lungs wth Air.

In the nine months that the Fetus is in the Womb it turns some millions of times bigger than it was when in the male Sperm, w^{ch} is much owing to y^e Soft consistence that it is in, for then the Blood is more capable to thrust out the Vessels, and there being then but a small cohesion in their coats, The Nutritive particles thrust & Insinuate themselves into the pores that are every where in the coats of y^e Arteries, And thus it is when any particle of Blood fit for y^e nutrition is circulating in the Canals, if there be any interstice it is thrust into it, by y^e succeeding blood still driving it further into y^e Interspace that is in y^e coats of y^e Vessels, and the Vessels are still thrust outwards, Seeing y^e Contraction & force of the Heart is vastly Superior to y^e force of y^e Arteries, And thus it continues to do so long as the hearts force is superior to that of y^e Arteries i.e. as long as we grow; But when the strength of y^e Contraction of y^e Arteries come pretty near an Equilibrium with that of y^e heart we cease to grow any longer & still y^e strength or Contraction, or Elasticity of y^e Arteries increasing while

And Decrease of the Body.

While that of the Heart is Decreasing, The Arteries at last resist violently the force & become so Rigid & Stiff as not to yield to it, and thus old age Creeps on, & y^e Body loses of its Bulk; This Rigidity proceeds from the Coats of y^e Vessels receiving no new Nourishment, and their being continually rubbed upon by the Circulating fluids, And the main Nourishment of y^e Body is in y^e Small Capillaries, for these are most fit to allow the Nutritive particles to be insinuated into y^e interstices of their Coats, seeing the force of y^e heart & the Velocity of y^e blood is so very small in these Whereas such a great supply is not made to the Coats of y^e Great vessels because the Velocity of y^e Blood is so great in them, as not to allow the Nutritive particles to get into their Coats else they would always continue of y^e same largeness. *L*

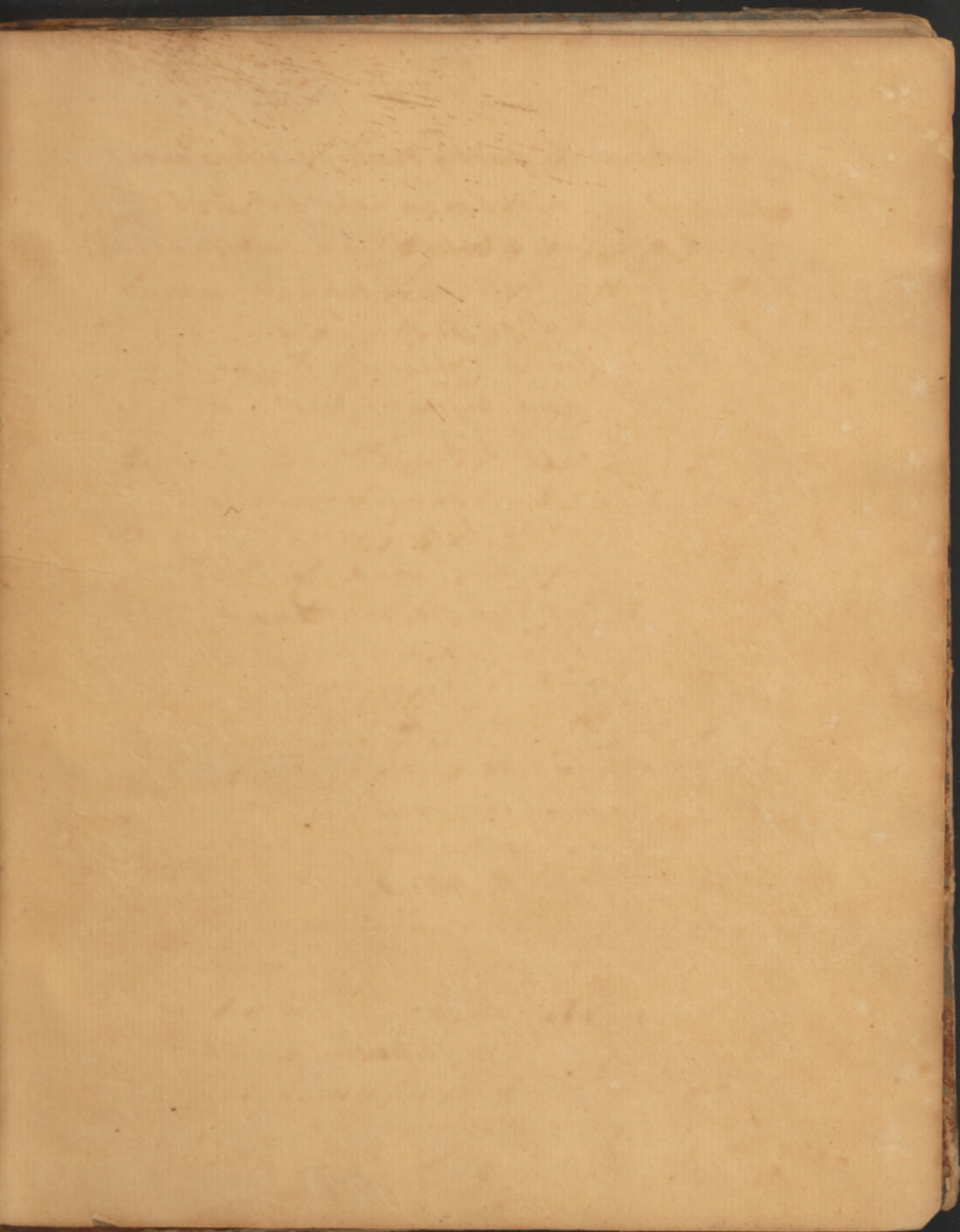
Thus you see there is a Plethora in y^e Vessels during the whole time of y^e growth of y^e body, for the Vessels are still further & further stretched till at last they come to their *Alknn* or Tone; So as it is said above a Plethora is occasioned by the Vessels being stretched beyond their tone, Lets us see how the vessels may collapse in a manner & a Plethora at y^e same time happen *L.G.*

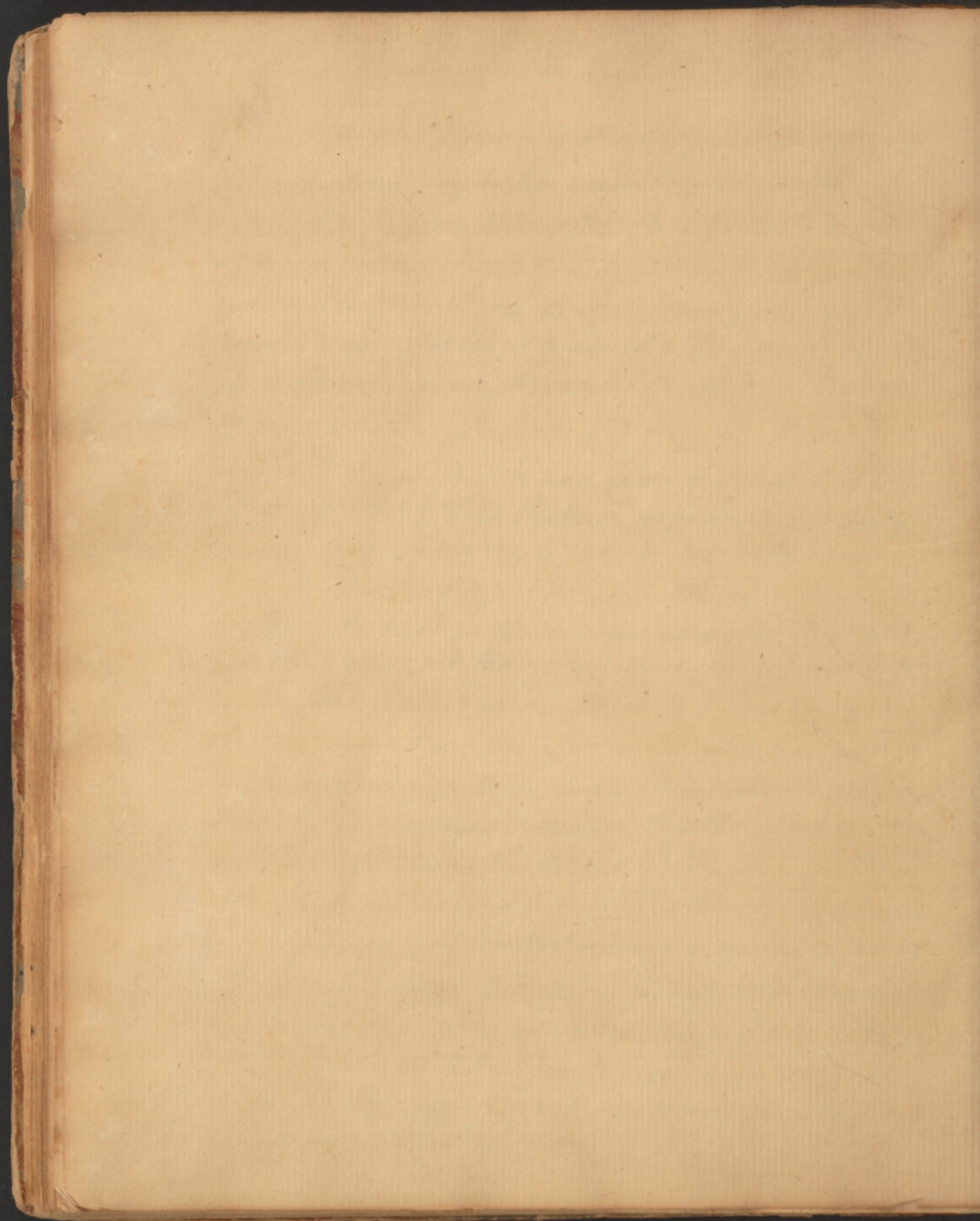
Of a Plethora & The Menses

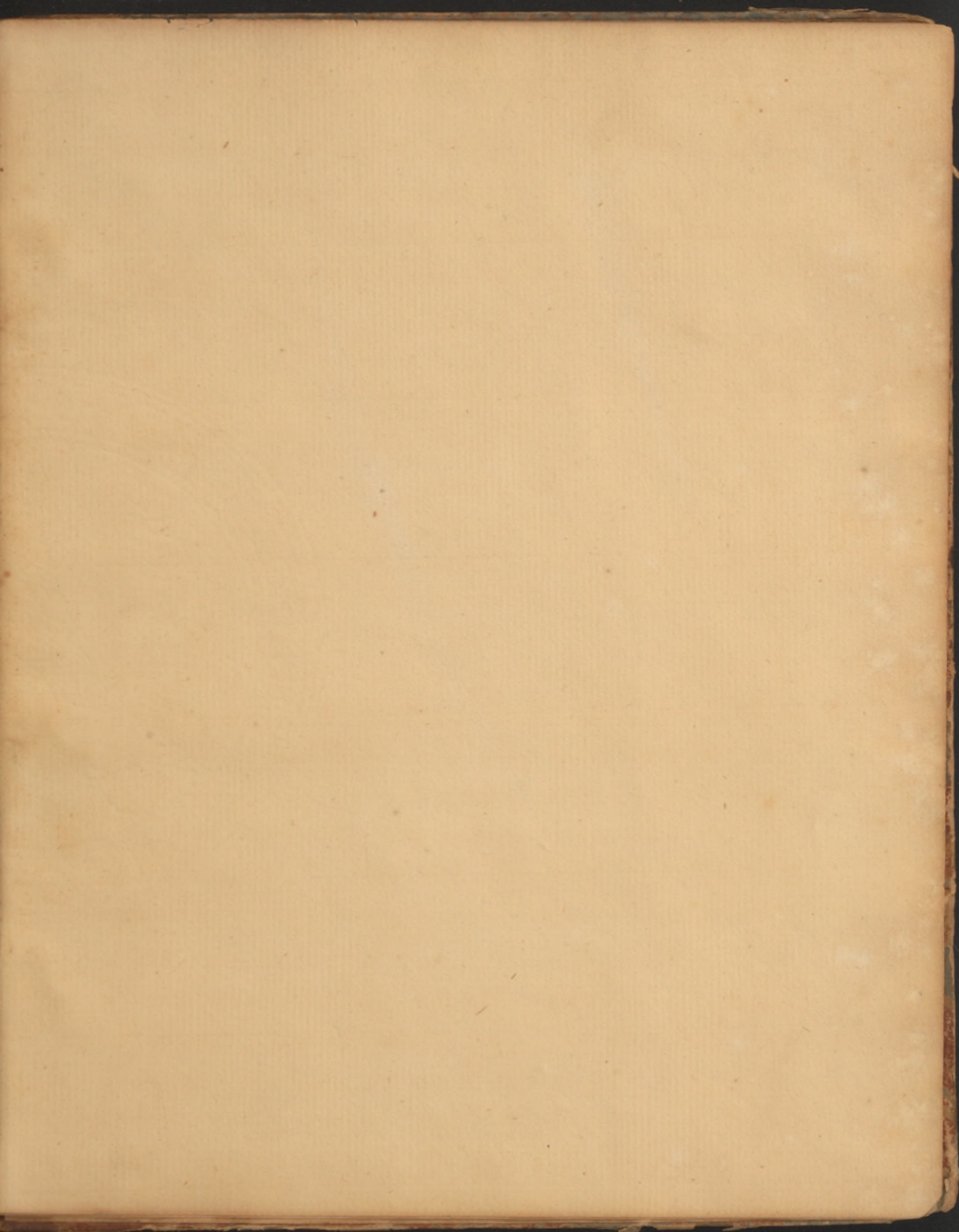
E. G. Bleed one frequently observing to take away but little at a time, make him use a spare diet, and the Vessells will so conform themselves to y^e quantity of blood that any sudden Repletion by full diet will soon produce a Plethora wth all its symptoms, whereas if the Vessells were stretched gradually they would be capable to contain a much greater quantity without any Plethora at all. The same case happens when y^e cavity of y^e vessels are much diminished by any Chronic Disease, after a sudden repletion; This Plethora or fullness is usually carried off in women by y^e womb, not only because of the small pressure this part has, but because of their erect posture, the blood in this case having a more favorable outlet at y^e womb than any where else, for its observ-
= vable that Apes & all creatures that have an erect
Posture have this flux whereas the other kind of ani-
= mals have no such thing unless when violently stimu-
= lated by an orgasmus Venericus they throw out a frothy
kind of stuff from the uterus. This flux is not by
a Rupture for reasons before Given but by y^e Extremi-
= ties of y^e small Arteries that separate y^e mucus of y^e Womb.
It has been observed that when y^e passage of y^e blood this
way has been hindered by an obstruction of y^e Uterine Vessels
it has broke out at their mouth, nose, orbits, yea at the
points of their fingers, in short any of y^e most favorable places
it could make its way out.

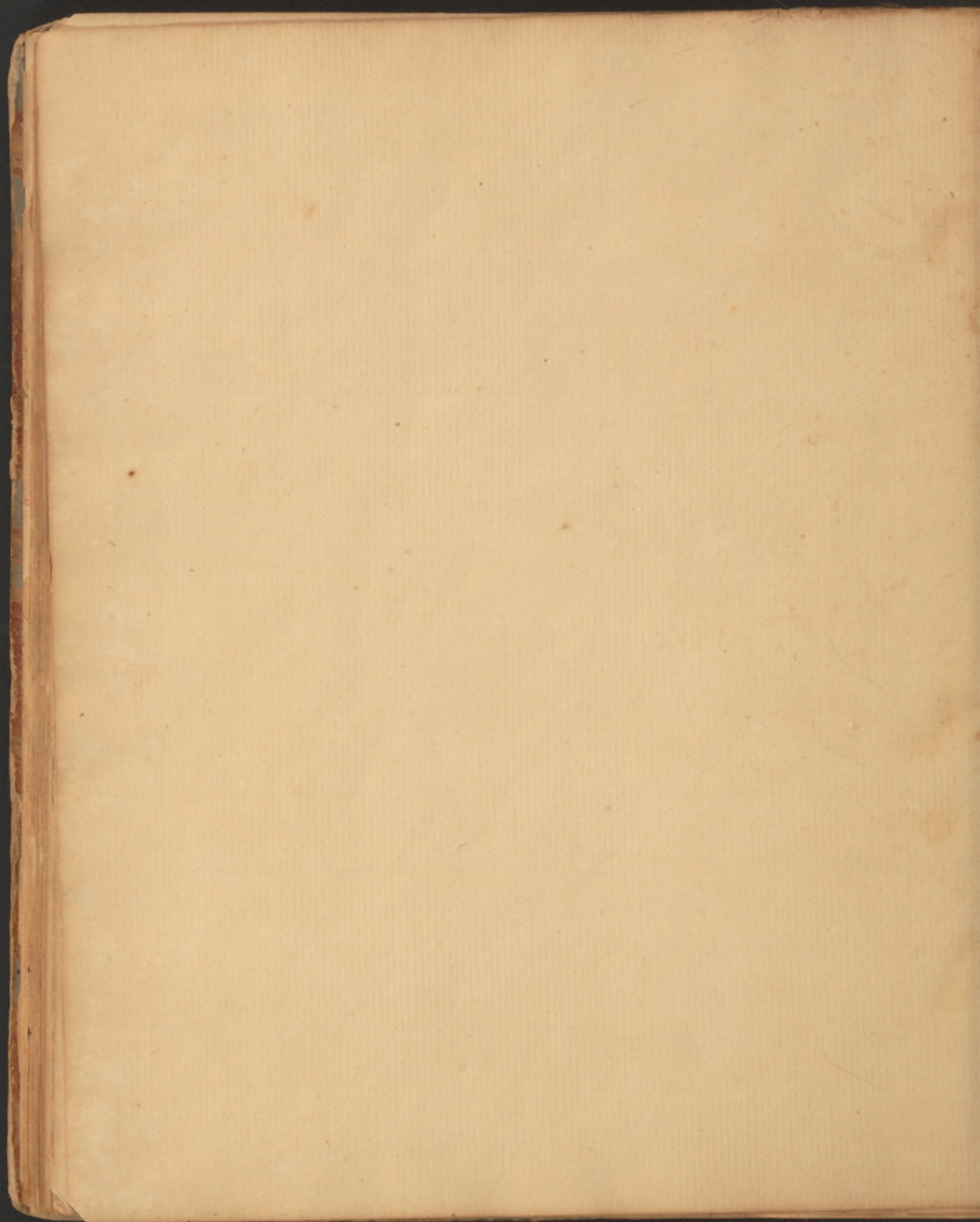
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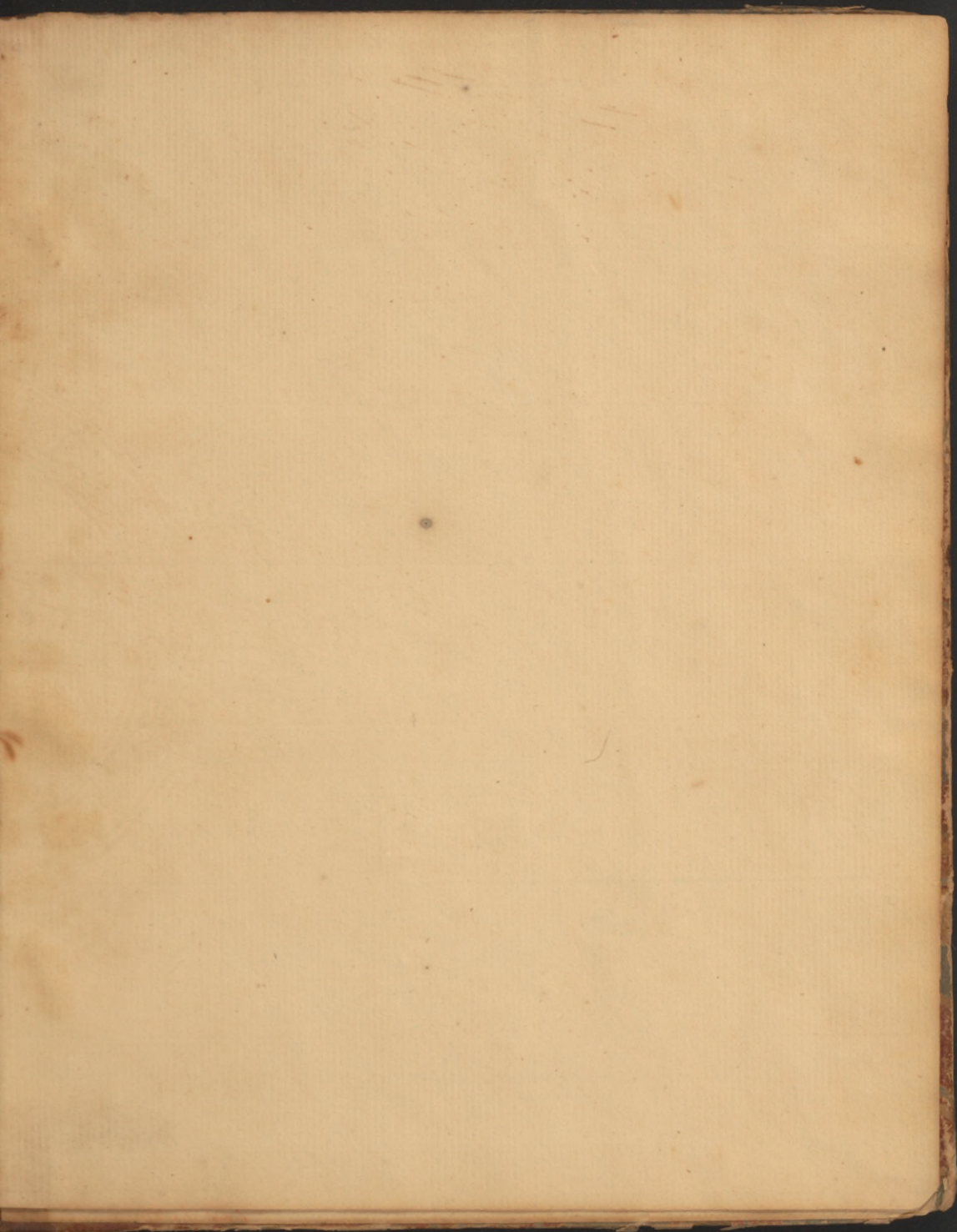
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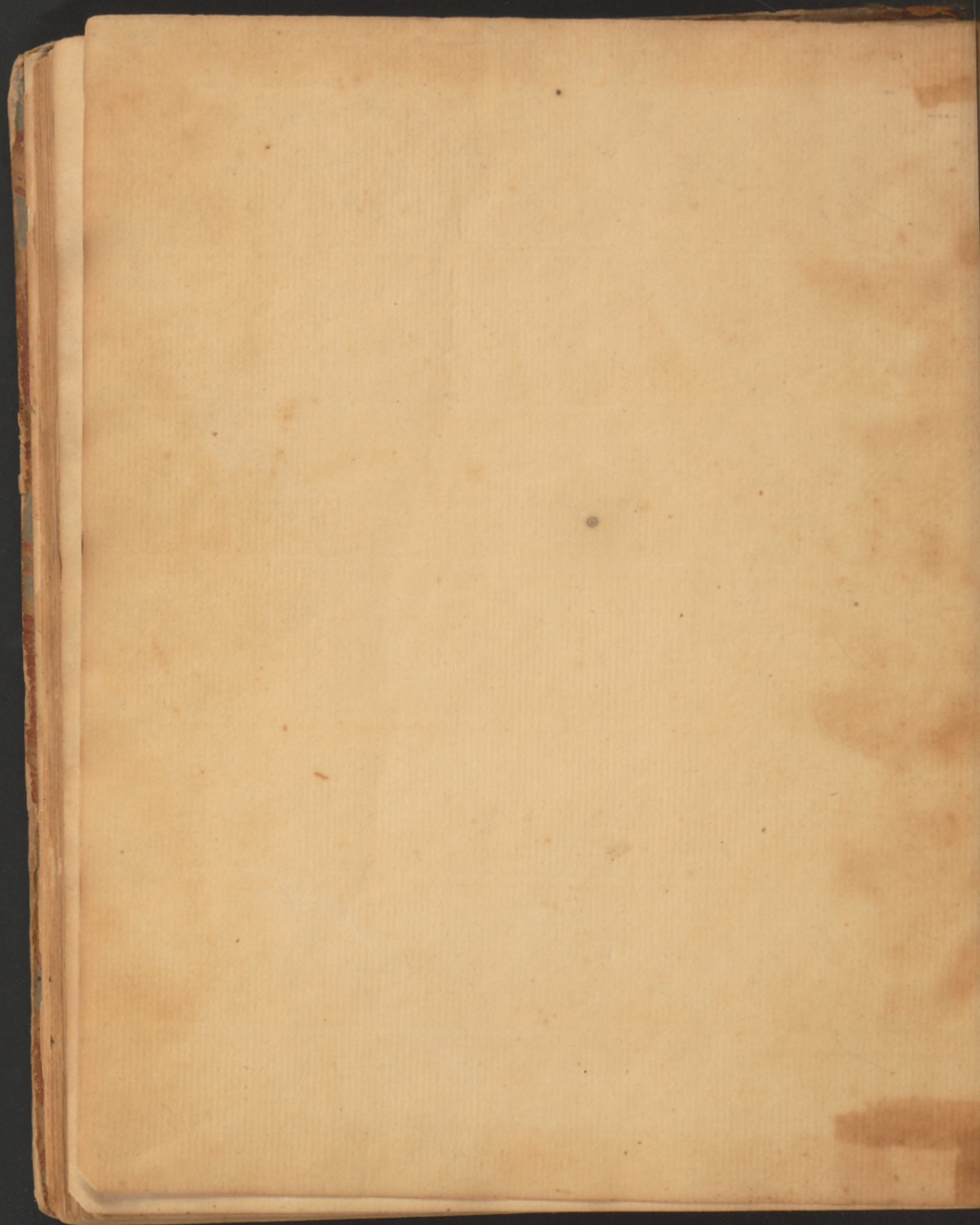












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