1766

Lectures on physiology by William Cullen

Gustavus Richard Brown

Lecture 2d Nov 10th

In the last Lecture I divided the History of Medicine, as far as it is connected with my Subject into seven Parts, or Ages. I said the first extended from the Beginning of the World to the time that Philosophy was conjoind with experience & Observation by Hippocrates, about fourhundred years before Christ: the second from the Establishment of Dogmatism by Hippocrates to the rise of the Empyric Sect which was commonly imputed to Serapion about the time of the Reign of Ptolemy Philadelphus; the third from the last to the rise of the Methodical which is a Branch of Dogmatism imputed to Themison in the time of Augustus Cæsar; the fourth commencing at this Period continued till the Dogmatism of Hippocrates was restord by Galen in the Reign of the Emperor Marcus Aurelius about the middle of the second Century. I said that the fifth Age was a very long one continuing till the time

Time of Paracelsus in the Beginning of the 16th Century is the 4th Æra was soon after strongly marked by the Beginning of Reformation of Religion by Luther; the Sixth beginning from this Period continued to the Discovery of the Circulation by Harvey & was generally received over Europe about the Middle of the last Century. The Seventh & last from the Discovery of the Circulation to the present time.

To return to the first of these Æra's we may suppose first of all that a natural Physic prevaild which could not go any length till it came to be joind with the refined Arts or natural Philosophy. Accordingly the natural Physic of the Greeks was obscurd by the more refined Egypt; & that of Rome by that of Greece. On this Plan we shall consider our Art as it appeard first in Egypt; we have several but imperfect accounts of the state of Physic in that Place. We are told they had Books upon several diseases & Arts & particularly that of Medicine, ascribd to Hermes Trismegistus, & committed to the care of the Priests. This Precaution might prevent the Mischiefs arising from rash Empirics in Medicine but avoided equally prevent the Progress of the Art; & indeed it was the common fault of the Egyptian Policy to fix Science too early. Another Regulation we find among them of confining the Practice of single men to particular parts of the Body in the Cure of Diseases, we therefore cannot in this Respect admire the Egyptian Policy, but as I said our accounts are too imperfect to justify us in concluding strongly against them. We have scarcely any Relics of the Natural Physic of the Greeks it being all involved in Fable. But it is most probable that it came to them from the Egyptians by the Hands of the Phœnician Merchants. Superstition is quite natural to man, hence some have taken hold of that handle to lead & govern them, & as the love of Health & fear of Death is the Chief foundation in Nature of Superstition, it gave a most proper handle to Priests to engage in Physic; & indeed not only then, but in all Ages they have, less or more, encroached on the Province of the Physician. Æsculapius was both a

an Egyptian & Grecian Deity; it was in his Temple that Remedies were committed to the Priests by Dreams; it is a curious inquiry how such these Priests became practical Physicians, or these last became a Profession of men seperate from Priests of Aesculapius; the precise time however we cannot exactly ascertain & we can only suppose that this separation of the Profession would take Place by degrees; & some time tho' not long, before Hippocrates. Tho' the Priests of Aesculapius employd Charms yet as those would not be sufficient, we may suppose they studied the nature of Diseases & Remedies the better to support their Trade. Their Observations would be recorded in the Temples, hence a register of experienced Remedies. Thus these Temples were so many schools of Medicine, & perhaps the only schools where it was to be acquired. The most celebrated Temples were those of Rhodes, Cos & Cnidos &c in this Shape then either natural or superstitious Medicine continued till the time of Hippocrates. During this whole Period it depended alltogether on experience; & little Reason was employd; for men uncultivated by Philosophy never deliberate. Sophistication being only the result of more enlightend Ages. we have no Materials to leadus to the Methods of their Practice. it is only the Writings of Physicians wh we can judge; but there are none in this Period. Therefore when we give our judgement on this particular, as we come to treat of the second Age, that judgement may be supposed to affect this matter equally with regard to the first. Hippocrates was supposed to have died the year before Alexander the great was born, 404 years before the Building of Rome, 400 years before Christ & 300 after Philosophy was introduced into Greece. As there was much system at this time it could not have been formd all at once by Hippocrates, & therefore as it must have been the Work of time we must look back for gradual advances of it. Men Naturally enquire after causes but we can not say to what length they proceed in this case by the Appearances of Crude Nature. To this Enquiry we must confine our selves to Greece. Thales, 600 years before Christ formd the

6 school, & not long after Pythagoras founded his school. We know they applied assiduously to natural Philosophy & Medicine, particularly Pythagoras Alcmeon is said to have been the first Anatomist & another was even famous for practising Medicine

Before Hippocrates tho' they attempted Anatomy yet Dissection had not yet touched the human Body & at this Period, in my Opinion, the use of Philosophy in Physic was very inconsiderable

Lec: 3d Nov. 11th

Methodics, while they endeavourd to limit Dogmatism did not exclude Empiricism. In Egypt we find it the obscurely — after that introduced among the Greeks not in its own proper form but as an Esculapian Superstetion. Tho' in the Management of Dreams & Trust-craft shewd itself, yet there was an aim at Experiment, Diseases being studied, to support the Trade, & particularly Prognostics. Hippocrates was bred in one of these Temples in which the Schools existed studied Natural Philosophy, separated this Branch, & began the second Period of our History.

The whole of that Philosophy was not the Invention of Hippocrates, it having been introduced to some

by Thales & Pythagoras 200 years before very early the Philosophers of Greece considered Diseases & more or less of their Philosophy; Alcmeon of the Pythagorean first Dissected & Empedocles from the same was Eminent for Practising. Heraclides we find commonly deriding the Physicians, & a formal Opposition between Empedocles and the Physicians had not yet studied Philosophy when Hippocrates appeard. It was about the supposed time of Hipp: that it was introduced into the Schools of Greece. Account is moneyst: with every other account that we have. So we find in the Writings & History of Hippocrates himself but he is not mentiond by cotemporary Historians & the only account by an obscure writer Soranus who Lived 400 years after Hipp: And I can not help suspecting the Prejudices of Galen any more than the Testimonies of Suidas make of Hippocrates's writings spurious. If we admit only for genuine the writings that consist only of facts they represent him as a Dogmatist, if we take in more of his writings we find to all intents & purposes we represent Hipp:

8as almost a Deity, & the Age in wch he lived as the most wise, but the Age in which he lived was the most frivolous. We believe he lived rather more early than is commonly supposed & in Thrace & other Provinces remote from Athens. hence so much the more admired, & his Character introduced by Dauples, magnified I believe them to have been as wise as the Age would admit of but his Age very imperfect. If we take all of his writings we shall find them inconsistent & absurd, if we take a Part we shall find good prognostics, little Practice & less System; the first & third Books of the Epidemics are pure & of some use, the others are of very doubtfull Application: the Whole of the Aphorisms, usefull but difficultied in this Age to support their Character. The Nature, course & Effect of Diseases differ considerably from those of Hippo: & therefore no straining ought to be used to bring them up to the Diseases of that Clime & Country; In the other Works ascribed to him you will seldom find order, method or Connection. Erasistratus & Hierophilus differed from, & detracted from him. & hence to de-

scription, declaim & inveigh against him & that his Name would have been annihilated had it not been for Galen. It appears that the Family of Hippo: continued. Nicomachus as we see in his son in Law Thraco. Next Xenocrates the last of the Asclepiades of any great name but tho the Foundations of Dogmatism was so weak that it was impossible to build upon them, yet Facts were better collected than by more Empyricism & hence Anatomy was cultivated by Hierophylus & Erasistratus. The Particulars of either of their Anatomy or Practice do not belong to this Place but they were both Men of Genious & were cautious & diffident of Dogmatizing & were for conforming their System to the Phenomena neglecting the Fluids. Erasistratus was timid in the use of strong Remedies. Hierophilus used a great many, this gave chief occasion to the rise of the Empyric Sect. —— Lect. 6th Nov. 12th ——

The second part of our Division gives the Age

10 of Philosophy & Taste; the Industry & good Sense of Herophilus & Erasistratus promised to put medicine upon a tolerable Foundation This was the Age of Ptolemy Philadelphus, all mere Dogmatists at this time; now the Empyric Sect arose they formd a distinct Sect; they were so from perceiving the Falacy of Theory & therefore recommended experiment: It is imputed to Philinus of Cos, a Disciple of Herophilus & Serapion the Alexandrian, which was the true Author is uncertain But I suspect each of them had a share in the Innovation & engaged in it from different Motives Philinus might be determind to favour Empyricism but as he was a Disciple of Herophilus he could not be so determind an Enemy to Disputation as the Empyrics were. The Egyptic and Med people who embalmd in as much Contempt as executioners, the Operator was obliged to fly from a shower of stones thrown at him by the Relations. & such was their Aversion at Touching Dead Bodies that perhaps only an Opinion of very superior Skil could in any Degree reconcile them both, hence Serapion would be more Expedient to set up in Opposition to Anatomy at Alexandria, These two Gentlemen could not all at once find out all the specious arguments that could be imployd against the Dogmatists, their Sect was reduced into three Parts and consisted of observation, History & Analogy. They proposed that a Collection of Observations should be made & their history made out of that, & if both these failed that they might have recourse to Analogy or a Translation ad similia. I shall not touch the Arguments on both sides as they are to be treated of very fully hereafter. The Empyrics subsisted till Galen, but they never made great Impression in checking the Dogmatists. We hear of no new, or efficacious Remedies & which was still more to be expected we hear nothing of their History which would have been generally known if they had done any thing in that way, I think it may be accounted for, such a System as that of Empyricism is always a cover for Dullness & ignorance & to prosecute a plan like this in a useful way requires great subtilety & refinement; & if any man

set seriously about it he would not speculate with such a set as Empirics, & rather assume the more specious name of Dogmatist.—

I have nomore to say on the third Part than that Dogmatism still persisted tho divided into little Sects, under the Names of their different Leaders, as Hippocratic, Praxagoric &c. all agreed in the general Plan of Dogmatism. I shall now passover to the Romans & shew how it first appeared among them. Excellent alice (Virg: Aneid: d:) plainly shew the Romans disclaimed all pretensions to Arts, wch they probably were without for 600 Years, & Cato about the 600 year of Rome gives you an Incantation on the Reduction of a fracture Bone which would not have been the Case if there had been any shadow of Science in the Country. The Empiric Physici came to Rome first, wch as it was rather under the form of Superstition than Science was suppressed by Arcacathus a Greek Surgeon he was cruel in his practice & brought Medicine into disrepute which afterwards recovered Grad with the Introduction & cultivation of the Grecian Arts & Sciences under the more gentle form of the Enistratian Medicine. Asclepiades came

to Rome among many other Greeks to make his fortune & from being a Rhetorician in which he was abundantly successfull turned Physician. He seems to have been imbued with the Doctrines of Erasistratus he turned a Dogmatist on the Physiological System of Epicurus, then in Vogue & illustrated by Lucretius. He formed new Theory & Practice suited to the Manners & Taste of the Romans, he gave wine to the sick & what is more luxurious still, Jelly water. He professed to cure Cucunde, tuto & cito.— With elegant Manners, specious Liberature, agreable practice & some Boasting, how could he miss to be famous; accordingly he was believed by all the Ladies in Rome to have raised one from the dead. He supposed the several Passages or pores as he called them, of the Human Body, of various shapes & Molecules passing through them exactly adapted to their Capacity, & he adopted these Pores & Passages to his Medicines & Practice. Since Themison took the hint & to abbreviate the Path both of Theory & Practice thought it enough to suppose that all Diseases consisted either in a Contraction or Enlargement of these Passages, or in a Mixture of Both, that is,

in the Contraction of some, & Dilatation of others, at the same time, & it shortend much the Indications of the Dogmatists, this was an easy Practice & was called by way of Eminence the Method. This simplification has been hurried since, the Followers supposing that most Diseases are reduced to a few simple ones. Dogmatising, thro' the whole immensity of Particulars into which men are naturally led, is on the one Hand unsafe, and, on the other, as few men can abstain from Reasoning altogether & be pure Empirics, it is better with Regard to the Bulk of men calculated as they are neither for the one nor the other Business, to give them such a Method, than to leave them to their own Opinions, wch will be ever precarious.—

This arose in the Reign of Augustus, was in some degree changed by Thessalus, under Nero & was the prevailing method when Galen appeard.

The Pneumatic Sect, Ariteus Cappadox the Dogmatist has given more of the History of Diseases, & experienced Practice, The Eclectic, which Celsus seems to have been, was a Sect, & likewise another was the Episynthetic, but we have so few accounts concerning them that I can say nothing certain, the their Name seems to indicate that they were the same as the Eclectics.—

Lect: 8th Nov: 18th

We have now come to the fifth Period & shall give some Account of the Revolutions produced by Galen who made a Change much more considerable for its Effects than Importance. His Father Lycon gave him an Education upon a general Plan, hence he, after passing thro' all the schools of Philosophy, studied Medicine under many Masters; he travelled to improve his Materia Medica, & was also learned in Anatomy & therefore came to try his fortune in Rome. He here found every Art in the Physicians to raise themselves and discredit others, hence he was obliged to leave Rome. He had however here gained the Favour of some men of Sense & Rank, by which means he was brought back in triumph by the Emperors M. Aurelius & L. Verus to Rome. He then gained the Empress Faustina to his side & consequently the Lady Practice. He continued to love Study among his Business.

We can now perceive how he attained & supported his character; by disparaging his Adversaries with Virulence, & praising him self, not without vanity; by this means he greatly contributed to suppress the other Sects. The Empirics tho' almost extinguished, but he disclaimd against the Ashes of Thessalus & exersed the Methodics their prevailing. The great Reputation of Galen, his high Rank & great Authority, & his employ his Authority to suppress them besides he wrote more than any had done before. He was as dogmatic as any writer before the disclaimd against as pernicious. Hence Galen & Hippocrates were commonly named. He did hurt by checking the lazy & repressing the ingenious. Galen also lived at a time when science was declining at Rome & over the whole world, & the Inundation of the Northern Barbarians afterwards but a long & effectual check to its Progress. No wonder then if Galens System was not retained in that Dark Age. The Empire was divided & his only remains in the East hence the System of Galen prevailed & Aribasius in the 13th Century is as much Galenic as himself.

In the middle of the 15th Century the Turks taking Constantinople ended the Empire of the East In the year 101 Mahomed & the Saracens spread their power over great part of Asia & the north of Africa; they Burnt the Library of Alexandria the most valuable in the World It is said Mahomed had some Partiality for Physic & wrote one himself, but there is no Evidence or appearance of it. Callue Lill a new race of Califs took possession of the Throne, who sought for the Greek Writings & caused them to be translated. They fell upon Aristotle & the Physic of Galen which was diffused over the Saracen Empire. We are not to enter into Rhazes &c or speak of their Works, their time is from the beginning of the 9th to the 10th Century They improved Pharmacy & Cookery upon Chimistry, but their aversion to dead Bodies prevented their cultivating Anatomy. By the Arabians Physic was restored to the Western Parts of Europe & passed over to Spain where Schools were Established as also in the south of

France & Holland. Literature & Physic was revived & spread over Europe from those very Schools

The first School of Physic was that of Salerno, the Book intitled the Sch: Salernitana gave their Doctrine, after that in many others till the end of the 15th Cen: it was then in common to them all to follow Galen who was not read in the original & tho' little known, the Lessons were given in Arabic. Hence Galens System continued as the only one till the End of the 15th Cent: We shall mention the Particulars that prepard for this Revolution; the Roman Language began to be learnd, & the Taking of Constantinople spread the knowledge of the Greek in the West. This & the spreading of knowledge was favoured by the Invention of Printing which increased from the year 1460. By the Marriage of Ferdinand & expulsion of the Moors all Spain came to be united, & so in France also some Events happned very favourable to exert Liberty Col: Cambes discovrid the West & Vasta de Gama the East. From the Beginning of the Study of the Greek it increasd & Galen & Hippocrates began to be more & more improved, some studied for the Arabians; The famous Controversies about Bloodletting agitated them in the beginning but could not long exist.

Galen had scarce been established when an Attempt was made to pull him down by Paracelsus.

In the 14th & 15 Cent: the Chemical Pharmacy made some progress in the Hands of Alchemists & Quacks. Hence the virtues of Antimony were found out & recommended. Paracelsus was bred by Chemists & spent his younger years in quest of Chemical Remedies. He performd remarkable Cures, & was hence made a Professor, boasted & made high Pretensions, & tho he may seem a very odd Character, yet he threw a Lustre on all his faults by some Effectual Remedies

Lec: 6th Nov: 15th

The Regular Physicians condemnd not only the Chemists but also their Remedies, & they trusting to their Medicines neglected the History of Diseases. First Gaul & after him but in

20 spite of the Efforts of his Master Silvius he gave a great shock to that great writer. The Authority of Aristotle in the 16th. Cent: was opposed by Patricius &c but more effectually by Galileo & Lord Bacon & these laid a Foundation to endure as long as any System that is sound. Next De Cart endeavour'd to establish the Epicurean Philosophy but still the system of Galen tumbled down the Operations of the Chemists, & rendered the Galenists vigourous, wherefore it was necesary to explode it all together, & hence in the Beginning of the 17th Cent: it was annihilated, & the antient Fabrick of Medicine receiv'd its finishing stroke

We observed that Galileo & Ld. Bacon laid a foundation, the effects of which were not very considerable till towards the end of the 17th. Century. Gassendi reviv'd the Epicurean Philosophy. In England Mr. Boyle & Doct. Wilkins &c held meetings for cultivating Natural Philosophy & at last were changed into the Royal Society. We may assert a Greater Knowledge has been made within these 100 years than since from 21 the beginning of the world till that time. Newton led in the Nat: Philosophy & Bacon in Chemistry. The Epicurean Philosophy of Gassendi & System of De Cart were favourable first to the Chemists & Cartesians next. Hence the System of Regius Sylvius de la Bue & Etmuller; & the Discovery of the Circulation of the Blood, particularly, gave the Hydraulic & the whole System of the Animal Economy. tho matters were hardly yet prepar'd for the Study of the Hydraulic. Borelli gave it a specious Appearance, & after prevailing in Italy it was brought into England by Dr. Pitcairn, spread into France & Germany. The Mechanical Physicians were always declar'd Friends to Observation & Experience. It can hardly be suppos'd that their speculations hinder'd their Diligence. Dr. Sydenham, who was bred in the schools of England deserted them almost intirely, & gave a work so far as it goes the most useful of all that went before, & his Country-men Willis &c neglected his Doctrines or opposed them. The Mechanical Theory is not sufficient towards a compleat system; the Facts, when they were

introduced more than ever. The Mechanical Doctors wanted to explode Chemistry, & spoil their own knowledge, as without it, there are several parts of the system of the Human Body not to be explained. Boerhaave combined Cartesius & Chemists & also admitted Nitre the only Remains of the Galenic. There was still a necessary part of your system that he had overlooked. viz: the Doctrine of the Nerves. This also in some degree supplied, Vanhelmont ascribd the various commotions in the system to an Archeus, & the judicious Hoffer admitted such a sort of Agent in the Body. What—

First it gives a particular explanation of the autocratia in the Power of Nature & in the Cure of Diseases. The Italians have been remarkably against Anatomy. they have had always a Fibd Practice & are noted Enemies of the Bath, & their Remedies that might hinder the Operations of Nature. you might then expect that they being in this Train would have stumbled on the Nervous System. Willis studied the Brain & Nerves & made a Pathology accordingly. & his Doctrine was soon after cultivated. D. Boerhaave entered into the same views, & said that the Nerves laid the Foundation of many Diseases. But Hofman came but late into it. It has now got over all Europe from Boerhaaves Schools & Van Swieten, Baauw Boerhaave, Gaubius & Haller have allowd the Nerves a great share. — Therefore our system is to be considerd as a Chemical History, Hydraulic Machine, & animated system.

Lec: 8th Nov: 1776.

A View of the Theorys of Different ages might have been required; but a History of Opinions is perhaps a History of the Follies of Mankind. I shall only mention the few writers in this subject: first, before the Times of the Romans no work remains but that imputed to Hippocrates. Many of which are of a much later Date than him, & are of little use as we can hardly fix the date of any of them. Hardly any one of the Works of the Dogmatists remain, but those of Aretius, down to Galen

There are likewise no works of the Methodics but that of Celsus Aurelianus, which contains much more of the Practice of the Antients than any. You will have it much better from Prosper Alpinus, who in the end of the 16th Cent: endeavourd to revive that Doctrine. next if we would take Galens own Personal system it is to be had nowhere but in his own works. As a great Part of our modern system is derived from him, tho the systems is quite layd away, you will have a good account of it in the Writings of Sinertus. Many a Thracasterus, Mercuriales, & Cesalpinus are hand. I can only recommend Cesalpinus & Lazarus who translates from him & Fernell. I can meet with no one of the Atomical Systematics that I can read, you are to take their opinions with regard to the causes in the Encyclopedia of Doreas who has given the Opinions of Peraelsus & Van Helmont. After that are various systems, the first of these is the Cartesian, you will find these most fully in Blancard &c. Chimist and Cartesian, were the systems of Willis, Sole 23 Bue, & Almullen; they then are to be consulted. In the Present time the Stalian, Hofman & Ruysch: systems are the only ones of Note. Stal has had many Disciples who have each of them given a system. We commonly take his system from Junkes, who is also more full in the Practice, But the system is better from Stall himself in his Theoria Medica vera which is full of exellent but abstruse Matter. It has ban proposed that young People should Study Mathematics or to learn to thinke, I immagine Dr Stall would approve this Purpose. Dr Hofm: has also had Disciples but his Doctrine is to be had from his own writings. Boerhaave is in every bodies hands fully evolved in Van Swetens commentaries. One or two Disciples to be noted, as De Gorter who has hardly made any Addition to his Master has entered into all all the subtilities wch are to be avoided even in the best system. Dr Hoyberg has pushd the same system to the Heights

of Mathematics. The Italians are keen and
virulent in disputing against others; they have
been usefull in collecting facts wch are often
influenced by this attachment to system.
Boerhaave has had a much greater share in
forming a sect & school than Bozman, who is
now beginning to be deserted.
Galens system was first cultivated in Italy, con-
tinued to be the chief School of Physic, till
the middle of the last Cent: when they admitted
first Mechanics as Bazlivis system. The Ita-
lians have continued to be very mechanical, but
no body remarkable, & Boerhaave much followed
with us last. The French excelled the Ita-
dy of Dijon: but had not the Abilities to get quit
of Galen. Then Cartesianism prevailed mixed with
Chimistry; in the present Age they begin to
be more purely Mechanical. For 20 years
past they have been Zealously attached to D. Boer-
haave. One Man has changed or wanted to change
their System, Savage, who has endeavoured to com-
bine the mechanical & Italian Doctrines, but

he is not like to have many followers. and 27
in spite of their attachment to Dogmas they are
combining the Nervous System. In Germany
in the Beginning of this Century the Chemic-
al system forced itself in. The Mechanical
has been introduced but not made considerable, by
Heister & Mr Lurz. Leipsic is one of the most
considerable schools. He in his Pathology introduced
spasm & Debility for Senability & Irritability.
Boerhaave is quite followed at Berlin; & in Brittain
there is a strong Bias to Empiricism. Sir Thomas
M. in James's time introduced Chemistry. Barrey
& Glisson more of no system, they have the Galenic
& Chimical mixed with many Interpretations of
their own. The Members of the Royal Society were
Chimical but not systematical. Bennet was by
Boerhaave called the Eclectic Doctor, so Sir John
Floyer &c. may bear the same Appellation. Mead,
Keil & Pitcairn cultivated the Mechanical. Win-
tringham, Huxham & Lobe are Boerhaavians.
Pringle, Baller, Senaac, & Morgagni have no dog-
tim at all —

Lec:

Lect: 8th. Nov: 18th.

Which is the best Plan of prosecuting the Study of Medicine, I will not dictate to you, I therefore shall laydown Reasons, all of which can not yet be known; a full discussion of them must arise from the Nature, Extent & Powers of Medicine: A Plan now may be necessary, that could not have been 1000 years ago: the Plan is also varied by the auxiliary Arts as they are more or less brought into use. I must limit the laying down my Reasons to you as yet; but as all of you are, I hope, acquainted with Anatomy & Natural Philosophy in both its Branches Mechanical & Chemical, I shall proceed to offer you such Reasons, for giving the Preference to this or that Plan, as you can understand. I shall propose two Questions then; first what, & how much is to be learned? Second. how those things proper & necessary may be acquired? The first Question arises from the Dispute between Dogmatists & Empyrics, & this Dispute has from that time subsisted & is not yet removed; I am afraid very few enter into it properly, or sufficiently seriously

Every Apothecary will tell you nothing can be Done without knowing the Reason: and that, More easy, will say Reasoning is nonsense. Celsus has given a most elegant Discription of the subject & Monsieur Leclerk is the best I know; at Padua for Auto Empyrics has labourd the Point: in opposition to the Dogmatists. Bonnius of Leipsic is the only one that has said any thing De Sophismatia fallacii. I hope the Discussion I am going to give may be a means of directing your Steps so that you may guard yourselves on both Sides; therefore the Arguments in favour of a Dogmatic or Empyric Plan are to be opposd to each other. — The Empyric Plan consisted of Observation, History & Analogy & hence proposed a simple Imitation in Practice; & when experience failed them they then had Recourse to Analogy, but that very comparison of unknown Phenomina to similar known ones is without Doubt Reasoning; & therefore it is unfair to call the Empyrics Irrationales, as if the Dogmatists only employd human Reason; Further than enquiring how Medicines operated in the curing of Diseases. — On the other Hand the

30 Dogmatists did not proceed by external Appearances, but enquired what were the internal causes or conditions either in change of the solids or fluids that produced them. From knowing the difference between the State of the Body in Health & Disease they formed their Indications of Cure. But you will easily see this resolves into the knowledge of the State of the Body in health & Disease which is Physiology; Hence Physicians have called Physiology the proper Theory of Medicine & it may very properly be so called still. ——

Objections to the Dogmatic Plan —

The Arguments against it have generally been drawn from the Imperfections of Physiology. Such Arguments are not very conclusive, but the Objections laid against the Foundation are much more difficult to Answer; The Foundations are said to be unsound, partly from the present state of our knowledge, partly from their own Nature being as they say, such. The Adversaries have taken advantage of every thing that has been urged both against Science in general & Physic in particular. But Arguments that equally affect every human specu-

31 -lation are not to be regarded, & we shall do well if we can put our Science upon the same footing as the rest; I only deliver to you the Objections against Theory itself.

View of the Animal System

I divided my subject into three Parts. The first is as of a Mixt possessed of particular qualities either in themselves, or with Regard to other Matters, under this Head is comprehended all that touches upon the Fluids of Animals, the Change of the Food into Blood, the Different Secretions, & lastly the Supplying the waste or the growth of the Body in consequence of Change from the same source; Now as all this Depends on Chemistry I shall call it the Chemical system. —— The second view is that as all the fluids are contained in certain Vessels & exist chiefly in motion, we consider these Motions, & the various impelling causes of the Motions. The Structure that consists of Tubes transmitting fluids in this manner is called organic & is in common with Vegitables. It comprehends the Blood, the Arteries, the Secretory & excretory vessels & the Alimentary Canal; which have all Fluids

moving thro' them; these will be called the Hydraulick System. — The third View of our Work, is that of an Animated System, or which is capable of thinking & from this a Variety of Motions are produced. The Organs of it are endowed with Sense; as the Brain & its Distributions thro' the Muscles & muscular Parts. This then to be call'd the Nervous System. —

Linneus's manner of distinguishing the three kingdoms is, Lapides crescunt, Vegetabilia crescunt & vivunt; Animalia crescunt, vivunt & sentiunt. —

A considerable Imperfection does at present, & will for a long time attend our Dogmatic System: I am to act as an Empyric that I may give them all the full weight of their Arguments, & will after perhaps turn tail & espouse the side of the Dogmatists, that I may act as an Impartial Moderator between them. Chimistry gives many Observations the most useful in an Empyrical Way, but it is remarkably deficient in its Philosophical Applications to Medicine; to Illustrate this, we have found the whole Powers of Nature are Attraction & Repulsion or Attraction & Fire; I shall willingly allow that the Application goes further, as to point out upon what Attraction depends (upon elective Attraction) but we don't know what that is, Philosophers are every day disputing about the Theory; they have not determined whether it is not a particular Elementary Matter or owing to certain Affections. But when we find Fire to be the great & prime Agent in Nature & know not upon what it depends, you will readily see how uncertain all our Theory with regard to it must be

Lect: 9th. Nov. 19th. —

The objections to the Dogmatic System lie against it as Physiology & we are not to object to men, but the System itself. Chimistry, as resolved into Attraction & Fire is in that State that what ever we pretends to know of it; but the Doctrine of the Animal Mist is still a more difficult part of Chimistry.

We have found saline Matters in the Humours but the Entire Mist is still unknown; perhaps that Process w^ch we name Fermentation is peculiar to

Animal Matter, or the Vegitable matters of which they are formed; but this is one of the greatest Mysteries of Nature, for a small quantity of Matter to assimilate a much larger into its own Nature

We know a great many Fermentations, & even the different fermentations known, are not near all the variety of Nature. Till the Doctrine of these is better understood, their productions in Animal fluids must be unknown; & secretion is strictly a Separation of Matter by a

Principles with regard to the Animal Economy.

So Borelli &c. in calculating the Power of the Heart have differed in their Principles from a few ounces to several hundred Pounds; thus Dr. Robt. Morgagni, Silvius, & Senac are opposite in their Principles; & for eighty Years past the Doctrine of Revulsion & Derivation has been undecided by the Mathematicians; & even supposing the Principles ascertaind, the Data are difficult to be acquired; we are not agreed about the largeness of the Cavity of the Heart, the Proportion of the Trunks & Branches of Vessels, nor their Action; Anatomy hardly in one instance gives the Proportions Parts, & tho' it gives the proper Parts accurately yet not the more subtile. It is probable that our Ignorance in Secretion is owing to a defect in Anatomy.

Likewise we know nothing about Motion from our not knowing any thing of the Structure of an ultimate Fibre. We have made very beautifull Theorems, we have got general propositions depending upon a force & Size not ascertaind: But that Proportion does not continue for two moments the same.

Two or three years ago by a Mathematical calculation they tried what quantity in Blood-letting ought to have been let; but every Physician must be determined by the Strength & frequency of the Pulse.—

Arguments against the Animated.

First objection against it is Thals view with regard to the question whether we have a rational soul governing the Motions of the Body, or whether it be an arbitrary one? we shall afterwards shew this question not to be of much consequence

Dr. Willes in England enters into the Doctrine in his Anima Medica; Gaubius has so great difficulty in ballanceing the Thalian Doctrine that you would be at a loss to say whether he is Thalez an or not. If the soul acts arbitrarily we must give up all reasoning concerning its Operations on the Body: but we must admit of a sentient Principle. Yet it may be alledged, that if this Doctrine be a fact we may proceed by steps to more general ones & consequently form a Theory. But with regard to the Sentient principle every man not only differs from every other but even from himself at different times, & the Sentient Principle gives under different circumstances a very different series of Causes & Effects: here Anatomy has failed us in teaching nothing of the Nerves either in their Origin or Termination. The different structure & Arrangement of the Brain must give a difference, which, however we know nothing of. So in the Extremities of Nerves tho' we see Organs of different Senses yet we must suppose a different effect of origin. We cannot say how the Optic Nerve is disposed to recieve the Impression of light, & we are also especially ignorant of the means of communication among the Nerves. We immagine it to be the motion of a Fluid from the common Origin of the Nerves along the different Ramifications, but whether it be a fluid, or what it is, we know not. Gaubius determines nothing, but says "Deus docuit" Therefore the Dogmatic Plan must be fundamentally wrong, & occasion not only present Difficulties but such as are likely to remain as being in their Nature beyond Human Knowledge. The Functions of the Animal Economy very often run in a Circle; thus the

Motion of the Nerves influences the Circulation, & that the former; likewise in the change of the Alteration there is a Modification of all the Circumstances of Circulation from the present state of the Solid parts which will be different according as they are differently affected. There is not one Function in which the Study of Chemistry, Hydraulics, & the Nerves don't take place altogether.

Lect: 10th Nov. 20th

I said that the Functions are mutually the Cause & Effect of each other. Of Vital, Natural, & Animal the Vital are more especially necessary to life, but if we cease to take in Aliment, or the noxa attending this & other natural functions be not guarded against, the Vital very soon languish; If we are not moving the Body, receiving good Air &c: neither the Vital or Natural can long continue; & therefore they also go on in a circle. Medicaments therefore must get out of this vertiginous round as soon as possible

I must add the Palsey of Human Reason, & the particular Palsies arising from the difficulties mentioned, & if besides all these you observe that they are commonly

ed to weak Men, you will see Errors unaccountable. Speculations are beautifully Ingenious often & may be admitted into the Schools, or for the amusement of the learned, but not in the important Affairs of Life. System is necessary, I think, in all teaching, that is to say the Memory can not take hold of a thing without arrangement, but no System is, at present, & perhaps never will be perfect & therefore the Rigour of System is compatible with Human knowledge. But Dogmatism leads to System & the more particulars a System can be comprehend, the more fallacious. Galen is blamed for being hurtfull to Physic, but Boerhaave would have done the same thing had he been in the same circumstances. Another effect of Dogmatism, is that it leads to Doubting, & the more a man reasons the more will he doubt. Gentlemen in the Practice of Physic are very often disturbed with immaginary Indispositions which they would be very free of if they had less Speculative knowledge. Hence the most Systematic have been the most timid in Practice; in short it has been objected against Dogmatists, that they are seldom anxious about the cure of their Patients provided they

treat them secundum Artem.

We must do next what is to be put in the Place of Dogmatism; the only other Alternative, the Empyrical Plan; I shall therefore point out the Falacy of it, & shew that it would be a bad exchange for Dogmatism; I might point out the general Arguments of Scepticism, wch as they affect Dogmatism so I might say they affect Empyricism too. The Senses are to be trusted but they are not infallable, yet admiting that they are to be trusted they give a groß or general Idea but not in weight & measure. Our judgement of length and breadth would go but a little way without artificial Measures; there is scarce one man in Europe to be trusted in drawing a Scale, so rare a qualification is accuracy among Mortals. These Foundations of Empyricism, as well as Sense & Experience might be urgd against the Empyrics, through all their three Divisions, Observation History & Analogy. The two first are the principal part of Empyricism Analogy borders on Dogmatism. —

Such Absorption as Imitation requires is very difficult from the great diversity of Circumstances to be attended to in each hereditary Taint — very obvious remarkable accident in the Course of life — the general Tenure of the manner of life — the Patients late exposure — & the immediately exciting causes: & then the present circumstances of the Patients Body & Mind. They are applied to the qualities velocity & the Strictness Laxity under which, vast variety is comprehended. And we must also attend to external Circumstances, as the Heavenly Bodies & internal the state of the Air: Then we must attend to the Course of Symptoms, & Series of Phaenomena not only by the Day but by the Hour, a part of this is an attention to the Ingesta & Egesta in which the Efficiousness of Nurses makes an odds; Lastly an attention to the final Event is requisite, if in Health, to the degree of it, whether it is more or less perfect; if in Death, we must inquire into the Seat, the Cause & Effect of the Disease. Now how many of the preceding Circumstances have either been considered by the Patient nor others, how seldom are

me masters of the remote Causes; & often how many circumstances do we overlook, & how many arcana to be observed at all, & what is passing in the Patients mind & various feelings; how often are we ignorant of the Suggestæ, tricked by the Nurses, & with regard to the Event how many things are then not attended to. It may be answered that such minute Observation is not necessary. They are distinguished into the Communia, Propria, & Accidentalia; the first not always necessary to be attended to & much oftener the last. But what are accidental what essencial scarce any mortal can tell, & therefore dangerous mistakes may arise from this source. It is true as the Art advances it will relieve us more & more in this Distinction. Perhaps in this way we may go to the length of Establishing the genera of Diseases or setting Orders; but I am afraid the species & Varieties will elude us. Often unsettled are the Pathognomonic Signs, while the remote Causes are not attended to, & some Accidents must alter the Nature of the Case. Therefore there will be occasion for strict Observation, & to deny that is deserting to Analogy. In Hospitals we can make these Observations best but with more pains than most of it is practised. The Measure of Heat & cold has promised to be a very important discovery; & tho' we have been 100 years in Possession of them not one good Observation has been made; even De Haen's are much disputed. Dr. Brown Langrish examined the Urine but scarce one of his Experiments will apply. Our Clocks watch numbers the Pulse; they talk of softness & hardness, but scarce any two agree in their senses there.

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Lect: 19th Nov. 21st.

Having spoke of Observation I am now to say something of History; & first all the Difficulties, oversights, Inaccuracies & Falacies, of observation must enter into History; there is a great difference between Reading of, & seeing Diseases; it depends on this, that many Symptoms very easily denominated, are not to be described; but suppose we had words that easily communicated one mans Idea to another yet the measure & Degree can not be expressed in Words; tis very difficult for any one man to give his own feelings exactly, but much less will he be able to perceive those of the Patient. Much is got by

observing the words, Gestures & Motions of the Patient that will be lost in Description; History then has all the Inconveniences of Observation & this more, that it does not communicate all that can be learnd by Observation; & it is rendered still more inconvenient from Languages, particularly those of different Countries & Ages. Another considerable defect of Observation I have reserved to this Place that is the great Fallacy of it from Assurance or Prejudice. Not to see in bright light or not to hear distinct sounds is odd indeed, but not more so than the Impudence of too many. We drop what is not former Purpose & add from our own heads what will set the work off in better Colours. This has been a great objection to the Dogmatists, but it does not affect them alone, for the Prejudices of Analogy equally affect the Empyrics. We should not doubt of having many Remedies in every Disease yet when we come to examine the matter we find often we have not one; and the fallacia causa pro causa common to both Empyrics & Dogmatists; But now are absolutely liable to detect Fraud & Imposture of the Patients.

A German Author relates upon the Testimony of his Patients, that after a certain Emetic he throws up Whelps; & with us, a Man Midwife is said to have delivered a Woman of a Number of Rabbets; the Patient always gives his complaint, Augments his Symptoms, & conceals such causes as may owing to his own Imaginations; according to Galen has long ago wrote a Treatise to discover counterfeiting Patients. In Philipus how frequent are Impostures When Profit or Reputation lead that way we find men have not scrupled to tell gross falsehoods; add to this the fallacies from supporting or Oppressing a particular Opinion, as well as the Vanity of writing a Book to get a Character. There is also a Fraud of which a Man is but half Conscious, that is, supplying many things in his Closet which he did not observe at the Patients bedside. Upon Observateur de Grand Mentieur is a very true & very common Observation in France. History in spite all these disadvantages extremely incomplete. We have all been disappointed in History, & in 30 years Practice I can hardly say that I have three times met with the same case I wanted. In the actual State of History, & qualities of the Observations if

you examine 200 of Recoveries & 1000 of Convalescence will easily see that one 4th of them will not apply in the Practice. They either don't let you know the Cure was performed, or they say it was effected by Remedies, that are known to be inert or inactive. Nothing is so obvious as the Impotency of Empyricism in its own proper Business, toward determining questions of Fact; For 100 years Appeals have been made to Facts on both sides, & disputed by each other, or reconciled by finding both False. The Questions concerning Peruvian Bark must be decided by observation alone, with regard to the safety of the Remedy, the time of the exhibition, & the different Effects on different Constitutions; but all these Points are yet undetermined. British Physicians most positively maintain that the Bark cures Mortification, I believe they are right but Scotch Genius it. With regard to Corrosive Sublimate the Edinburgh & Vienna Physicians are at Wars, & the same Vienna Physicians & almost all Europe differ about the Cicuta. The Alterations of Diagnostics are almost entirely lopped off the Haze

but we are almost equally engaged in Disputes, Facts. With Regard to a number of Remedies that have come in Vogue at different times, much might be said; for my time, Quick Silver, Soap, Tar Water, Warm Remedies, & James's Powders, have all been given to the Publick with high Recommendations. It is easy to shew the general Falsity but with regard to the particular we find that nobody can much rely upon them. Therefore from the whole of what has been said, I would infer that Empyricism, as consisting of Observation & History is quite lame & insufficient. The Empyrical certainty is presumptive, viz: that we shall find in the Histories of Physic a Case such as the one before us & a Remedy adapted to it. The Empyrics have not had the benefit of this, nor been able to keep themselves to it, except some such bold enterprizers as Dr. Ward who when called to a Patient who told him his Symptoms Push, push, push, I know nothing about your Symptoms. Don't tell me of them, there is a Remedy that will cure you. I shall now proceed to take the third part of the Empyric Plan, Analogy 4th

Sydenham has very where imitated.

The Empyrics have always been attacked to Medicines of Sensible Operations; so for right they are certainly the most efficacious, & the present Attachments to Poisons is I immagine well founded, & if a man will venture to blunder on he must make some Cures, a very few of which will establish his Reputation. Failures are easily Excused; the Violence of the Symptoms is blamed & the Constitution as well as the Rubbish is imputed on. Since Empyrics have left Observation & taken this way of it. I shewd the Ancients did very little in the way of History; & the Chemists who are properly the Modern Empyrics have done much less. The Empyrics have not neglected Bleeding, Diet, & Regimen & the Dogmatists have been led to study these; both have had their Bias that has proved hurtfull. The hardy common People, the Vulgar favour Empyrical Remedies, while the Luxurious great will require Asclepiadean Remedies. Which if you attend to the Cause rather makes for the Dogmatists. The Method of the Empyrics is rash &

they can not even foretell that they shall cure. Dum Artem, or leave me to die with out hastening their Fate. I shall either trust to Nature or consult a man who has Studied, & whose Delicacy & Education will never allow him to hurt me (if he can not do me service), must be the Language of every Man of Sense.

Lect: 12th. Nov. 25th.

I suppose you will not rest in either of the Contradictory Conclusions which I have drawn from Empyricism & Dogmatism. At Analogy which remains to be spoke of, our Representations must tend. Ideas bills us in an unknown Disease, that a Patient was allowed to die without a Cure being attempted which might have been made out, had Analogy which he call Similitude been tried. I have frequently met with Pleurisy, & found V. S. to be a usefull Remedy in it; If I should meet with a Splenitis attended with fever, & hard Pulse, &c. I have not found that exact concourse of Symptoms before but I have recourse to V. S. as the Disease is similar. If I should meet with a third Disease in which there was an acute pain causing Cough, but no fever, If I should in this case apply Analogy I would do best

& therefore I find caution necessary in the use of this Analogy. I find then it was the chief Rule & Power that constituted the Comparison & made the Resemblance, which likewise warranded the Resemblance in the Cure. But further to give another Example I must write another Pain in the Pit of the Stomach & fever with it; & of from Dissection I find the same Internal Inflamations & from the Appearance of the Blood find the same fundamental similitude I get a much more general Analogy & am led pretty fairly to conclude that V. S. is usefull in all Inflamations; hence I conclude that the System of the Antient Empyrics was imperfect in not generalizing of Facts & so extending their Analogy. From Celsus & Galen we find they had not this & had only recourse to Analogy on particular occasions when their Experience failed them. Of the Empyric Plan, Analogy is the only usefull part; hence Sydenham is the only considerable practitioner in this way. If Sydenham had not adopted many general facts from Hippocrates, he could not have gone so far as he has done. This fact "that Nature cures diseases" has given the whole Train of Sydenhams

Observations, therefore there is no doubt but that Sydenham would have added many facts more known if he had lived till now. By persistency in this Method we may hope to arrive at last at a Plan superseding all particular imitation, & which is the Right of Dogmatism. V. S. in all Inflamatory Diseases is usefull, but a Gastrotis is an Inflamatory Disease & do we conclude Venesection is necessary in it? or that Analogy proceeds upon Syllogisms? To this I answer that Logic has been employd in explaining it & giveing Rules for the conduct of it. It is very much neglected, not that it does not explain every process in our Reasoning, but from the Abuse of it in false Reasoning. The Errour is this that in all reasoning one of the Premises is always an universal Proposition, Hence arises the Foundation of all Errour in reasoning this way. We correct this Universality by Induction, accordingly all human Reason resolves into Experience & Induction from it, wh therefore regards the Practice or Theory, & all that is

reduced into Cause & Effect; that is to say, we only know that certain facts have a Contiguity in Point of time, the former we call Cause, the latter Effect. Sydenham has the same foundation as Empiricism, which is the attaining facts general. Under a Biass to Dogmatism this excess is Hypothesis, & in that case we fancy facts, or form upon too short an Induction of them. This is the Error of Dogmatism, but it is an abuse of the human Faculty. Again, in Empiricism the Error may be confining to simple Analogy & neglecting to generalize it by employing Induction. The Bias to Dogmatism is necessary, safe & proper. Particular Experience is lame & contingent when not frequently repeated, & unless modified in this way is of very little use; & when so modified it is the best way of bringing out & applying particulars; & Dogmatism has always been cultivated in this way, foolish as many of its professors have been, they have so proceeded; so Chemists & Cartesians have proceeded. At present the Stahlian Sect have observed more fact relative to the Plethoric State than any other; likewise the Hoffmannians have given more

general facts upon their Nervous System than could arise from Imitative Analogy; may Sir Isaac Newton & I believe, every Philosopher assumes a general fact, when confirmed by particular Observation. Muishenbroeck & Cot the first a Mechanic the second a Chemical Philosopher have been engaged in the random way; but few men will be diligent in making use of such facts for most must have a general Rule. We in Physic have obtained ways very few Pathognamonicks, & now for as they are we have set about generalizing them of late; which very Scheme, I hope will future open a way of extending & filling up the number of particular facts. A larger Range is allowed us and we may obtain Facts from various auxiliary Arts So Chemistry has given a great Number of Facts usefull to explain the Nature of Digestion. The Hydraulic Machine is of some Service to it being taken from it. I have said that that Physicians disputed for 100 years past upon Derivation & Revulsion; Silva has in this way applied his Mathematics wrong; & Sr Isaac has overthrown the Doctrine he so established if it is

by an application of the principles, misapplied by Silva & no objection to their just & cautious application. If Van Swieten has said that fevers are owing to the Impetus faciens, & if Hoffman has in any measure attempted to explain the Nature of that we may suppose both those of Advantage. Further Reasoning is necessary & the only means of correcting false Reasoning. It is an Art like all others in which we become dexterous & strong by the Exercise of it. I even maintain it is unavoidable; the Empyric System would be nothing without Analogy; I can venture to assert that of a pretty general acquaintance I have among Empyrics I never met with one that avoided Reasoning. Nay they not only employd Analogy but if they did not get an obvious one had recourse to a far fetched one; nor can any of you, if you examine the state of your minds, say you find it otherwise. If Reason is unavoidable it is only Reason that can render Reason safe; you can never be secure against Error till you have examind it. I shall add another Reason for what

I advance; I have given two or three Instances and 85
more might be adduced if necessary, in which even unlimited Dogmatism has been of use; but will it not be much more so, when more cultivated? we have only begun within this 100 years to correct our System, & only begun to our Stock of Facts in the present Century. It has been said that we ought generously to plant for Posterity, but this has not been the case so often as has been alledgd, for I doubt not but the present Planter find as much pleasure in raising the tender shoot as his great grandson can have in cutting down the Tree. ——
The first part of our Plan for a System of Physic is collecting our facts; now these facts are first to be taken from the Art itself & recorded in such a History as that of the Empyric Plan, & therefore our first step, is the two first Parts of the Empyric Plan; But as fallacy is here to be guarded against, it may in a great measure be removed by mentioning the source of that fallacy. But some particularly fallacy will either be removed or diminished by a constant Attempt to generalize; every general fact not only corrects Errors but delivers

from the Palacy of minute & particular Observations. Further, facts & experiments are to be collected from Natural History from Mechanical & Chimical philosophy, from the Chemical Analysis, & from Anatomy & observation of the sound & morbid states of Bodies. Now with a Collection of Facts from all these sources, & from all Ages & Countries we provided, & may, I hope, lay the Foundation of a secure & sound Analogy.—

Lect: 18th. Novr. 26th.

These are the few propositions to be carried with you & which I mentiond not satisfactorily yesterday; that Analogy is unavoidable on an Empyric Plan, that it should be extended to more & more general facts, is truely Reason; & being thus extended a little further, becomes Dogmatism. Analogy, Reason, Dogmatism, which in my Opinion are all one, & the same things are necessary for bringing out the particular facts that are to be the Foundation for the whole & the surest means of avoiding Fallacy. Reason is also necessary because unavoidable to the human

mind. And I may add as an Argument a posteriori that this method has been of considerable use already; & if so in a short time, how much more so will it be in a much longer time. You will determine with me that we are to cultivate Medicine upon a dogmatic Plan, taking in the most valuable parts of the Empyric Plan; We are to lay our Foundation in Induction and History— Our Facts are to be collected from the Art itself & we are to attempt an Nosologia Methodica; that is, a Reduction of Diseases into Genera & Species. Sydenham very judiciously attempted this long ago but his Plan was neglected, till Savages within this 30 years took it up; others have touched it, but their labours is small in comparison of his & the Work still but begun. Gaubius in ordinandis Morborum Differentiis, touches the foundation says that we need not despair of Success "Sydenham &c"— But that work for Point is still at a great Distance, & one may come sooner at it by the study of proximate

Causes than by extinal Phenomina. It is certain that Diseases of the same extinal Phenomena may arrise from different proximate Causes & therefore may be very different in their Natures. If we are to study proximate Causes this is Dogmatism in its full form. This part of our Plan has been objected to, but after all the objections made to it, it has been attended with use. An Example of this may be Anatomy which by observing the Parts affected to our Eyes, has enabled us to understand the Nature of many of the common, as well as peculiar phenomina of Diseases. Morgan could not have reasond as he has done with out Anatomy. Remote Causes very often illustrate the general & particular nature of Diseases. and with regard to remote Causes how many assistances do we not obtain from Mechanical or Chemical Philosophy. Will any body doubt of the Advantages of Physical Geography. Chemistry has given facts determining the Effects of Aliments. The Nature of the Disease is often illustrated by the Nature of the Remidy. A common Remidy indicates a Disease very much

of the common Nature; here Chemistry— There is no building upon a Foundation of Empyricism, without Dogmatism. How is the whole to be conducted, & this knowledge to be acquired? shall it begin with Empyricism; stop there; or proceed to the Study of proximate Causes. We must employ more or less of the Synthetic Method, & must unite our Facts; It will be necessary in any Event but more so at the present. There is no delivering a Course of Practice without a set of general Rules, wch last are only a Course of Institutions. A Particular here deserving your attention is Experientia laudatur & alget. What we know has been collected from Dogmatism; & strip the professd Empyric of what he gets from the Dogmatist, he will appear a naked unfledgd Animal, a shapeless unlicked Cub!— While I acknowledge that Dogmatism has done much mischief I say it has done good upon the whole, & the Salaries attending it may

60 be guarded against by the Means I have hinted
out. I alledged the System was affected with
almost Incurable Imperfections, but there I hasted
the Matter too far, & the objections lay mostly
against it as a System, & as such they should stand
& are likely to stand long. System is ornamental to
order, but System gives neither perfect in the Whole
nor its Parts; it has also covered dullness. The several
parts of Dogmatism turn so much in a
circle that we are said not to know any of the
Parts till we know the whole; but this Objec-
tion is common to it with all the Sciences. Tho'
I admit these general Objections yet we are master
of many usefull particulars in System, & I think
we are at liberty to cultivate it. I have warn'd
you already & shall every where guard you against
mistakes where I see occasion.
I should now proceed to the several Parts which
Medicine comprehends, & say how they are to be ar-
ranged.

Lect. 15th. Nov. 24th

General Plan & Course of the Study of Physic

I can by no means say how a Course of

more years is to be undertaken in one, or how 61
the Science is to be attaind without a previous
knowledge of the auxiliary Arts & Sciences; in
short I can not see how a man is to take a
part of this Study only while every part is
necessary to the knowledge of the rest; I am
to say nothing to such Students, & passing also
over the consideration of the Apothecary, I am
to say how a compleat Physician is to be form'd
in the full extent of the Dogmatic Plan; & not
only how the Able, but how the Ornate Physi-
cian is to be form'd. While you regard all you
aim at the Fortune of a Rabbi, I would have you
to put it upon the same & Merit of a Boerhaave

I wish I could find out a means of acquiring a
preparation from Nature; viz: what we call
a Genius. I must be content to say in general
that a man devoted to the study of Physic should
be of good parts, sound Judgement, & fond of
Study. Every one who does not find a Disposition
to assiduous Application should abstain from
the Science. With regard to the Preparations of
Art, he should first be generally fourn'd in

literature. Most sciences are only to be come at by the Medium of literature; & to say nothing of the Antients, most of our modern works are delivered in latin; it is the foundation of every thing that can be called literature. It has been alledged that learning is not very necessary, but if you will look into Morgagni de causis & sedibus morborum you will see what advantages that gentleman has received from writers before his time. To the study of the latin is to be joind that of the Greek chiefly for the sake of the antient writers in that language & because the latin can not be acquired without it. I would have added to this, the knowledge of modern languages; the French writings are necessarily studied, & so much the more that the writers of other countries chuse now & then sometimes to use the same language. also the Math which I have been recommending should have been acquired in younger years, & if these are still to be acquired I would have such persons not to begin the study of Medicine untill he shall have acquired them. Next as logic & meta-

physics are as it were the Analysis of the human soul; they are necessary; but it is not my business whether they be taken from Aristotle or from Locke. Also the study of Criticism & Morals is necessary; the first is an ornament, & the second necessary to the understanding the operations of the mind. Boerhaave was lucky in having studied Divinity first, & these other Branches belonging to it; amongst the rest logic which made him a more ornate Physician. Next every Branch of natural knowledge, & therefore the Mechanical & Mathematical ought to be known. From a raze for mathematics which lately prevailed we have almost fallen into a total neglect of them; but this extreme is more dangerous than the other. Mathematics are not only necessary for Physiology, but for the other Branches, & necessary to explode the false Applications of mathematics. & I would even recommend not to be content with the knowledge of the general parts of Mathematics, mechanics & Hydraulicks, but the whole. There is a natural connection between every Branch of natural knowledge. Chemistry has been considered as a Branch of Physic but most un-

Ch- happily fore it. But it ought to be studied upon a phylosophical Plan, without which it can be of no use even in Medicine. And here I would not have gentlemen to set any limits to their studies. Every fact in all these sciences has a connection with almost every other. But you will observe consequently that the knowledge of the several bodies upon which the different sciences the student has to operate, must be studied, that is to say natural History; this is necessary to the knowledge of the other sciences as also this of Medicine. Natural history has been divided into three parts: Botany the first which has been cultivated chiefly by Physicians: It may be cultivated as soon as the understanding is ripe to comprehend it. The second is Zoology which may be also taken as soon as it can be comprehended; but it will in general be better to let it alone till Anatomy is understood. Next Mineralogy which I think is not possible to be comprehended without Chemistry. I would recommend this advantage to you to be drawn from the study of natural History viz: that of Systems, Genus & species. This has not been applied to any part of science, but natural History, & in this skill of late only to Botany. I have hinted that the Nosologia Methodica is properly the first step in our system, and has fell short of the Perfection it might have acquired from an Inallentic on the Causes of method. The next step is the knowledge of the human Body. It would be lost time to convince you of the minute application it would admit of, or to say how far it extends, & that not only human but comparative Anatomy is to be studied. The prosecution of this I shall leave to your Professor, & shall only say that you are to consider it chiefly as a work of Memory. Many means might be suggested but I shall mention only one, that is the frequent application of the Pupils to their use viz: to Physiology in which your Professor supersides me. Now, these preliminary Observations being finished [illegible]

proceed to the Consideration of the Proper Study of the Art, Body.

This may all be comprehended in the Aphorism "de Cognoscendis & curandis Morbis." When the Institutions are studied it is proper to proceed to the Practice which is to be learnd partly by precept partly by Examples.

— Lect: 10th Nov 28th —

Definition of Medicine —

Medicine is the Art of preserving Health & curing Disease. here it is defind by it's end & purpose; this would seem to require an Explanation of the Terms Health & Disease, what at present may be left to common experience and apprehension. In its full extent it takes in other Animals comprehending the Brutes &c, We are confind to the Health & Diseases of the Human Body; I have made it an Art, but it has been considerd as contemplative & as a Science. So Boerhaave

of these "eorum" he gives no sort of a

character, but it is difficult to do that and explain Medicine by the Means employd in it; for here the Actions of the human Body, as well as the ceasing & intermitting of many of these Actions are employd among these Means. It takes in the Air, & the Relation that the human Body bears to every thing about it. The Course of Practice says Boerhaave, "est Disciplina &c.

It is a Collection of Doctrines & precepts first to be applied to the Individual, but these can not be well understood unless considerd in the Abstract. In the Cure of any Disease hardly any one Symptom is considerd but with a Regard to others & so in treating of the Causes. At first sight it will appear that these general Doctrines apply to a great many Subjects, & we must take them seperately and in a proper order. Boerhaave makes his Division into five parts to wit Physiologia, Pathologia, Semeiotica, Hygiene & Therapeutica; The first treats the Doctrine of health, the second the doctrine of Disease, the signs & forming

& these &c. But this Division is not good
& remedies are to be thrown out. you will plainly see that it is a Doctrine not to be understood
till after the Practice. Hygiene unites with
the Therapeutics in this; that the whole may be
divided into the contemplative & practical;
but I think Hygiene may in great measure
be neglected in our Institutions, as bringing
by a repitition of the Causes; I would therefore propose another which has been followed by latter
Writers, & reduce Medicine to three Partitions
Treating of Health, which is the Physiological; the second the Consideration of the Body
in a morbid State, which we call Pathological comprehending all the Foundations of the
medies; The third I would call the Doctrine
of means or Therapeutics, and you will what
our Course will be nearly Therapeutical —

I might mention a new Division of Gaubius were I not necessarily to take notice of it hereafter — We began with Physiology; as

Medicum est Norma curvi, so we can only know
the morbid State by tracing the Sound —

It explains that Constitution of the Organs
& that Condition of their mutual Action upon
one another, on which Health depends.
Health is that Condition of the Body by which
the several functions are performed with ease
Alacrity & a due steadiness. These Actions
are many & various but we must take them
seperately, & consider the Whole. We find it
difficult to observe a proper order & Method; different ones have been pursued. There are two general rules to proceed upon, from particulars to
general, or from the more simple & easy to
those that are more complex & difficult. This
can not be done more in our branch, than the
Pons Asinorum or seventh proposition of Euclid
be put out of its place. The second is that as our
general purpose is to explain Causes & Effects we
must begin with Causes; or with such facts as
are previous in Nature to other Facts. We shall
in some cases find it prudent to make use an

exception to this general Rule; and as to the Motions of the human Body running in a circle, & their being causes & effects of one another, take the following Remark: If we look into the Human Body we see it as a System of Tubes, conveying fluids from one part to another, & nothing is more important than Circulation which when it ceases in the Whole body; dies ceases, when in a part that is affected with Disease; But when we consider the Heart as the prime mover, we would begin with it; But on the other hand whatever power of Motion it has in itself these are not durable; & the cause depends from without, as the Nerves. Therefore there is some Function previously necessary that is in the Nerves; these we trace to the Brain; and in going this length so far as yet we avoid a circle in tracing the functions. But, on the one hand we stop the heart by cutting off the communication of the Nerves with it, & on the contrary if we cut off the communication of the Heart with the Brain, by means of Blood vessels, we stop the Exertion of its Functions. But we may still consider the brain as more primary; as is exemplified by the case of the sleeping Animals. I would then conclude that the Functions of the Brain & Nerves may be considered as the primary part; and that this may be considered as the first cause, upon which, more or less, all the other Functions must depend. I would accordingly begin in this way but as this Doctrine has not been delivered I shall not attempt it immediately, but will perhaps try it afterwards; but before I make such an attempt at any time, I must be guided by my Experience; that is to say I must first be satisfied that I shall be able to say any thing worth your while upon it, I am therefore to begin with the Circulation, & then proceed to the Brain & Nerves & last of all to the Natural Functions & as Haller is to be a sort of text Book I must keep to him as much as possible; He gives the

Circulation first, next the Cerebrum & Nervi, & last the Natural Functions. Boerhaave's plan of beginning with Mandication &c was a very difficult order. —

Lect. 16th Dec. 1st

I would recommend to you not to read the large work of Haller, unless when you are at a loss to understand the Elementa, as your time, if you have any thing considerable to do, will not admit of it. I am also to recommend the carefull study of Anatomy before you come to this place. I shall keep as closely to Haller as I can & when I am to depart from him I shall previously inform you. —

First — Fibra, Tela cellulosa

All Animals substance may be reduced to fluid & firm. He avoids beginning with the Fluids because they are of a different Nature and indeed they are best to be learnd after considering the Solids & their various Action. The Solids are to be considerd as the Basis of the whole Body; But Dr. Haller has here transposed against all the Rules of good order, in giving us a very Difficult Chimestry, and in involving us in the Doctrine of Nutrition &c. —

"II Solidorum &c ——— in organicum"

Haller here would seem to confine himself to animal Solid in its aggregate State, and to go no farther than microscopes enable us to discern and he has reduced that to Fibre, Plate, and irregular mass, or Mass of undetermind figure. Every Solid is as you know of three dimensions. Where the Length & Breadth differ in their Proportions, so as that the Proportion of the former to the latter is much greater it is called Fibre; When the breadth bears a greater Proportion to the length it is called Plate; the third part is that in which there is nothing determind in their dimentions. —

"III Fibra &c ——— pertredo. In this and the IV. V. & VI. he endeavours to shew that the more steady parts are earthy & that they are connected by a Gluten, Dr. Boerhaave whom Hal-

Cr has followed in this particular; endeavours to explain the more intimate Nature of Fibre or indeed Animal solid, by calculation, putrefaction & in some measure, by Dissection; he reduces every part of Animal substance to an earth, & employs Arguments here & elsewhere to prove, that this is the fundamental or essential part, while the others may either be absent or present. And he says that solidity is entirely owing to these earthy parts. Gallidges by the effusion of Water or of Oil that solid Bodies after loosing their cohesion become firm, & elastic by a gluten that these parts in the Body are united into Fibre, Plate, or inorganized part, all this we owe to Boerhaave, who has been followed by de Gorter, Gaubius, & others as well as by Haller. This Doctrine leads to the Notion that Animal Solids are an heterogenious Aggregate, and that their parts lay seperate, as in a Table or Chair the parts are mechanically united. But every thing

of the Animal solid leads us to think it an homogenious mass & I consider the whole of it as gluten. From any Notion of Nutrition it appears that the first Stamina are most near to a fluid state, & that every after addition is in the form of a Fluid. These organic Matter in the form of Bone, are first a gelatenious Fluid In the Spiders web, as an illustration of this, is a subtile Fluid when spun out, & afterwards becomes solid. The same is the case with silk. See Paragraph XIV. Haller ends in the same Opinion

The whole then is a gluten under various Degrees of firmness & solidity. In the End of the IV. C. ——— resident:" It is said to form every Animal in its first & Original State. Hallers reason for distinguishing solids into gluten & Earth, is their seperating into these parts &c. But these are resolutions. Every part of the gluten so resolved is liable by putrefaction to the same Resolution, into an earthy part; Whereas all that he means is breaking down the original parts. His experiments of restoring consistency

by adding Water is also imperfect & does not restore Solidity. You make nothing resembling Animal Solid more than you would resemble a piece of Chalk. No more proof arises from such experiments, than Water being added to Meal gives an Idea of Vegitable Cohesion; besides it applies to no purpose in Physicks that I know of, for it is still the Gluten from which we must explain the Effects of Animal Fibres & their Cohesion.

We can neither take away nor add by our Applications, the earthy Parts. Haller goes further & hints that Gluten is formed of oil & Water. It would be lost Labour to trouble you with the Imperfection of this Chemistry. I shall take a more correct view of the Nature of Animal Solid. A Fibre is properly a Homogenious Aggregate. Here Haller's Earth & Gluten, Water & Oil, may return upon us, but they apply to no part of that Mixture. They do not explain the Nature of Solid Mass. He says their solidity is owing to Earth, their Cohesion to Gluten. But what is the Reason of their ac-

creting Gluten, the Reason is no better than the old Gibberish of the schools "quia habet in se vim Glutinantem". We have got a much more general Law than referring it to any one principle, which is that it is the natural property of all the Parts. We know nothing of the real mixture of Animal Bodies. We know an Acid & Alkali make a Neutral &c so on; and the Chemists will venture to trace this question, but it is well known they do so upon the most slight Foundation. I refer the Consideration of this to Chemistry & to another part of our Course, under Gardiner's Pathology. We shall not there find the new Doctrine that Air is an Ingredient in Animal Solid, and the Means of Cohesion of the other parts therefore I shall say a few things on it here. This Doctrine is from Dr. Stephen Hay, taken up by Dr. Mobraid & very fully treated in Haller's great work. Air does enter into the composition of Animal solides & gives us reason to suppose, there may be still other Ingredients, nor is it any more to be consi-

ward as an Ingredient than D^r Haller's Elements. Perhaps it being there is a mark of the Cohesion of the substances & when it is removed perhaps the consistence is diminished. And all the Objections to the common Theory of supposing all the Properties of Bodies to depend upon one of their Ingredients is likewise equally against this. But these Properties depend upon a mutual Mixture or Arrangment of all their Parts. If we admit a Cement to account for Cohesion we shall have no end of Hypotheses; According to Hales gives us Haller, Gluten (this consisting of Oyl & Water) and else where Iron as a Cement. Brian Robinson in the second Edition of his Work intitled Animal Oeconomy, with the Additions that make it a third Edition, has contrived an elegant & accurate apparatus, to ascertain the Cause & principle of Cohesion. His experiments deserve to be consulted, but must be diversified if you would receive real Advantage from them, from his third to his seventh observation.

Lect. 17^th^ Dec^r 2^d

What has been said of the Gluten as a connecting medium is Hypothetical: and with regard to the presence of Air & its being thought the means of Cohesion, the same thing may be objected. Brian Robinson says a peculiar Acid gives the peculiar degrees of Cohesion in Animal Bodies; he has contrived a very elegant and accurate Apparatus, as I have said, to ascertain it; he has given the various relaxing proportions of different Bodies, and also two Tables giveing the relative Powers of these different matters in this Respect. I will point out some of the more remarkable particulars on this Head, as I am not to take up your time with them all. He finds that upon the Application of any Fluid whatever, Hair seems to admit some degree of Extention. And those Powers that do not relax so much, he calls strengthning. But first Oils of any kind have very little effect upon Hair,

nor does it follow from such an Assertion that Oils are useless as we employ them in Medicine & common life. But Hairs from their polished surface have misled him to conclude the same thing as to the Effects of Oil on them & other Bodies. I have no doubt but that Oils on the Cuticle of the Body will give more mobility & Flexibility, and Water gives great Extensibility. Neutral Salts have little Effect: even the fixed Alkaly would seem to have extremely little Power. A strong solution of Salt of Tartar gives an extension as 20, whereas the Lixivium Tartari per deliquium is very weak. Therefore when this is compared with the other there is room to suspect some inaccuracy in the experiment. Another Fact is that Spirit of wine gives extension, & Rum & Brandy more but none of these spirituous liquors give great Extension; it is thought even to contract Animal solids. The Elixir of Vitriol relaxes to the proportion of 84, warm water to 80. All vegetable

Solids relax more than the others saline 81 mattter, but still less than cold Water. For Fluids then have more power of relaxing than Water. The juice of Hillary, of Water Cresses & that of Scurvy Grass, relax more than water. The volatile Salt of Sal Amoniac gives an Extension of 72, more than the double of water but the Salt itself does not so far as Water. Great Use might be got by repeating this Experiment, but more from diversifying them; but you must proceed upon a different Chemistry from that of Robinson himself, if you will turn them to real use. At present then I must say that we know little of the Nature of Solids, only that the Gluten admits of various proportions of Water. Its qualities are different Degrees of Cohesion. Elasticity & Flexibility; but these depend upon different Proportions of Water; these qualities I must enter less into as they can be only touched upon in the Pathology. When a particular of Physiology can not be understood till we come to the Pathology I shall willingly digress it.

In the VII. "Fibra vero ——— structuræ facies" he mentions two kinds of Solids, and speaks more particularly of Fibre and in the VIII & VIII, of the "Minimum & aliud genus" a distinction which I think, evidently improper. The Universality of Fibre in the animal Structure is not proved so far here by Haller as may be. I pass chiefly over the seventh, eighth, Ninth, & tenth P. where he gives the Structure of the Parts which will come in better in another place. I pass over also his Description on Nutrition & the growth of the Parts in his fourteenth & fifteenth P. and the Doctrine of Secretion, of Fat & Oil in the 18th. 19th. & 20th. all these manifestly must be referrd to another Place.—

Next then with Regard to the Structure of the Vessels, Boerhaave maintained the Opinion of a series of Membranes, & of different Organs compsed of these (in Hallers Physiology Page 23?). The Notion of Membrane has been that of a Web consisting of so many Vessels interwoven, as of a Weaver should weave a Cloth of Glass Tubes, as you will see at the end of the XII Par. "Membranæ vero ——— contexuntur". He does not allow his Lineal Fibre to enter into the Structure of Membranes. Boerhaave said that Membranes consist of Fibres laid parallell to one another in Cylindrum lonamve convolutum, and when convoluted into Tubes & Cylinders, that they make the smallest Vessels of the Human Body; and he adds that a second order of Membranes arising from such Vessels, forma secundi ordinis, & these a third, & so on, &c. Haller has declared against this as False P. XII "Vasa quæ Tunicas ——— superaddentur" and he explains himself by saying that when the Vascular Coat is thoroughly imparted, that the Cellular is by far the most considerable Part & therefore chiefly constitutes the Membrane. It is true that in some of the Cellular Layers there is a Plexus of Blood-vessels, but there is no Foundation for supposing that they are there formd to give a Membrane of second or third Order. In the

 larger Membranes, the Plexus's of Vessels appear of a larger Size but that is owing to a Bulk of Vessels being necesary. Haller says that the whole Body is formed of Cellular Texture, that is he insinuates it in a very strong Manner as at the end of P. XXII. when treating of the Importance of cellular Membrane he points out how many Parts it gives substance to. He urges the same Opinion strongly in the XV. P. Now, that the Cellular Membrane has a large share in the Body is not to be doubted, & perhaps there are not two Fibres applied to each other without it, yet it does not follow that the whole Body is cellular Membrane; for the whole medullary substance of the Brain and Nerves, the Muscles, Tendons & Ligaments by Hallers own confession are not so. But whither the Membranes of the Dura Mater, and Tunica Musculorum are Intirely so is the question. P. XI. gives the Foundation of Hallers Opinion "Tunicas autem ex Tela cellulosa fieri demonstrat Oculus". and afterwards

"Durli & Membranae Nervee Intestinorum
facilis per flatum in Cellulosam mutatio"
We find the seemingly compact close structure of these is changed in to an appearance of cellular Membrane &c. These are his Arguments and he applies them to many particular appearances of the Body, But the straight Fibres when present are extremely weak, and when the Membrane is filled up with Water or puffed up as he would have it, there is no wonder if they intirely disappear under such Experiments, and elude the sight.—

Lect: 18th. Decr. 3d.

Cellular Texture is indeed every where in the Body but does not every where make the whole as appears from the medullary substance of the Brain & Nerves, In all the Muscular Coats there are two parts where it is doubled as in what are called the Membranes of the Body. Haller says from Masceration they appear intirely cellular and another Argument for him, on the other hand, is that Steatoms. turn evident Cellular—

Membrane into that sort of Membranous Tendon. But the Fibres are manifestly resolvable into still smaller Threads than it consists of; therefore this Texture may really & truely be present though it does not appear and they may be broke & disappear in Maceration: Of this we have proof. Haller himself found the whole of the Muscular Coat of the Aorta disappeard in Maceration & all the Coats put on the Appearance of Cellular Membrane: therefore we cannot trust these experiments made on the other Parts. And indeed it goes too far in the other Instances which Haller refers to in the Dura Mater which he also subjected to Maceration. He acknowledges with all other Anatomists that the Dura Mater & Pericardium are of a Fibrous Texture, for the greatest part of Anatomists find also a fibrous structure on this last And if Du Hamils Doctrine, that Bones are formed by a succession of layers from the Periosteum be true, then the Pericardium

too is a Fibrous Structure. And while in almost of all these Parts I have excepted it is evident to the Eye that a Fibrous structure is present, I would conclude that there are few parts in the Body purely cellular Membrane

The assuming a fibrous structure explains better the Growth & formation of the Body, & Cellular Membrane upon that supposition is the Consequence not the Cause of Fibrous Structure. Therefore Haller does not reason fairly in concluding against the Irritability of many Parts from their not being Fibrous

Further not only the various Membranes may be divisible into Fibres, but every sensible Membrane in the Body may by its Windings be divisible into Layers. The Experiments made by the Sypho-Anatomicus, which is an Hydraulic application of Malpi to anatomy, is the strongest proof of this, by means of which such layers are evidently discovered. However Du Hamil found the Periosteum timid by Disease, he found also layers. The Pleura peritonæum, Pericardium, dura Mater & inner Coat of the Aorta,

are all subdivisible into a variety of layers.
The Bones & Horns of Animals are thus formed
Most of the solid Bodies with which we are
acquainted, we have reason to conclude, were
first in a fluid state, and the transition of
fluid to solid always in the fibrous way as
in Salts, Metals, & earthy Bodies. There is a
difficulty when the solid is formed from the fluid
more suddenly, as in melting; here we might
expect a more irregular, or no structure of the
kind at all; but it is not so, for both melted
Glass & Metal, are formed in the same way.

I now proceed to more particular views of
Organization, that is, of Vessels, and shall turn
over to the next Chapter of Haller, his Vasa

You may consider that I am entering into
this as one of the chief Functions of the animal
Body. I shall divide it into four Heads; 1st The
Vessels, thro' which the Blood passes; 2d The course
it observes in passing thro' these Vessels, or what we
call the Circulation 3d The Power by which it is
moved in them, & last by we shall speak of the
laws of the Circulation. I would have begun with

the Heart, but can not do that without departing
too far from Dr Haller

Vasa

I shall begin with the Arteries & shall first
consider the substance of them 2dly the thickness
density & strength of them 3dly their Figure
taken in its circular section, & the proportion of
Arteries to one another 4thly their course & Ramifications, 5thly their communications, 6thly
their Terminations. First then with regard
to the substance of Arteries, they consist of three
coats; the external is cellular, the middle one,
Muscular, & the internal compact membranous
The true state as in P. XXIX. Quo interior &
Arteriæ propior, eo hæc cellulosa tunica solidior,
& villo mazis est obsitata. The external more
loose till you come to a more dense. there
is no Fibrinous coat, as by Maceration
the inner part of the cellular which has
been called so, is easily reduced to a cellular
substance, and here Haller's Experiment is
fairer than before, and yet he owns himself

that in this Membrane Fibres is frequently to be seen, Monsieur de Toe, in the Memoirs of the French Academy in Route Animals says that he found this cellular coat appear thicker than in the Human Body and thicker in men than in Women.—

2dly the Muscular coat in N° XXX. "Interna luminique propior ——————— exprimere". has been of late disputed; It has Fibres very much arraing like other Muscular Fibres especially these in hollow Cavities, but it differs from Muscular structure in being much more compact. The Muscular Coat of the Intestines is also much more lax tho' however it is analogous to it. The same Fibres are solid "Solidelatis valis conspicua" and as it discovers reconsiderable Irritability it has given great Doubt whither it be really Muscular or not. He says "a minorum Animalium Arteriis abesse videntur" If he could make out that smaller Animals want Muscular coat, it

would to me be a proof that they are also wanting in the greater; they may be present in smaller Animals, yet indemonstrable on account of the Tenuity of their substance. I leave the inner Coat to you to be taken from Dr. Haller, & other Anatomists. With regard to the second, Various is the density of the several Coats; Haller says "Robur Arteriarum satis magnum est" Wintringham junior, making experiments upon the Aortas found a Portion was broke by a Weight of

and below that, that another Portion was broke by a

but for all this strength Haller very properly says, that they may be broke or burst, & give occasion to Aneurism. He imputes the rupture of Arteries to the hardness of the external cellular Coat, and says that a force beyond what that can extend to make it give way & break. but it may also be the muscular Coat that gives way and occasions the failure. The Muscular Coat has Resistibility, and the Extent that it admits of is much more

bended, there hardly being any limits to that of Cellular Membrane, and par licularly in the Veins "Non difficilime rumpuntur, & facilius fere quam Venarum Tunica" N. XXXIV. But this must be imputed to the want of Muscular Coat in Veins, but it is the external Coat that gives way. So Winteringham found only the external coat to give way and not the whole Artery. Haller therefore is wrong in applying the Cause of the failure to the external Cellular Coat only ——

Lect. 19th Dec. 4th. —

We have explained the solid parts, or several Coats of Arteries; I now proceed to consider the Strength of these, having already spoke in some measure of the comparative force of the Arteries, I go on now to say in which of the Coats the strength resides; it is different in different parts of the System, and Winteringham observed that the strength of Arteries increases as you go farther & farther from the heart. This is a new Doctrine contrary to the opinion of Savages; but whether this increase of strength is in any exact

proportion always, is to be doubted; in the ensuing time it appears to be the general Rule but not exactly adjusted to the Proportion of distance from the Heart. You will find this in N. XXXV. "ut fluidi Impetus —— minuendum" We shall find presently that there are some other circumstances, that render the Action of the fluids more uniform than has been imagined; we find that Aneurisms happen near to the Heart; but that is owing to the Arteries being constantly full, and the Action of the Heart being more strongly exerted upon the Aorta. And therefore the Rupture is not owing merely to less force of the Artery. Under the same degree of thickness of the sides of Arteries the specific gravity increases as you go from the Heart. Since then the Density & strength of the Arteries, increase as you proceed along the branches, yet their becoming thinner in the same progress renders them more flexible and more readily dilatable. It is unlucky that Winteringhams experiments have been made by him self alone, and not repeated or diversified by others

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

Thirdly we are to speak of the Figure or form of the Arteries; you consider that in a transverse Section, they are every where Circular, in opposition to Archipiades and Des Cartes, who supposed Vessels of different shapes and adapted to matters of different Figures; Nay they must all of sume a Circular shape. Keller is too minute in insisting that tho' Nature's circular Section might not perhaps always happen, to assure of there be a Bony Canal we must expect a difference in this Respect. A transverse Section of the Encephalonal Sinus of the Brain has accordingly a triangular Shape but that is singular and no where else the case.

We think Arteries are cylindrical. Former Physicians thought it answered their purpose to make them of a Conical Figure, but in that it makes no odds whether they be so or not. Anatomists have now agreed pretty universally to their being Cylindrical, and the same purposes in Physiology equally arise from either Figure. Haller is not very clear on this head. Between any two Branches they are undoubtedly Cylindrical. You may consider them as a Cone in the Diverse sense of all their Branches. Haller says T. XXVI. "Ubi vere arteria aliquamdiu sine majoribus Ramis sunt, parum cedenter convergunt, aut omnino nihil quidquam, deinde cylindricæ sunt, vel lentissime diminutæ, ubi capillares vocant, & quocunque ubi globos palant?" You see a sort of hesitation he is in, in determining this part. But instead of considering the Arteries as Conical, there is more application in considering them as an inversed Cone. In any ramification the capacity of any two Branches always exceeds that of their

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

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

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

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

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

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

Lect: XX. Dec. 5th

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

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

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

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

other subject. The whole termination of Arteries may be reduced to these four Heads, the last admitting indeed, of various subdivisions

In P. XXXIV. & XXXV. he answers in the Affirmative; and does not doubt but that Arteries have the third kind of Termination into Vessels of Reduced fluids, and carry fluids thinner than the common Mass. It is not necessary to determine any Figure, but that these are very universally Vessels of the second order, is not to be doubted. Martin has calculated the size of Blood-globules of the first order, but we now question even the Division into the second order. Haller observes that Anatomists & Physiologists are willing to indulge themselves, in supposing that the Division goes to a great Degree of subtility. But in P. LXV. he denies very properly that they go all the lengths they have been imagined. When we can perceive the red Globules, and Wax pressed into Vessels that are allowed the Secretory & excretory, there is reason to believe that there is no intermediate Series

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

Veins

The substance of the Veins is remarkably thinner than that of the Arteries, and not so easily divided into layers, or Coats. In most or all of them, at a little distance from the rise are no seperate Layers. In the Veins which terminate in the heart there is evidently a more muscular structure than in the muscular Coats of the Arteries, hence that Portion has been called the Sinus Venosus, & supra cor ——— circumponuntur. Under this thinness & seemeing laxity the Muscular coats are more apparent than those of the Arteries. ——— Furthermore, they are too, firmer in proportion as they recide from the Heart; but in certain Veins, a superior firmness to that of the Arteries does not appear. Vasibus ——— circumpuntur. Doubt

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

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

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

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

Lymphatics

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

Heart —

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

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

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

Course of the Fluids

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

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

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

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

Lect: XXII December 10th.

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

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

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

mint to be wrong; He gives the ordenary opinion with regard to both "ea ergo percurrunt" he adds in

CXXIII "etsi multa &c. vocamus"

He points out so many circumstances, the foundation of the calculations, and none of them sufficiently ascertaind, and therefore it is superfluous for me to give you any estimation or calculation here; I would almost say they have all been building in the Air. Senaac says justly, little genius, a great deal of presumption, long Calculations and few conclusions appear in such attempts. I would add an obvious one; It is true we may make some Comparison of these Calculas but in none can we conclude absolutely, for at the same time that the Heart is raising the blood to such a hight it is pushing it thro' the circulation with considerable force. I have said, that the motion of the Heart is

a muscular power, and of a peculiar kind from its being subject to a peculiar irritability. From the Paragraph of Haller referd to, you will se how they have explaind the manner in which the Blood issues out of the Heart; but what ever be its velocity it is constantly suffering retardation from various causes; It is of more importance to consider these Resistances; These have been variously enumerated and estimated

Consideration of the Resistances of the Blood

The first is, that the Arteries are at all times in a state of distention; there is then no empty space in the Arteries to receive the Blood thrown out of the Heart; the Blood therefore must be thrown out with such a force as to occasion a dilatation of the Arteries sufficient to receive the new quantity of blood thrown into them. In order to make such way for its motion, the blood must be pushed forward in the Arteries dilated; during the Hearts con-

traction there is but a third part moving into the Arteries, therefore there are 2/3ds to be thrown out, and this must be done against the form resistance of the Arteries.

The Contraction of the Arteries restores fully the force of the Heart lost in dilating them; whether they do more is to be considerd after. Therefore the necessity of dilating the Arteries is to be left out and not considerd as thro' the whole course of the Blood. Another resistance arises from the surrounding parts, such as other Vessels, cellular Membrane, Muscles &c. all these concuring resist the Dilatation. But they are all too in some measure Elastic, and therefore restore what was lost of the Hearts motion; to them is added the whole weight of the incumbent Atmosphere, which has given a high Idea of the Hearts force. But the pressure of the air returns the same force that was lost in moving it, therefore all these resistances do not retard the motion of the Blood except by their Friction, a circumstance

common to all motion. Another resistance arises from the quantity of Blood to be moved and often also contrary to its gravity. But if you could make an estimate of the modification it gives to the Impetus of the Blood, we might make some use of it, tho' you can hardly consider a posture of the Body in which the Ballance of the Heart is not the same. Therefore with rezard to the Hearts Action, considerable variations in the posture have no effect, tho' they have with rezard to the quantity and impetus in flowing into any particular part. The Retardation of the Blood is supposd to arise from its moving from a narrower into a wider capacity. The Vessels as I have said move from the Heart in form of a diverging cone, the Branches as you proceed from heart are constantly of larger capacity than the Trunks. The retardation of the Blood is in this Proportion; the slowness will be inverly as the squares of the Diameter. It is agreed that an enlargement in general

takes place, but the degree of it is not determined; whither it is in uniform proportion or considerably varied over the system, as Senac and Haller are of opinion, whereas Haller has said that in the capillaries the case is different. I have dissented from him; I have shewn that every Ramification must give an enlargement of Cavity. With regard to Haller thinking the trunks to the Branches as two to three, in measures which he has taken from Senac, he was in a great mistake. We may take the square of the Diameter for the Area of a circular section. Haller has taken the sum of the Diameters squared that number, suppose the Diameter is as 12, the square as 144, and the trunk divided into two Branches, the Diameter of each of them is 8, the square 64, the sum of these 128 will fall short of the square of the Diameter of the trunk; but if you take the sum of the two Diameters

it will exceed by a great difference the Diameter of the Trunk. Senac gave matter but did not take Estimates, and such as he has are far short of Hallers. When we have allowed retardation from any estimate, the resistance arising from that will be difficult to settle. The diminution of the Hearts velocity will appear very considerable. Haller has observed that the state of the Circulation is not according to such calculations, that the velocity is considerably greater. CLXII If so it will give a presumption of some considerable falacy attending these calculations, but we can not say any thing till we estimate the considerable force raised from the Arteries —

Lect: XXIII Dec 11th

I have said we can not admit of such Enlargement as Haller has given. It is not necessary to enter into the subject of the extreme by greater velocity of the Blood in the extreme Vessels; we shall else where consider this more perfectly —

Other Causes of retardation. first the flexures of the Arteries. If a flexure is without diminishing the capacity, no other resistance happens but that of a greater quantity of the fluid applied to the sides of the flexure. I see no friction; for where flexure happens there is dilatation and some times elongation; now this this Portion so dilated is Elastic yet there is always some momentum lost. But if we can suppose, in the various changes of the canals, that there is a diminution of the capacity, it will make a great odds. If you inject the carotid, by laying the Arm across the Body you can almost entirely stop the Injection says Haller; this in the dead body; But in the living body, I believe in the various motions the diminution of the capacities is very inconsiderable. Indeed the flexion that is made where an Artery is changed into a Vein I would suppose considerable resistance; but as most of the Blood rather passes by Anastomoses than by the reflexion of the Arteries

Another resistance is that which the various angles make in passing from their respective trunks. If a fluid moves through a strait canal, the force which moves the fluid every where parallel to the Axis is the chief, and very little pressure will be made to the side. If an Aperture is made any where but in the upper part, it will appear to be nomore than the effect of the gravity of that Aperture. The lateral pressure of fluids is only in consequence of some resistance given to their direct flow which last will always be made considerable, and the lateral is constantly diminishing from an acute to a right angle. But the lateral may as an effect of Angles increase to such a proportion as to be equal to it. I would add that this consideration is not of such weight in the

Animal Oeconomy as has been supposed commonly. In the Stasis of Lexarigent resistance can produce any effect. Therefore after all that has been said of Angles affecting the motion of the Blood, it may be so in some degree; but it is difficult to apply the Reasoning in any one instance. Haller says the greater go off at greater angles, the lesser at lesser. By small vessels near the Heart passing off at right Angles, the force of the blood is demenished and the danger less, and thus the impetus is proportioned to the smaller vessels.

Resistances from Anastomoses of the small Arteries. It is certain that opposite currents must meet with each others, this is a considerable resistance to the motion of the Blood in the extreme vessels, therefore there should be frequent rupture. I therefore believe that, especially in the extreme vessels, the enlargement of Capacities, takes place, and accounts for few obstructions

One of the most considerable resistances is that which arises from the friction of the fluids against the sides of the Vessels. There are two views of mechanical friction, one that arises from the inequalities of the sides of the Vessels, this we may call the friction of Attrition, which is almost the only one that has been considered of late. The other is the mutual adhesion of every two surfaces in Nature to each other. There are scarce two bodies in nature that do not adhere. Air which is Elastic has considerable adhesion to all other Bodies. With regard to the force of these in the Animal System I take it to be inconsiderable, because all our

globule are of a perfect sphericle, and such friction chiefly takes place in the case of solid & solid & solid to solid. Fluids are friction wheels moving round their own centers & wounting friction. And physiologists who have most considerd this have not attended to its nature. The other, viz. friction of adhesion may be considerable, but some things can make this less so. 1st fluids applied take it off, or diminish it. now here are our fluids applied to the surface. This is the base of the Arteries and Veins and the friction & adhesion on them is that of fluid & fluid which will be various according to the various nature of these fluids most of which have much viscidity. The Animal Blood is a fluid quite sui generis, a heterogeneous mass and whose parts do not mix but are kept perfectly blended together by motion, and so passing thro' very subtile canals

will have the resistance we would expect. That is done by heat, but chiefly by another fluid which keeps it from running into concretions, and which does readily unite with the coagulable lymph preserves the fluidity and obviates friction of adhesion. Particularly it is in the larger Vessels, where the globules are, in considerable number, and that there is any viscidity in the red globules, I shall afterwards shew to be falacious and therefore they never concrete with one another. But in the smaller vessels where they do not enter, and where we do not suppose the viscid and tenacious excluded. There are other fluids, as the watery serosity that will answer the same effects; this we shall more particularly afterwards explain. I should have spoke of the adhesion of the particles of the fluids to one another, but all the same observations are to be made to the one as to the other, and the same thing

prevents the adhesion of the particles to the sides as that of one of them to another.

But still there is a considerable adhesion in Hydraulics, and I doubt not of its taking place in the Animal Oeconomy. Hales and Savages by slitting up a portion of the Intestines and injecting part of the Mesenteric arteries, and examining them at different distances from the cutting, found the motion much greater in the larger than the smaller vessels, and this is imputed to friction depending upon the inequality of surface of the solid to the fluid. But it will be much more easily accounted for in another way, and even upon D^r. Hales's experiments.

Lect. XXIV. Dec^r. 19^th.

Viscidity is not perceptible in the common heat of the Animal Body. Hales injected various liquors into the mesenteric Arteries and observed what time they took to pass, and Savages has repeated those experiments, but both their

conclusions are wrong: for the slower progress of the fluids is owing to the diminished capacity of the canals, and even Hales proves this by allowing that the liquors passed more slowly in proportion to their astringency. The liquors passed much more slowly when liquors were added externally, therefore that retardation is inconsiderable from friction and much more owing to the diminished capacity of the Vessels. I would not say upon the whole then, that there are no retardations at all. There may be some, tho' inconsiderable. And it may be a doubt that the Heart can overcome those resistances and therefore Physiologists have had recourse to the action of Arteries. It is a dispute whether the Arteries be elastic, returning the same force which they received from the Heart, or whether they be muscular and return a much greater force than they received; and give me leave to say this point is of more importance than

any other in Physiology. Dr Haller has endeavoured to shew the force of the Heart to be enough, while Dr White has denied it to be sufficient, and inserted for a muscular power of the Arteries. A Dissertation De arterarum & venarum vi Irritabili by one Forshaw has just now come into my hands; if what the Author has advanced be true it will shorten our reasoning considerably. Mr Forshaw & others who argue for the action of Arteries thus reason in this manner, that there is a muscular coat which adds a motion to the force of the Heart, and that it is of an Irritable and contractile nature as Forshaw says; and lastly that the irregularity in the distribution of the Blood is owing to the Arteries. If that distribution be owing to stimuli they say such a stimulus is in the muscular coat of the Arteries. Then they allege that the force of the Heart is not sufficient to move the blood with so much velocity in the extreme vessels also. They say that the Arteries are

able to extraordinary dilatations, to Erosions and Ossifications, and when these happen that the parts supplied by the diseased Artery are afflicted with gangrene. On the other hand their antagonists, say that there is an appearance of Muscular fibre, but then it is of a peculiar kind, and as proof of irritability, & that the inequality of the blood can be explained by other causes, that the Arguments are good in favour of the force of the Heart as being sufficient. The question turns upon a few principal points which are these. First, The existence of muscular structure. secondly, Irritability; and last by the various proofs of these. With regard to the first, in the Arteries three are strata of Fibres, not in the Veins, unless in that portion called sinus venosus next to the Heart. Therefore Anatomists have made them real muscular Fibres. However of late Doubts have been raised. They are different in their situation from what appears in

180 muscles. Muscles are much more loose, have a much larger proportion of cellular membrane, and blood vessels. In the muscular coats of the intestines, and sinus venosi there is a much greater similetude to muscles than in the Arteries, where the appearance is much more tendinous. But Anatomists have made no observations on the distributions of blood Vessels along them, which Hales has remarked. Another question I would put is to say whether there are are not Muscular coats that differ considerably in formes and compactness; whether tendinous fibres are a continuation of fleshy fibres? if it be so the strength is soon reconciled; and there may still be contractility in this, tho' not so great. In the muscular coat of the Intestines the fibres are thin and soft. The Bladder of urine is indowed with more irritable fibres, which are much more pale and compact than even those of Arteries. There is one fact in favour of the muscular coat of Arteries. Lason has shewn in what manner muscular coats were affected in the case of Phthisis. This observation still wants repetition; but will be, after such repetition if found to hold, a strong presumption. Further we would think that nature had provided a muscular coat for the motion of the Blood. But for strength a cellular coat is entirely sufficient according to ventzing[illegible] experiments. Therefore this coat is not given to the Arteries merely for the sake of Strength. Considerable wounds that do not reach the muscular coat give Aneurism. Nor is it well founded to say it was given for Elasticity, for nobody says there are longitudinal fibres (upon which Elasticity depends). This Elasticity depends upon cellular substance alone, and yet this elasticity is much greater by length than breadth, as you will observe in Savages. But tho there are doubts at

tending this reasoning, the presumption is for muscular coat. Verschuir owns it to be very different from other muscles and is obliged to have recourse to some other cause, that there are different conditions in the human body suited to irritability, that may be, but it is not yet near well enough ascertained. Verschuir says the muscular power is greater farther from the Heart, his reason says that the arteries near the heart should correspond to it. Whereas there being more inequality of distribution in the Arteries more remote from the Heart, a greater muscular force is required. It is necessary to seek for surer evidence of their irritability. Hales who fluctuates on this subject, alledges, no irritability in the Arteries. Some of his arguments are bad, because the Arteries shew no sensibility: he ties a Nerve, the Animal expresses pains; this argument would say that

the nerves of the Arteries were not sensible. The argument is good for nothing since the very quantity of cellular Membrane occasions the deceit. He seems to give a more decisive proof regarding their relation to stimuli. Chemical stimuli do give an appearance of sensibility, but that is no proof: for those stimuli act upon every part of Animal substance and even a long time after death, and also in the fibres of Vegitables. Haller alledges that mechanical stimuli produce no irritability; but he makes the trial in circumstances that are not fair, as on the arteries some time after the Hearts motion has ceased, for they are then in their contracted state, as appears in the Bladder of urine, which altho a most irritable organ, when in its full contraction shews no irritability at all ——— ———

I shall now speak of Muscular Structure and divide what I am to say upon it into six heads. 1st the particular Evidence of Muscular structure. 2dly their being actually irritable. 3dly in case it should not be clear, to consider what presumptions arise, from phenomina in the living body. 4thly whether the power of the heart is alone sufficient to carry the fluids thro' all the Vessels. 5thly whether there are not diseases shewing the power of the heart to be ineffectual. 6to the presumption lies in favour of Muscular structure, which is neither for strength nor cohesion. Haller has added that in a variety of experiments there is no irritability in the Vessels. Of the two kinds of experiments to wit the mechanical and chemical, this last can not hold because they act much in the same manner on dead as on living bodies. Therefore from the application of mechanics are we, to conclude, and Haller and his pupils do conclude from three Bubonum negatives have not the weight of one affirmative experiment, but it is against all the rules of Logic to draw a general negative from a particular one. Newton made a particular experiment ~~the~~ throw colour into distinct masses of different forms and no mathematician in Europe could imitate the Experiment, till he confirmed it.

while all the rest of Europe refused the fact, yet the negative does at present, and did prevail. Hallers negative experiment however is not to be rested upon. It is difficult to make the experiment on living animals and it would be too much to conclude from experiments on dead; but Haller was deceived by making his experiments after the action of the heart had ceased. W.m Fordyce in his dissertation (de Ephem: 047) produces

seemingly very clear and circumstancial Experiments made before a number of his friends and some of the most ingenious professors in Holland, and therefore we must admit them as a decisive proof of the Instability of Arteries. But further it will be proper to shew that the Phenomina of the living body strongly confirm it. The first principal argument drawn from Inflamation: while the Action of the heart remains the same, the redness and tumor in the part inflamed, are sufficient proof of an encreased impetus of the blood there. What does this depend upon? many have long thought that the obstruction of certain Vessels can produce it. But take a portion of the body that transmits a certain quantity of fluids, take away the one half and the Vessels must be more dilated, swell, and give the red appearance and throbing; but this is not sound, unless

of one of two branches being stopt it does not follow that all the Blood passes thro' the other. The resistance goes back to the Heart and is distributed to the rest of the Body. I said that encrease of the quantity of the Blood does not occasion much harm as all over Vessels are easily dilatable. But we know also of fact that obstructions do happen without Inflamation, so Haller proves that the vessels carrying the obstructed Blood become empty all together. But while obstruction is unfit to account for Inflamation, it will not when the obstructed part is small and the Inflamation very great. In the case of a thorn thrust under the nail, the Inflamation often extends to the shoulder itself. But this leads to another supposition, that the encreased impetus is owing to stimulus, and that Inflamation is exactly in proportion to the Sense of pain, and therefore stimulus; but such a stimulus cant

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

Where a coldness and tremor occurs in one Arm or in one leg it is generally followed by considerable heat in the part. This often happens when the heart is not affected, and this is a certain proof of constriction and obstruction. Every other instance of topical affliction is almost a proof of the same thing.

When Eruptions happen in the face only we may suspect a particular Disease, but if we find the Arteries of the face are more dilatable, and in so far as the face variously expresses the sentiment of the mind, while the Heart is not affected, these give a proof of irritability. Also Eruptions which I have seen occupie the whole of the a limb, or half of the body, as if a line was drawn from the top of the forehead to the extremities, is owing to the change in the state of irritable fibres. It has been thought that there are paralysies which affect particular parts of the Arterial system, it affects, while it affects the motion does not disturb the heat or sensibility of the part. There can be paralytic cases where the vascular system is not affected, but the coats of the Arteries are not affected in the Palsy. I saw a case, where there was loss of motion in one arm, the state of the pulse and warmth remaining in their proper degree while the other was cold, had not pulse & the motion being entire. Both affections were in some measure transitory, in the space of an hour or two, the heat, colour and Pulse returned, but the same Phenomena often occurred during the life of the Gentleman.

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

Lect: XXVI Dec^r. 16^th.

Haller in S^t. XXXII. gives the whole of what he says upon this Subject. I have shewn that Hallers negative Experiments give no conclusion. I have rested a great deal upon the contrary experiments of M^r. Fershust

but the presumptive proofs of irritability
make very much for it. So I mention'd Inflamation as a proof that the action of the Heart is not increased. I took notice of, topical fevers where the hearts action is not principally or proportionally increased. To these may be added Hemorrhages which also blushing. Laquei Nervosi surrounding irritable sphincters and vessels. are quite hypothetical. On the other hand the examples of Palsy as examples of an ~~Atrophy~~ atonia in the state of the vessels. I mention'd the atrophy here as depending upon a weaker action of the Vessels. In the case of Gangrenes, there is a very strong presumption of Atonia in the Vessels of the part, the dry Gangrene Necrosis as Savages calls it, where heat, pulse, Motion and sense are all taken away. There may in some cases be a putrid ferment or stagnation but otherwise

where there is neither tumor, relaxation nor flaccidity. It must be on the solid path. Gangrenes brought on by cold also if we are right that cold brings upon the Nerves even the commencement of gangrenes, where the fluids are quite by affused, yet these affections spread farther in the solids. There is a case by D. White of Apoplexy in a child where after for some days the Pulse had been strong and full, it became weak in the extremities. I can not say that this is quite conclusive as even fullness of the Pulse in some cases may arise from the Vessels being over full. A set of Arguments to be taken notice of are, Stimuli applied to the fluids have been reckoned an argument. But the excretories are irritable, which irritability may propell the fluids thro' the follicules connected with them. There is no way

in general does increase secretion, and by actuating the whole vessels of the gland: but it is impossible to say which is their irritable portion, where it ceases and the elastic begins. But I would conclude that all stimuli and irritations exciting excretions, are owing to the irritable force of the Arteries. As we see in the case of perspiration, every increased force of the circulation should increase that of all the excretions, but this is not the case. I must conclude, that there is less irritable principle in the large than the smaller vessels. To finish this subject there is a experiment made by Anatomical Necks, "That tying in composing the nerves interrupted the secretion of that part" but I find no such thing. He adds that the nerves must necessarily concurr here but there is no particular experiment. Now I think from the whole

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

for the heart in his experiment not only sustains a certain collumn, but is able to promote it thro all parts of the system. Others as Haller suppose the heart is equal alone to move the fluids of the body, and that against considerable resistance, which must be a very great force. But that this so does not appear. as says he when a person falls into a Syncope or has been drowned all motion of the heart ceases, and the heart set into motion again moves the whole; but many and repeated contractions of the heart are necessary and that is constantly adding a new momentum. Now Hales's experiments make this applicable to the Heart, where he shews that the Blood rises to 80 inches, and but a small way at each systole. You will also more plainly perceive the motion of the heart when there is none in the Arteries which is gradually added. In Lewinhoek, apud Van Swieten mention is made of a Bat sleeping and all

the vessels at rest; where by heat at first the Action of the Heart is restord, oscillations are then pervaded in the vessels, and at length the fluids are broke down and the circulation entirely restord. This has disturbd all the Physiologists. But this is only reputed pulsation, which appear to me to be such as taken down the force of a single contraction even lower and renders, perhaps, still a contraction not improbable, and the force to ballance the resistance may be sufficient. But as we can not estimate the resistances we can not ascertain this Ballance. He says in the Paragraphe mentiond before that the Power that overcomes them is very great; very true: but it is a pitifull principii in placing that power in the heart. A very eminent Physiologist has observed the objections just now mentiond. Borelli has calculated the Resistances to the heart to be 180000. By Hales it cannot be more than 60. nay it is not equal to the third of that.

But false calculs are so much employd here that there seems to be no conclusion. The heart at each contraction throws out a certain quantity of blood: suppose 3ij the time twice seconds. you can find us that such is the velocity of the blood; this Velocity must be retarded by the dilatation of the Vessels, and you will find the Heart's motion so prodigiously diminished by the time it reaches the small Vessels that it cannot be supposd sufficient to answer the purposes of the Circulation in these parts—

Lect: XXVII. Dec: 17th—

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

for if you say that the Arteries alone propell the blood, I immagine that the repeated pulsation of the Heart increases the course of the Blood; and another principle principle is that the Heart alone performs this. What ever the Action of the Arteries be say some, it must be greatly less than the force of the Heart, but I am persuaded this, which is a pretty universal opinion, is very far wrong. For let the motion of the Blood during the diastole be more or less increased, as you please, if the Heart be a power of percussion, it must accelerate the motion, therefore I conclude that the Arguments drawn from the velocity of the Blood are inconclusive, and I add further, that the fact of the great diminution of the velocity of the Blood is false. But if we take Hales own calculation, we find him right in allowing that the velocity is greater vastly than it should be. Nay, if I even take Keils, that will not hold since we perceive the Blood spuing from a small wounded Artery to be much greater than that calculation allows. And even the minutest allows the Velocity to be actually much greater than agrees with any of the calculations you should allow for Deception on this way.

Therefore I would say that the Blood receives a Dilatation from repeated pulsations of the Heart and still more from the Action of the Arteries. The instances of Resistance are considerable, the Action takes place against the contracted force of the Arteries, against gravity, and considerable external Resistances. The foot vibrates when one leg is laid over the other, and by this means you may count the Pulsations of the Heart. You may hang a weight as great as the man, to his foot you know it can bear and you will still perceive the Pulsation. But this is no more than a power of perception, and no professing power as Dr. While without proof alledges; and all the Phenomena of the apparent strength of the Heart may be explained in this way. I must observe that the Isthmus of the Action of the Arteries, from the Heart being unable without it to propell the blood, is still not disputed. As the circulation, as Sinac says, is carried on in the diseased state of the Heart it is a great Argument for the power of Arteries. We find the Heart ossified, spheculated, affected with mortifications and abscesses, but what is also against that reasoning is, that it is not many of those explained what part of the Heart is affected, whether its muscular part or not. There may be erosions, ulcers in the Heart and its muscular part entire; and where the Muscular circulation has been affected, nobody

180 has said how far the Circulation went on. I am certain that in the state of the Heart described by Dr Cullen the Circulation could not go on: and therefore this general declamation of his does not apply. It not only proves that the Heart does little but in many cases does nothing at all; which is too much. In some cases the Ballance of power may be for the Heart, in others, for the Arteries: but there is no conception of the Arteries acting independent of the Heart; when the only stimulus is received from the Heart. In a word by proving too much proves nothing at all: Some Animals have been mentioned to have existed without Hearts. I find Van Swieten enters into this subject where he treats of wounds in the Heart: Vol: 1. P. 258. He mentions accounts given of many Animals without Hearts, and discusses the matter with this general Conclusion, that the inaccuracy of the Analomist occasions the opinion of want of Heart in many Animals. He mentions an Edenburgh Rat, taken from our Medical transactions, but still there was an Auricle in it, which performed the office of the Heart: Swieten concludes, it is not to be admitted that ever there was an Animal of any Bulk that could exist without the Heart, or some thing Analogous to it. There is one other particular which belongs to this subject, the Action of the Arteries in a diseased state; In which cases, those who deny the power of the Heart say the Circulation notwithstanding goes on, and they too refer to our Physiological Transactions, where in a mortification of one leg there was found an ossification of the Vessels; there is another given by Forshuer who was present at the amputation of a limb from which no blood flowed, the Patient died, and being opened it was found that the large Artery above the Amputated place was ossified and only for a small way. Also in the same dissertation an instance is taken from Kimpher of an Amputatio incruenta; in this case too the Patient died and they found that the Vessels above the Amputated place were ossified in a fluid state, that it was thought the Ichaelus extended to the Vessels there; but the many ossifications of Arteries where the Circulation went on, leads us to lay no stress upon these two examples. A partial ossification will not imply want of power in the Arteries. A firm sized Tube has been inserted into them, and the Circulation still went on a pulsation being found in the Arteries beyond the Tube. Various Aneurisms atical Dilatations are only partial; very rarely orderly circular, and we further know that in Arteries, Ossifications do not occur in the muscular coat. Upon the Whole I shall observe that from the Action of the Heart and Arteries nothing very clear is obtained: The irritability of Arteries is established by Forshuer, and the presumptive

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

Lect: XXVIII Dec 18th

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

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

In the first place, constat inter omnes that this motion takes place in small Vessels, where there can be no visible proof; and therefore, first the negative experiments so industriously adduced by Haller and his pupils, can not have any effect. Leeuwenhoek does observe in several portions of the system more undulation or alternate subsiding, but that the whole moves on in a stream as if thro' an elastic canal, which is Haller's opposition. Haller has been at much pains to shew that his observations conform this, particularly in the cold Animals that the blood moves as

of it were in metallic canals. There is a portion in the System where these Contractions happen but not visible to the best microscopes, and therefore Hales might miss of seeing what really existed. Dr White goes too far in using the Arguments of Whitbright the Petrapolitan, and proceeds by calculation to shew how prodigiously small these motions must be; but white Bright's calculation will not hold. Haller also should have shewn that a certain cause of the Dilatation of the Arteries given could not be extended to the Arteries of that size. It affords no Conclusion because it goes a great deal too far, and goes not only against Irritability but flexibility and Elasticity. Haller gives proofs of these every where, while he is at much pains to establish the doctrine of Rigidity in the small Vessels. V. XXXVI. "Ratio motus". That change of the state of the Arteries which he speaks of is only to be explained from their flexibility or contractility. But Haller has given another proof of the flexibility of Arteries, that is in the circumstance of Derivation. When ever he wounded Arteries on purpose he found that there was immediately a conflux of fluids in all directions, not only from the larger to the smaller but a retrograde motion took place; he calls this Derivation, and speaks of it as a Law unknown, but tho it is of easy solution. If Upon

when this, that the Arteries are full continually and when that fullness is taken off there is room for their contraction. All these are proofs of irritability or an admitting of tension and contractility. When the cause of that tension is taken off. Quenhorst and others have observed that on many occasions you can see a retrograde motion from a single Branch into a common trunk, and by and by passing off by another Branch, this is more rare in living animals but especially occurs in dying ones, when the Action of the Heart has ceased. And there is this Oscillation or Ballancement from one part of the small vessels to another; whether is it owing to the Vessels being full and therefore contracted? The question is whether it may not be produced in elastic vessels? if the flexibility be considerable it may be accompanied with an Elasticity, which may change its direction. But I suspect something more, the alternate irregular motions in dying Animals are the most analagous to the motions observed in the motions of the Heart and Sinus Venosi. A retrograde motion is made into the veins, hence the sinus venosi become turgid, now if elasticity be equal to this in the small arteries, it might have had place in the Auricles and sinus also. Therefore these oscillations in dying Animals I consider as a consumption of

their irritability. But they are no proof of the vibratory motions in the still smaller vessels tho they sufficiently disprove rigidity. Let us consider then if there is any necessity for a new power.

It does appear that the power of the Heart and Arteries, carry on the fluids in every part of the systems and there is no doubt but the same thing takes place thro' the Veins back to the Heart since the venous motion is so strictly connected with every power of the heart and Arteries. When a ligature is applied upon an Artery, the Contractility beyond the ligature is powerfull enough to push the blood into the corresponding veins; We can, by interrupting the power of the Heart and Arteries, stop all motion of the Veins. Injected fluids pass more easily into the various sinuosities of the Body, and the power of the heart and Arteries can even force red blood into those sinuosities where it is more difficult, therefore they will more readily be able to propell the Blood where it is more easy. In this subject there are two mistakes, the first is, that (it is said) there are a great part of Arteries beyond the beating System: in that we may be mistaken, there are very few parts in the body in which there are not sensible beating Arteries, and therefore there is no room for minuteness of subdivision, below the beating part and almost extremity of Arteries. But the disappearing of the pulse may be in growing less and less and after it is altogether imperceptable it may still exist and extend farther than we can discover by much, nor is there any room for supposing it to stop all at once and that the Blood is propelled in quite a different way. The second supposition is on a false foundation, that the Power of the heart and Arteries donot extend beyond the alternate acceleration and retardation. But beyond that does not the Blood move by the apulsanus of the impulse of wave succeeding wave. Therefore I see no reason for supposing a part of Arteries in wh the power of the Heart and beating Arteries do not take place. But as it appears there is no necessity for this theory, let us see if there is in fact any such power. This depends upon stimuli.

Lect. XXIX. Dec. 19th.

Most of the Arteries of the living Body alternately compact and together with the Heart propell the Blood and as the Heart is the foundation of this motion it will be greatest nearest the Heart, and less and less as you recede from it, and you may expect that at a great distance from the Heart it will cease altogether, and the blood go on uniformly. It has not yet been explained how far this action of the Arteries goes on, but it has been supposed that they cease long before the end of the System, and that the impulse of the blood almost ceases at the same time; hence

a new power, an oscillatory motion, has been spoke of. How far any such power takes place is not easy to say; and I have observed with regard to it that there is no means of making it evident to our senses as it must take place in Vessels so small that many of them escape our best microscopes. We add that the Physiologists, who with the help of microscopes have not been able to observe any such motion, can not conclude negatively. And therefore we say that this motion depends, either upon the necessity of such a power being employed, or upon certain Phenomina only to be explained upon the supposition of its having place. 1st against the necessity of such a new power I observed, that there was sufficient evidence of the Heart and Arteries being able to propell the blood along these last and return it by the Veins to the Heart. The powers of the Heart has been spoke of as going no farther than the alternate relaxation and contraction, or the alternate retardation and acceleration which is nothing it and fairly; I take no advantage of this bright to calculate. The dilatation and contraction must be greater in the Aorta and less and less along the System, and if it be so it must be immensely little in the extremities, but if it be taken even three times greater still the eye

the Dilatation will be too small to be even an object to Microscopes, therefore it is not certain that the latter cases. Wave is universally succeeding wave, the motion of the Artery decreasing, and will come to quite imperceptable at last. 2dly we take no very fairly the extent of the power of the Arteries, when we reckon the impetus of the Blood impending upon the Heart and Arteries quite vanishes when the full pulsation ceases. For the impulse of wave succeeding wave. I added yesterday that there is room to believe that both these powers extended to the utmost limits of the Arteries. I said that we could perceive it very near to the extremities. The reason Haller gives that the red blood and coagulated matters penetrate almost into the smallest vessels of the system certainly argue against any great number of decreasing vessels. Indeed too much industry has been used in this, when it has been also extended to the secretories and applied to the several excreteries of the Body. We take in the Vessels of the Testes

or I would say that even this consideration does not touch a general power; For long extended secretories and excretories are certainly very rare. Each of them are adapted to particular uses and depending upon a contractile power of their own, and are always endued with compression and stimuli; this however does not affect the general power. But further there may be powers that carry fluids thro' long Vessels, that we have no distinct

idea of, as in the Vessels of Vegitables, where Humours are filtrated thro a porous texture, and applied by adhesion and friction. In the case of our nerves, I have no regard to this consideration: Unless there is a peculiar circumstance, that gives a particular reflexion to the light, you cannot distinguish between hollow and solid. Another objection made to this is that the Nerves are considered as hollow canals: because we see a great portion of the Animal System consisting of hollow tubes we think the whole to be tubular. I shall shew elsewhere that Nerves are not hollow Tubes; their motion is such as is found in the whole Texture of Vegitables, or in the most part of their substance. We find Powers in nature adapted to this purpose that we have not thought of, as Electricity. There is a power analogous to Electricity in Vegitables, and I have no doubt, that what we call the Nervous fluid is transmitted along the Nerves in a Manner: This indeed is but conjeture; but it is fit to ballance conjecture by conjeture, and prevent ourselves from being misled. I find no arguments of sufficient weight with regard to excretories. Calculs shewing how little force the Heart exerts in them are quite imaginary. The powers in them may be totally different and either oscillatory or not. The effects of Stimuli in exerting Secretion are all

But all these arguments to
jacks.
him from the power of stimuli in Inflamation may be explained by the power of Arteries, their irritability which perhaps extends over the whole system. How it applies to establish an oscillatory motion out of the reach of the Heart I can not perceive. In all the case of Inflamation can any body say that it depends upon Vessels of a certain size, whether Capillary or not? Who will say that the Power of Stimuli acts only upon Capillaries of the third order and not upon those of the first, and as far back as the Heart itself. They may if you please, be more irritable. Inflamation presumes universal irritability. That it must constantly be in small Vessels of a smaller size, I see no reason. Merely in evacuating excretories and leaving empty space behind, they naturally draw from the Arterial System. But if there be a system that extends from the excretories to the surface and from thence to the Arteries, and so back to the Heart, this Argument too will apply to establish universal irritability. The Balancement in the small Vessels of Dying Animals are proofs of stimuli, but do not disprove the oscillation of small Vessels. But there is no question with regard to the possibility of such oscillatory motions. It appears that Arteries are not only flexible but irritable and con-

not suppose it to take place without beginning at the Heart. Every view of the operation of Arteries addresses to this supposition. Various causes are supposed to occasion this oscillatory motion; heat, the composition of the Blood and its constant intestine motion, the Heat when increased, may give dilatation and contraction, proving a Stimulus; but is there any such heat ordinarily in the extreme small vessels? That hypothesis I shall take notice of in an other place. This heat must be less and less as you approach the extremities. Heat uniformly the same, can be no stimulus. With regard to the Blood consisting of Particles that are movable, volatile and Acrid, I would allow it to be often but not constantly such. Its constant adhering will not allow, proves a stimulus. The constant acrimony of the Blood, becomes familiar to our Nerves, you must suppose either an increased acrimony, or increased sensibility of the Nerves to account for this. What is occasional can not be brought in as one of the ordinary means employed by Nature. With regard to the intestine motion of the Blood it goes on slowly, and it is promoted by constant motion. There is no all denying that air is constantly escaping and giving the inflammable necessary to such intestine motion. But I would conclude that there is an oscillatory power from the Heart to the most extreme Arteries, and that a power remains to carry it on in the returning veins on the one hand & excretories on the other, or that nature has added powers different and unconnected with these; which leads to the means of promoting the circulation.

Lect: XXX Dict: 99d.

I have no doubt but that the Blood is propelled in the Veins by the Heart and Arteries. Some have said that the Blood is not propelled in this way any further than where we see pulsation. What ever accident interrupts the Action of the Heart yet the action of the Arteries is added and when the motion of the Blood ceases in consequence of dilatation, yet it does not follow that the Heart and arteries only were stopped; The same tying may interrupt oscillatory motion. It is true that as in drowned persons the motion of the Heart is renewed, I have shown that one single pulsation is not sufficient for that effect, but that many are requisite, and therefore the Action of All the arteries have been brought in. Haller then is wrong in the conclusion he draws from this example. Also the Arguments for the contractility of Arteries in Lect XIX only apply to a simple Elasticity of Arteries. I have said before if that was the

base the Arteries only restore so much of the Blood's force as was lost in their dilatation. Here Haller throws in the motion of the Blood after death "a morte generali" When the irritability and contractility of the Muscles is lost the whole system of Vessels appears remarkably flaccid. This flaccidity allows the Blood to move by weight alone. This effect of weight is various according as the fluids are more or less thin, how ever diffidities are more considerable in those who died of Putrefaction. An Elastic air variously moves and impells the Blood. Haller goes on "invenis magoribus sanguis celerius movetur". this must be an acceleration as in the Arteries from the diminution of the cavity of the larger Veins. He seems to take this acceleration of the Venous Blood for an increased impetus; Since he thinks "simul frutis minuitur. But friction and adhesion to the sides are one and the same thing. I should have added before that Haller says he never observed any adhesion. "verum cum impediat". He adds that the weight of Blood every now and then is resisting to its return; But the Heart gains as much in one part as it loses in another by this weight. He observes that little or no assistance is to be expected from the contractility of Veins; it is to be observed that the Veins are elastic but that they can give no additional force to the Blood. Haller adds that this motion is purely simple elasticity. However the experiments of Mr. Hershaw tend to shew that the veins are considerably contractile, and irritable as in the case of ligatures employed by him. But this experiment is not sufficient & that may be owing to their being stretched beyond their natural tension. It is then an ambiguous experiment. But he has rendered the matter much clearer by shewing, that the touch of the scalpel, the tearing by the forceps, shewd irritability. But of this I doubt, and I think all his experiments have been made to right the Heart. The only question remaining is to say to what length the Muscular fibre may go along Veins. Unless then the experiments be made far from the Heart I deny this application. Tho' I would not directly condide with Dr. Haller that they have no contractility yet I would look out for other powers. He takes up these in V. We must take these which he speaks of seperately. But first merely from sections from the ends of Arteries, what remains should help than in the Veins; therefore in the extreme Veins the Blood should be most visible. I find nothing in this for I cannot perceive that the

quantity taken from the Venous Blood by secretion can affect the Veins, considering the frequency of the circulation; as is evident in the Kidneys. Suppose ℥j of Blood thrown from the Heart at each contraction, and a Drachm, or ʒj into the Kidneys. If there is a stain of the fluid, that is a 60th part abstracted it would give a much more copious secretion, than takes place. If every minute would make nearly a quarter of a pint in an hour which could never affect the fluidity of the remaining Mass. Now as it is even much less in the real secretion the effect must be still less considerable. Take extraordinary cases of quick secretion of urine; and you will find the effect can never be considerable. I would observe again that all that portion of fluid resorbed into Veins can not answer the effect here mentioned: take notice that it is coagulable by mph, and should rather favour the Coagulation of the venous Blood in case of accidental stagnation. But further says Haller the Veins get a quantity of fluid absorbed; he has not touched this in his larger work. The Blood in the Arteria pulmonalis is still venous. The Lungs shew a considerable exhalation which is also venous Blood from the end of the Arteria pulmonalis. But Haller seems to reason that nations efforts in extraordinary occasions answer, to account for her ordinary functions. Then is no doubt but the Blood would form acrid if it had not a new supply from the Alement. That means of supplying venous Blood mentiond by Haller is neither true nor necessary, and wrongly explained.

Lect: XXXI. Dec: 23d

Haller imputes the motion of the Venous Blood intirely to the Heart and Arteries; yet in Sect: CLXXIIII, as if the Blood were but weakly propelled by these, he has recourse to other powers. We may put a muscular power in the Veins, and even when they can not be demonstrated, but as it is mostly over the whole system, it can not be supposed sufficient to propell the venous Blood. next as to his saying the venous Blood is more fluxile, I have shewn that secretion can have no sensible effect upon it. If the more fluid discharges were to continue, it would affect the density or fluidity of the Blood. A supply is necessary, and the ordinary supply is by alement. Sect: CLXXII "adjicit pulsus vilos". That the muscles in their contractions become at least thicker in one part of their length, as well as of considerable hardness, and when contiguous to veins will force the Blood towards the Heart, is not to be doubted; that frequency of pulse, heat and redness ought not to have

Lun mentiond first; as this were the last proofs mentiond by Haller of inerad Arterial motion. There is another consideration here which I am surprized should have escaped Haller, viz: that the muscles comprese the Vessels that are in their own substance. However, that the Blood is squeezed out of these Muscles is not certain. Haller sums to observe this and says "palluere nunquam lædi" tho the change of Colour is not evident to our eyes, & the Colour of the Muscle may remain the same from the Ballance of the Arterial Blood yet this consideration may still have place. A trial of it might be made of the Arm of a strong man is immersed in a large bell-mouthed glass tube and surrounded with water, during the Contraction of the several Muscles of the Arm it may be observed whether the water rises or subsides. The water upon trial does subside and shews the Bulk of the member to be diminished, which is a presumption that this is one of the propelling venous powers. It has been taken notice of almost by every writer that in the Abdomen the Muscles relax and contract, and that in their Contractions the whole Abdominal Viscera are more or less pressed, & that the Blood in the veins, in the erect posture which is most frequent, is by this means helpd forward. But really the alternate action of the Muscles can have no effect. The Abdominal muscles yield and the viscera follow them. It is no pressure then, tis the most gentle Action; therefore "id in Abdomine Diaphragma prostat, & abdominalium musculorum conjuncta pressio" is improper. It is the Diaphragm, and the circular prepare that have any effect there. Every effort that we make in a full inspiration, as to squeeze out the Faces urine &c, propells the venous blood. It is assisted by a full inspiration and some Contraction of the Abdominal Muscles. These do frequently occur in the Actions of Life, and may propell the blood in the Cava descendens. He adds also in the same Par: a pulsation arising from the pulsation of the Arteries. I mentiond before that what of the Hearts force was lost in dilating the Arteries was recovered by their contractility, and that the same thing might be said of the pressure of the air, that the resistances arising from that were compensated by its reaction, but that this advantage could not go far, therefore in the ordinary state of Arteries the pulsation can not have place here. He adds another power, that of direction "nondum satis cognita". He began to suspect a singular power in this. So in Sect. LXIII. he says "quicunque fuerit". If by nondum satis cognita and quicunque fuerit, he means that it is not sufficiently attended to, he is right. But the thing

170 itself as I said before is easily explained, it is only supposing that the Blood-vessels are every where filled, so as to stretch them beyond the state of which their natural contractility would bring them to, that is to say the state they would be in if they were empty. Now if an Aperture should be made there will be an efflux, and that efflux will be in proportion to the tension, and if you suppose the force of the Blood very nearly ballanced by the tension of the Vessel, it will likewise from the Ballance on the side of the tension, and produce a retrograde motion towards the aperture made. And we can suppose that the same phænomina would not appear in the large Veins as in the small ones. I do not then see wherein it contributes to promote the motion of Venous Blood by the tension, and may in this light sustain the humours to the Heart, but it can not promote it unless when you add the power mentioned next "Denique multum potest respiratio cum qua alternis momentis, sanguis, per vim derivationis in laxum pulmonem &c" now besides the contraction of the Auricles and sinus venosi, & the contractility of the whole venous system, but does this propell the Blood? During the diastole of the Heart, it is true the venous blood is propelled, but during the systole it is relaxed, and

in the trunk of the Brain it gives alternate 171
risings and contractions. A free and easy respiration is what especially secures the free motion of the venous Blood, but does not afford it any assistance "Anastomoses academique in arteriis faciunto that is to say where ever there are Anastomoses making opposite streams of Blood they occasion retardation; but then they compensate that by the greater force with which they flow from obstructed places to the more free. V.CLXXV. "Hic præsidium est abstinentia ut sanguis in homine sano, qui corpus suum, quantum satis est, exercet, moveatur ea velocitate quæ sufficiat ut tantum sanguinis vena cava corde reddat omni pulsu, quantum arteria aorta eduxit" This is the conclusion of all that is to be said upon the motion of the Venous Blood, that as much is restored to the Heart as taken away from the Arteries. It may. It may not happen that in every pulse there is equal quantities brought and carried away but these inequalities are always compensated in any number of pulsations taken together.

Lect. XXXII. Dec.r 24.th

The motion of the Blood from the right ventricle to the left and from the Arteria and vena Pulmonalis to the Heart

In this Viscus, 96
in the lungs the Vessels are alternately contracted and relaxed

I am next to speak of respiration, and shall depart from Hallers order, passing quite over the fluids which are to be considered in a different way from him. The circulation is to be considered from the right ventricle to the pulmonary artery and back to the left Ventricle. The alternate contraction of the lungs makes the function of respiration not separable from the powers that carry on the circulation 1st. I shall refer you to Anatomy for as much of that as is necessary here, 2dly I shall consider by what means the Air enters and dilates the Lungs, and is again expelled ——— 3dly The effects of this upon the motion of the Blood from the right Ventricle to the left, and also what Changes the Air undergoes ——— 4thly why the Contractions are alternate. And lastly shall give some miscellaneous particulars not brought under the former Heads. The effects of respiration on the state of the Blood, will come on better in another place.

The Lungs are a Hollow Viscus surrounded in a Membrane that compose the air, while it is at the same time considerably flexible, and dilatable, and again contractile. They consist very intirely of a cellular substance contractile and elastic, that they are naturally dry and empty and every part communicates with every other of the substance of the Lungs, and all with the Trachea Arteria, which last

communicates with the Glottis, and throws out the air into the external Atmosphere. Further the Aspera Arteria is subdivided, that Air entering by the trunk can be distributed to every minute Portions of it. The Aspera Arteria and the Bronchia, consist partly of Cartilage partly of Membrane; the former are connected with the latter and there are evidently muscular Fibres which can contract this canal both by its length and breadth, and therefore the Air Vessels of the Lungs in the Aspera & its Branches are of various Capacities. The manner in which the Bronchial vessels terminate in the extreme parts of the Lungs and of the Cellular Substance Malpighius's opinion is attendant given up; but whether the cellular substance has any determined form, or how more strictly the cells are connected with the Bronchia is not well known. This however has no effect upon the explication I am to give, of respiration. The Lungs appear to be capable of being dilated by air in a certain quantity. I now proceed to the 2d point ——— I suppose it is not necessary with Haller to define Air; you all know that it is an elastic fluid, pressing in all directions, and therefore

the external Air will enter where there is one of less density. This is understood by you all. Take a Bladder with a cavity communicating with the Atmosphere, you may make air enter by pulling asunder its two sides; or if you can place the Body in the receiver of an Air Pump. So if you suppose it placed in a [illegible] Bellows so as that Air can only enter in by an orifice in any of these ways it can be understood how air enters in by certain cavities; such is the situation of the Lungs, in a cavity which does not admit air but by the Glottis. This Cavity in its natural state keeps the Lungs greatly contracted; within the size that their delicate membrane readily admits of. The Lungs are every way enclosed in the Thorax, are bounded at their inferior part by the Diaphragm. The oval and state of the Diaphragm is such as from its attachments to the Sternum, Mediastinum &c, it is convex towards the Thorax & concave towards the Abdomen; and by the moveable Ribs the Capacity of the Thorax is most diminished.

The Thorax being in this contracted state is capable of considerable enlargement first by the contraction of the Diaphragm, which brings it to form a Plain more nearly rectilineally, moving its middle part from above downwards, and thereby increasing its dimentions. This enlargement alone answers most of the ordinary purposes of Respiration. But the abdominal Viscera must be removed which is difficultied by pregnancy, Dropsies, and by the supine posture; therefore Nature has provided for the lateral dilatation of the Thorax, which is done by the motion of the Lungs and the flexibility of the Cartilages. If the middle part of the Ribs is drawn upwards every two opposite parts will be set at a greater distance, and the transverse section enlarged; & the elevation of the ribs will not only bend but possibly push forward, the sternum, & this capacity of the Thorax betwixt the Sternum & and Vertebra will be increased. The Ribs are moved upwards by the intercostal muscles in ordinary respiration; in extraordinary, are assisted by many others that lie between the scapula & Vertebra, or between the former and bones of the Head. The only question arises, with regard to the intercostales externi. The intercostal muscles are divided into two layers; it has

been doubted whether they could concur in one and the same operation; they have been thought to act alternately; Haller will shew how much they have been controverted. He concludes that the internal as well as the external, pull the Ribs upwards. The external are so situated that their fibres in passing from a upper rib to a lower, are inserted in the upper, nearer to the lower, farther from the center of motion. They are fuller towards the Vertebræ. The contrary happens in the internal layers, they are full towards the sternum, and wanting toward the Vertebræ. And this shews what are the effects of their action; Haller does not mention this in the prima lineæ, but it is fully discussed in the larger work. If the Thorax is empty there will be a vacuum around the lungs or Air less dense, and the internal surface left beset with air, or if they are filled with elastic air it will dilate the lungs, but become more rare, It has a connection with the external. This may be variously modified as there is no air in the new born infant, or as it is dilated, it does not signify whether there

is air between the Viscera and Thorax or not, for air must enter just in proportion to the enlargement of the Capacity. We have then accounted for inspiration. Next the air soon after is again expelled; without touching at the cause why, I speak of the means whereby this happens; these are various; first, the elasticity of the cellular membranes themselves. The contractility of these with the surrounding membrane will always bring the lungs to their contracted state, and they have a share in expelling the air, but this is assisted by the muscular power of the Bronchiæ, viz: that portion which is muscular. As distension is the most common stimulus in irritable fibres, this will occasion their contraction and the expulsion of Air, But if the Thorax was to continue in its dilated state, these last powers would have to oppose the whole pressure of the external atmosphere.

Lect: XXXIII. Dec: 26th

I mentioned the effects of the contraction of the diaphragm, the elevation of the Ribs, and the action of the muscles subservient to respiration. But this might be merely in consequence of the elasticity of the lungs, the surrounding mem-

brane and muscular fibre). Yet not only these powers, but contraction must also take place which is the restoring the thorax to its contrailed state. The Elasticity of the ligaments and the weight of the Ribs will bring the lungs into their former situation. The Ribs are actually pulled down by the additional muscles. These powers restore the contrailed situation in as far as it depends upon pulling down the Ribs: But the contraction of the Deaphragm has the chief effect; it must, be relaxd and pulled upwards by the elasticity of the parts; but the abdominal muscles, all of them pull upon the Viscera and push the Diaphragm. These are the powers by which the thorax is reduced to its contrailed state.

In ordinary cases the sterno-cleido's tend to pull down the Ribs, and in extraordinary the sacro-lumbalis &c.

Why are the motions of the lungs alternate? But we must first consider the effects of these alternate motions upon the course of the Blood.

The Arteries and Veins of the Lungs are subdivided, or nearly so into the same degree of minuteness as elsewhere, at least into capillary arteries; and as the subdivision happens in a shorter space, there must be much more frequent ramification and change of Direction. Now their Vessels

are every where dispersed among the cellular substance of the Lungs; and unless the Vessels of the Lungs are perfectly rigid, they will not suffer the diminution of cellular substance, without that But may not the change of the state of the Blood be affected by a peculiar circumstance. Winslow and Helvetius say they are formed into Rugæ and can reduce themselves into a less capacity; But I have not found it so by observation or reading other Authors. The Bronchiæ from mixture of Cartilage and membrane, are stretched out in length by the air, and contracted again after expulsion. It would seem to me that there are circumstances in the Blood Vessels corresponding to those of the Bronchiæ. Upon this occasion physiologists enter into this, and also think that the contraction of the Lungs may have an effect in compressing the Blood Vessels. I see no reason for such an opinion, when we consider how easily the contractibility of the lungs is overcome, and occasion a considerable distension. At the end of inspiration the course of the Blood must be considerably interrupted. I recurd to mention, that at the end of respiration and Inspiration all the symptoms appear of the Blood being interrupted, the emptying of the right ventricle of the Heart descending in the Cava, and particularly the Vessels of the face. This is done both by expiration and inspiration. In the

last some have supposed that a full inspiration might increase the pressure of the Vessels, but this is not confirmed by observation. Therefore when the Thorax &c. yield no farther the Blood may be compressed in the lungs. Haller has raised difficulties, which it will be worth your while to attend to in CCLXVII. and the following. But him Haller is wrong; first in fancying the change of the air to unfitness for respiration, consists in a diminution of its elasticity; and if confounding the cause of the interruption of the Bloods motion in so full an inspiration, with the cause of death when ever the air is contained for any length of time in the lungs. By a construction of the Statics the interruption of the course of the Blood is to be accounted for. The motion of the Blood in the lungs is interrupted, by their strong dilatation, flexures and compression of their small vessels. The Bloods motion is most free at an intermediate state, but which rather approaches to a full inspiration. The expiration is never full, a considerable force keeps the lungs in a loose and extended state, and inspiration is always shorter than expiration. This we shall apply in explaining morbid Phenomena hereafter. But as to the motion of the Blood it appears that of a great quantity is to be transmit-

ted, it requires a more frequent respiration. And a frequent alternate respiration will necessarily expede the motion of the Blood. and thus a quicker return of Blood to the right ventricle will make a more frequent respiration, and vice versa. But to understand the cause of alternate motion we must consider the effects of air taken into the lungs. ——

1st The atmosphere is cooler than the human body, when taken into the lungs it must suffer a change of temperature; but it is of more consequence that air being frequently employd in respiration ought to be considerably changed; in what manner the Physeologists have long doubted. Perhaps it loose some of its Elasticity; But air of various dizees of Elasticity is pretty well accommodated to the Business of respiration. Accordingly mankind live easy upon the tops of high mountains, where the Mercury has stood at 60. Dr. Hales has given an experiment leading to explain this. He took a quantity of Air sufficient to serve the lungs for two minutes, and by applying it to a dissicum of fixt Alkali, he made it to last ten minutes. From this experiment Haller observes that Alkali has a remarkable power of absorbing a moisture from the air. But this does

This is a dry Alkali not dissolved which Hales employed; and as it was an alkali not perfectly mild (which absorbs mephitic air) it rendered this applicable. Now such a mephitic air does arise from the Lungs of living animals. — The purest air that you will take in and throw out again if you apply it to a solution of Calcarious earth it precipitates it; and it renders a caustic Alkali mild. This air is a sudden poison; so animals placed in the way of effervescing liquors or fermentations, from which a great quantity of it is always escaping, are immediately killed.

Lect. XXXIIII. Dec. 27th.

A question has been started whether this mephitic air is to be considered as totally distinct from common air or a species of it. We shall consider it as a species since it is steady in its appearance. So you may take Limestone and take away its air, when, upon restoring it you will find it exactly the same. Mephitic air may be present in Bodies in considerable quantity. From whatever source it is drawn it kills living Animals. It is equally poisonous to the animals that do not breathe as all as to the breathing animals. A frog will die as soon as a Bird in an Air reptile with mephitic air. We observe that it is rendered innocent merely by being mixed with common air, and in that case it loses all its distinguishing qualities. A mephitic air seeming to be generated in animal bodies is absorbed by the the common air in inhiration and thrown out in expiration. It may be applied to supply the place of foul air for it has the same effect. If fresh air is continually remixed it will render the mephitic air innocent. But if the whole air about an animal be taken in and thrown out in a certain time so as to be more and more impregnated, it will kill from double poison and interruption of Respiration. It appears that atmospheric air unites with it and forms a neutral in a certain quantity. It is observed of most poisonous substances that a certain degree of diffusion renders them innocent. The effects of common air in rendering the mephitic innocent has been supposed to be owing to diffusion. An air enclosed with an animal

. But air dissolves various bodies and unites with them, and so it is with mephitic air. The whole doctrine of the effects of air upon animal Bodies, will enter into our Nitrology. I must mention the effects of air arising from inflamation. There is some thing analogous to breathing that

burning Bodies are constantly resolved into
Vapour, which extinguishes all Inflamation.
The pure air extinguishes fire, and the vapour
of burning Bodies is equally a poison to
Animals. I own, that the air of burning Bo=
dies will reduce a caustic Alkali, is a doubt
the pure air is more purely present in the
case of burning Bodies; in the case of inflam=
mation more blended with a volatile acid.—

By what means the motions of RESPI=
RATION are necessarily alternate.—

Here there have been various Hypotheses
which you will find in Haller, but nothing satis=
factory; and the motion may be more simply
explained—

First as to the necessity of expiration following
inspiration. If by the power of the will the
the power that lifts the ribs upwards. the elas=
ticity of the ligaments and cartilages compress
the Lungs. If we can find that Dis=
tension is a stimulus to all muscular ca=
vities. And the contraction of the Diaphragm
pushing downwards becomes a stimu=
lus. That follows inspiration; with regard to
the renewing of it, we are to notice without
having recourse to the power of the will. we
shall find that most of the alternate motions
of the System proceed from instinctive Unea=

sinefs. The motion of the Blood, and hence the
evacuation of the right Ventricle is interrup=
ted, then is a regurgitation of the Venous Blood
all of which gave uneasinefs.

— Miscellaneous Particulars — of these
I shal give one. I observed that respiration
depended upon an equilibrium,
as in most cases of the condition of Animal life
the external air is cooler than the bodies of
men, and therefore taken into the most inter=
nal parts of the Body, and it must be heated
beyond what it was, and thus encreased in elas=
ticity. Take a Bladder, and tie it up with a very
small portion of air and expose it to the heat of
the fire and you will soon find it extended and
able to overcome the pressure of the whole at=
tional atmosphere. This happens every time
that fresh air is taken into the Lungs. Some
have thought that necessarily a portion of air
was if its exit by the Glottis be any how pre=
vented the Lungs must be distended to a ve=
ry great degree. But it explains some of the
most difficult Phenomina of Hales, Bous=
low &c as that of the air ejecting out of the Lungs
and giving room for the fresh air to rush in
but it is supposed to be . That an opinion

made in the Thorax does not immediately interrupt respiration. Now it goes further, for when not only this, but when the sternum was intirely taken of and both cavities of the Thorax laid open, the Animal continued to breathe. Hence some thought that animals had a power of breathing. But that is explained by the difference of temperature between the external and internal air. When the Thorax was intirely laid open and the animal continued to breathe a large quantity of fresh air was taken in and thrown out merely by the alternate contration and opening of the Glottis. A portion of fluid and the Glottis was contracted again & but they were constantly smaller and smaller till after a few respirations, they intirely ceased. For the cavity one cavity being opend, it had its contractions and dilatations tho not synchronous with the others which was owing to the air being pushed in and stimulating respiration. A great many considerations are couched as the uses of respiration to the Oeconomy, but these belong to the Chimical part of our Course, where we will consider it under the Head of Sanguification. Also the consideration of Coughing Laughing

& will be rather more properly considered under the Pathology —

Lect: XXXV. January 6th

The Action of Muscles depends upon a Power conveyed to them thro' the Nerves. The motion of the Nerves depends upon the Soul. We can observe all the modifications of thinking, depend ultimately upon the impressions of external Bodies on the nervous parts. Hence the consideration of the nervous part must be of the greatest importance in the animal Oeconomy. This which I have made my second part should have been sooner introduced but it is embarrassed with some difficulties and obscurity, and therefore for this year not brought in till now. We now enter upon it following Dr. Haller. It is about 100 years ago only, since the subject was touched and by Dr. Willis who's Theory was trifling. But the whole Physiologists were engaged soon after in another system which took off their attention. However from this Bazlius at long after aimed at a system in this way. From him and the fanatical of France, something is to be learned. Hoffman made a compleat system of it. Stahl and his followers necessarily took it in in their. Haller in the occasion he has given for enquiries into sensibility and Irritability, has contributed

his share, and Gaubius has introduced it as a principal part of his Pathology. In the various posthumous piece of Boerhaave, de Nervis one have many useful things upon it. No body has treated the subject more fully than my worthy predecessor Dr. White. Dr. Robert Huck in the 7th Section of his Lectures on Light, has given a Theory of the operations of the Nerves. Dr. Hartley has attempted the same thing

he in this Analysis of the soul has given us full observations. All these have touched the subject superficially, and given no tolerably compleat enumeration of particulars. I shall give you quite a new plan. Whether you take the human System to be a purely material system, or partly material partly immaterial you will find it to be a Machiene. sui generis, and must be studied in it self. Nwithstanding what ever peculiarities may be in it, it may be put at length upon the same setting with every other object of the human understanding. General laws or laws as we call them may at length be obtained. But it will be difficult to do. that from the diversity of Phaenomena. seldom do the same external agents produce the same effects; because the subject operated upon is liable to the greatest diversity. not only one man differs from another, but the

same man is hardly two Hours or two minutes the same with regard to himself. as also happens in the moral World. But the diversity occurs chiefly in what we call the mental operations and our subject taken in its full extent necessarily therefore takes in the History of the human mind; on this I shall give a good number of reflexions. No body can judge of parts till he has heard the whole, you are therefore to suspend your criticisms till then; in the meantime while nobody has been able to avoid entering into the history of the human mind. Boerhaave has said all problems, with regard to the physician are solved, when our enquiries are pushed upto the human mind. But if our soul ever acts seperately in that case, I own its causes are out of sight. But tho' the soul should be allowed to be a seperate and distinct substance, yet it is by its mutual connection with the Body influenced by it and again influences it. It is of no consequence to attempt the modus operandi of this mutual action. ~~as we must do~~ But admitting, as we must do, their mutual operation, we must on many occasions enquire how the soul acts upon the Body. Boerhaave here could not observe his own rule. I say all this to show that metaphysics are unavoidable to us. It is well understood

190 by every man of science, that metaphysics are necessary in every part of it, and particularly in this part of ours. I formerly mentioned many grounds of doubt on this part of our Science arising from its particular Nature; But the absolute necessity of metaphysics will perhaps render it always difficult. Most of men either have not the necessary leasure to enter into it, or can not enter into it for want of shadiness and genius. Now I may frequently appear to you superfluous, and somewhat obscure and difficult; but this may be owing to your not perceiving the application, and to your want of in the exercise or even to your dulness. —

Plan

Then is there no room for mathematics upon which we can sufficiently build the rest of our System. It must be got by the method of induction, which requires the enumeration of facts and Phaenomena; But I must attempt a choice of order, and so far as I do that I am attempting more general facts, or leading towards them. My general plan then is the enumerating facts and Phaenomena so as to render them most usefull. With regard to what are the proper limits of our subject. The common origin of the Nerves, medulla cerebri and cerebelli, medulla oblongata and

spinalis, and the productions of them which are very minutely dispersed thro' every part of the Body. In the extremities they are connected with the organs of sense and motion. The first are of Variety and much greater than has been supposed commonly. How the organs of motion are diversified is more uncertain, but we may take them in one general View. It is in these organs of sense and motion that our subject is limited. It is merely the sentient extremity of the Nerve only that belongs to the consideration of the nervous System. And all the apparatus for receiving and communicating sensation to it do not properly belong to that System. Again in the Muscles their contraction in its causes, modes, and effects, belong to the nervous system. But the effects of that contraction in moving the Body do not belong to the subject, and may, as we have already done in the part past be considered Separately. In like manner on the other hand in the chemical system the fluids are often moved by Muscular contraction; but that may be considered as the Action of certain mixts upon one another, totally distinct from the nervous System. Now having thus fixed the limits of this part, within these we seek for the proper arrangement of the Phaenomena mentioned. It will be best to consider them as causes and effects and in the order that they lead to. Other Bodies in nature are in constant

motion; and touch, move, and impelle, other Bodies.

We can perceive that their motions are chiefly confined to organs of sense. We shall find that the sentient extremities of the Nerves thus moved by other Bodies, propagate a motion to their other extremities, or sensorium communune, and this impressed motion, is very generally and very universally attended with thought. And according to the nature of the external Body moving and to the organ moved, various modifications of thought arise. There is a certain series of modifications of thought which constantly produce the action of Muscles and here we have motion communicated to the sentient extremity, as a cause of muscular contraction its effect. We can perceive then, our order will divide itself commodiously into three distinct parts viz:

Impression, Perception & Contraction

which is our plan. The Action of external Bodies on animal Bodies is what I call impression. Whenever the impression ceases these modifications of thought take place, which is perception. Under this I consider every thing that consists in modification of thought which produces action of Muscles, and this muscular action is the Contraction I speak of.

It may be a question whether Perception always intervenes between impression & Contraction; as Dr. White imagined, or as others, that impression without the intermediation of perception produces Contraction. It is certainly more rare that the intermediation of perception does not take place; In many instances all that we can say of impression is taken from perception; and the Contraction is the effect of the other two yet the mind perceives these Contractions, and accordingly they may be considered in their turn as impressions, and the matter to go on in a circle. But we must keep them as distinct as possible in order to talk of them with the greater clearness. To return I have taken the hint from Dr. Grubius in the Division of mine but have made some difference in the terms. What I have called impression, he has called irritation. But it surely is not evident that every impression proves a cause of Contraction; and so far as impressions affect the motions of Animal Bodies they are not all irritants, but many of them are sedative, that is to say tend to allay the motions of the Body. Two remarks are to be made on stimulus and irritation. First is a proposition of Dr. White's "a stimulus"

194 says she "produces a contraction". But what is stimulus? it is not known a priori what it is. I could in like manner observe in the N°CLXXIV. of Gaubius that he plainly implied the word irritation, which is accordingly to be admitted for a general term. But it will lead you to observe from the use he makes of it there he means impression more generally. I go on now to fix more precisely the meaning of the term impression as we employ it. It may be taken for any impulse of external Bodies on Animals. We mean the action of other Bodies upon the nervous parts of our own, and affecting the motions of the System; An instrument making a Wound does not belong to our Head of impression. You know many parts of the Body may be wounded without affecting it. Nor is a liquor which is thrown into the Blood-vessels and coagulates the Blood, to be considered as such, and it must have many effects. Mr. David Hume employs Impression in opposition to Idea: Idea, says he, is that modification of thought which by various means may be renewed in the mind, without the presence of the external object which at first occasioned it. We not only consider the modification of thought but the motion in the nervous System: And if it shall be shewn that Bodies can act upon our nerves, and excite motions without an Idea excited we also call these impressions. Under this Head of impression I also consider all those modifications that often successively arise in consequence of impressions, viz: if they are the beginning of new affections of motions of the System. To one man the same thing will be painfull that to another will be pleasant; and even to the same man at different times. This pain or pleasure I call a new modification of the sensation or Idea recieved; and if it proves a beginning of new motions or new affections of motion I call it impression. In me, a thing having relation to my good or evil will be a cause of hope or fear, and therefore will be a beginning of a new modification of motion. On this subject I have very frequently taken hint from Gaubius, and have him in my view; you may compare his Tractatus de morbis solide vivis with what I have said. It is proper to observe that in every perception of ours there are several particulars to be considered. Haller in N°DLVII. takes notice of them, to which you may attend to. The limits between perception and impression

He places first the external Body surrounded;
secondly the impulse or motion excited on the
organ of sense; thirdly the motion then com-
municated to the brain; fourthly the mo-
dification of thought thence arising; fifthly
the consciousness of the perception received—
Others, as Dr Porterfield, have made some de-
parture in the arrangement. The believe, which
he treats of you may consider as a property in
the rays of light or of different Degrees of Trans-
gibelity, and secondly as a property in the Body fit-
ted to receive one ray more than another and thirdly
the communication of it to the sensorium communis
fourthly the Idea in our mind, and fifthly the
referring Colour to the external object. The two
first of Haller plainly belong to impression, and
the Idea of the mind to perception. It is only the
motion communicated to the sensorium that is
ambiguous. Doct Porterfield refers it to impressi-
on as I do, and yet as it is in the confines of both
it may belong to perception. I am next to speak
of external Bodies as causes of impression, and
what it is that they excite in the nerves.
The Causes of IMPRESSION may be two; bo-
dily or mental; the Corporeal are the action of
matter upon matter. Whenever we can observe or

infer the impression to depend on matter,
such an impression we call corporeal. The
mental again are all those modifications of mind
that are the beginnings of new motions, and may
be considered as impressions. This division would
seem to be the same with Whytt's in the fourth
Page and seventh Paragraph of his nervous Disor-
ders. I do not mean that mine should correspond
to his, it being very faulty as I will shew afterwards.
Corporeal impressions must be divided into exter-
nal and internal; the external are the actions of
Bodies evidently situated without us and which act
upon the substance of our Bodies; and these are
evidently external impressions. But there are
other impressions not so evidently such, which
must also be arranged under this head; such as
food or medicine operating upon the internal
parts. But it is the same thing whether they
act upon the surface of the stomach or the intestines
or act upon the skin. May extraneous Bodies, as
worms even produced in the Body are excited
from our Bodies and likewise to be considered
as extraneous or external impressions. Liquors
excreted from our Bodies and acting internally
upon it, such as the Biliary juice may be con-
sidered as such. — Internal impressions are
the actions of the Body in a sound or diseased
state, and an ambiguity may arise here; if this

be compared with the last, whether the sides of the stomach or food introduced is the cause of the perception. In this way you may conceive of external corporeal impressions. What I have to say next will apply to the internal, but as we can not always be certain of giving clear Ideas in this way, external corporeal impressions may be divided into Mechanical and Chemical. Mechanical impressions depend on the general properties of Bodies, as pressure, size, and figure. As to the Chemical I must own that they can not be supposed to explode motion and its effects and therefore may agree with the mechanical. But when the motions and its various modifications are not to be evidenced, I would call them Chemical; As those of the mechanical are always attended with evident motion. But there are actions of inanemate Bodies upon each other, in which we can make the same distinction. This is the foundation of the distinction between the objects of chemical and mechanical Physiosophy; and in other words chemical impressions are those, which are made by the Bodies that are objects of Chemistry. Haller has charged the Life of chemical into venena which is wrong. Whatever shall be said of the propriety of this destinction it is useful; it obviates many frivolous Theories which we have fallen into on this subject. —

Lect XXXVII. January 8th

It is possible that chemical and mechanical impressions may be of one and the same nature. I must say that I am of opinion the whole operations of impression are mechanical at bottom. If all our sensations do arise from motion either increased or diminished in the extremity of the Nerve, and thence propagated to the sensorium communis we can not conceive any thing but mechanical impression. It must be all impulse or momunt, or again resistance or inertia. If there be any other modification the chemical must act in the same manner. The soul and Body do act upon one another, but no body in their wits pretend to say how this action is performed. There is another use of this reasoning, to obviate false theories, we are apt to be limited in our notions of mechanism, we are apt to conclude that there is a painted Body in every stimulus, or such like modification of figure; if we see it in one instance and we refer the operation of all stimulants to this. The Corpuscularian and Epicurean Physicians of old produced much theory which was

frivolous from too limited views. Gassendi, Des Chartes, and Mr. Boyle, will furnish specimens of this. Look into the corpuscularian chemical theory of Bomberg and Lemery, and you will see what nonsense is there; and too much of this is even to be found in the great Dr. Boerhaave. I will show you how Dr. Gaubius in his aeritates morborum humorum Paragraph. 299 and following ones treats this subject. His idea of acrimony is not from a notion of figures, but from its proving a stimulus to animal Bodies, and drawn from analogy. "Acor in genere &c." This definition may be varied in this manner by leaving out what we learn only by experience afterwards. I say all that we can say is, that acrimony has the power of stimulus, and the pungendo &c. of Gaubius is to be rejected as only to be learned afterwards by experience. In § 292, he explains this: "Acris mechanicae vis &c. in currant". He speaks of sharp pointed Bodies that by acting upon a small portion they render it more penetrable. He explains next what chemical is: But we shall presently shew that this is a very false reasoning.

Gaubius is diffident of it himself & says we are ready to push such an analogy; but let that analogy be pushed no further than experience shall shew it to take place in fact. We find it difficult to discover pointed bodies in figures, and has recourse variety of them. I will not say that the actual figures are not required. It is certain that stimuli on our Bodies may be very different from mechanical art. And further

That is to say as mechanical require to be put in motion. I immagine this means nomore than that Dr. Gaubius saw that the something different mechanical from mechanical put in motion, tho he could not evolve his own idea. Let me attempt to shew that this notion of figure has been pushed too far. When a piece of thick glass is shatter'd if there are any inequalities in it the glass flies in pieces; but this is very different from the action of a Wedge. Vibration can be excited in the air that will make a glass fly in pieces, but no body ever thought of reducing that to the operation of mechanicisms. I believe, nobody doubts that magnetism and nitre. I believe, nobody doubts that magnetism and electricity depends upon a subtile elastic fluid; but no body has call'd that mechanical. If the ab

traction of cohesion depends depends upon either, we see a subtile elastic power whose impulse may be variously modified. From all these we will see a variety of operations that at the bottom must be allowed to be mechanical, but very different from any that we know to be such. I shall leave you to doubt whether the magnetical and electrical powers (tho they are particular) are chemical, I say the phenomena depending on attraction of cohesion that are chemical & those of Heat. I shall put one illustration; If it shall be found from our observations, that what ever tends to separate the particles composing our nervous fibres proves a stimulus to them we readily perceive that chemical solvents do in a different manner from knives or wedges. Gaubius when he explains the different manners of its operation; "quae quidk". Rodendo gives an Idea of a thing Gnawed with teeth. I will carry it still farther and consider it more minutely. First with regard to the more obviously mechanical, which depends upon the motion of large masses. These act by pressure or impulse of Bodies in motion, applied either to the middle portion while the extremities are fixed and tend to bend it or to one end or both while the other is fixed to extend it; and thus

is one other viz: the action of sharp pointed bodies. It comes to be varied as they are single or simultaneous ones they are modified in an order of succession. Moral Physiologists wanted to unite this in one View as it all had a tendency to destroy our nervous humour. But how perfume will do this is difficult to say. In deed the action of pointed Bodies may do so, but it is to be doubted if its operation is to be referred to this head. We have many instances of the action being exerted at a greater distance, our fobres can be set at a great degree of distance without this. There may be another theory than that of separating the particles of our fobres. The single effect of points in electrical Phaenomina, in passing from Body to Body, and several Phenomena in Chemistry, leads us to suspect that a very subtile division of Bodies gives them new & singular qualities; If so be our electric system may be very different from what we imagine. But us not be rash; there may be modifications of the actions of Bodies that we have not dreamed of. In Par: 229 Gaubius is wrong in assuming the term acrid for stimulus, while he takes no notice of the other stimuli, which

may be called equally acrid. Strong light and strong sound may be acrid but they are not to reduced to the mechanical acrid. Even taste & odour may be mechanical stimuli but not sharp pointed Bodies. What he says in Part DCLXXII. is extremely proper, and the precession that is in it may escape you, "ut affulsio &c Violenta &c" That is to say he still recurs to his old explanation, but it is "quae bonae sicne", He is ready to admit of some thing else.

I am to proceed now to speak of chemical impressions that we are chiefly obliged from their unknown nature to take them from the various objects of Chemistry; they shun a different relation to animal Bodies, by affulsing different organs of it, or different parts of the same organ. —

Lect. XXXVIII. Jan. 9th

Dr Gaubius 233 Par: "punzendo &c has indeed given the language of Pathologists: he in it has committed a fault in almost every word. If you take acre for quequid valet stimulare you may but to say that it operates punzendo is false, there being many that operate in a very different manner. And if he should say he did not mean to comprehend every manner of operating, I say there is little use in seperating these from the last; for the modes of operation are not even all the mechanical ones. Acrid is whatever stimulates and mild does not. But he has erred in meaning chemical and mechanical modes of operation, and his conclusion is false. — The mechanical are such that in sensible masses they move the more considerable parts of our Bodies. Those that act upon small portions of our Bodies are not chemical, but mechanical. And further when the qualities depend upon attraction of cohesion, I call them chemical impressions. Nothing is more foolishly presumptive than to think we can make any thing complete. As to chemical impressions they are prodigeously diversified, and varied, if we consider them in the extent of all the objects of Chemistry, and even as they are related to our Body. But it is not our business to give all the objects of Chemistry, and we can not yet enter into those that relate to our Bodies till

. All these chemical agents are in a fluid form, without which there is no action. Some phaenomena give doubt but not to the proportion of one out of a hundred, and fluidity is necessary to their acting on our Bodies. Of fluids there are two kinds, vapours and liquids

elastic and inelastic. Now these two Bodies as such have some differina in their manner of action and are more or less adapted to act upon particular objects and of more or less extent in the human Body. Bodies in the state of vapour are of more extensive power in the system. The action of Bodies is very often confined to a small portion of the system. In other cases, while the topical are little perceived, their effects are more generally extended over the system. —

The Effects of Impression are reduced to Stimulant or Sedative. —

What I would call mechanical, is that which in sensible masses moves considerable parts of us, and what ever we think of perspiring, bending, stretching, we would suppose the produce corresponding excited motion. But we have examples of them proving sedative. But I believe their sedative effects might be said to be in consequence of their evidence destroying the part affected. As for example in the clubrical stroke. The pleasure of titillation and a high degree of pain may alter the mode of impression while the impression itself is Stimulant. But chemical impressions are frequently sedative. We can difficultly conceive any operation, and it is impossible to examine it to

be sedative. We must find out how one action in one point can produce a cessation of it in another. I shall give you an Hypothesis which must be attempted. There is in our Nerves a fluid enhollow Tubes either confined or adhering. Now assuming this there are various modes of transaction which we can think of, and among the rest mechanical impressions, act upon our nerves, which produce oscillations and vibrations to considerable distances, and therefore from the ~~origin~~ extremity to the organ of Sensation. Chemical operations may act in this manner which is analogous to sound, where vibrations are produced in the sounding body. and we have the motion of one body communicated to another by producing the same motions with that, and the first by means of an elastic fluid the air. The Vibrations of other elastic fluids may be communicated to our Nerves and excite vibrations by direct impulse on them. Light produces heat in Bodies by acting upon a fluid that is capable of Vibrations, and Newton has shown that their action is not upon the solid Bodies themselves, but upon elastic fluids every where surrounding them. or by a subtile elastic fluid. The Vibrations may be

which even of these we

 employ we will not find the explanation of sedative. Therefore I have ventured to say that it is of a peculiar nature and mixture, & capable of being combined with other Bodies, and without motion, variously modifie its properties. Mixtures in Chemistry destroy volatility & vapour. Bring certain Volatile fluids near to one another and they soon become fixd Bodies. That is one View of the ~~[illegible]~~ operation of Chemical Bodies on our Nerves. We can say no more till we prove it. There are some other operations in Chemistry as antizymics which check fermentations. These chiefly consist in preventing motions that would arise by their contiguity. The juice of the grape would give motion by elastic air, but apply salts, & no motion appears for years. Take this then as a necessary step before I proceed to the different motions. I shall first show you an application or two of the Hypothesis which may be a presumption for it. And first the explanation of a puzling Phaenomenon "that the same impression may prove both stimulant and sedative in different parts of the Body and in the same part at different times; it is only supposing that one part of the operation produces motion, when acting upon our Nerves; but when it has entered

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into them, mixes with the fluid and compose or deminishes the motion; Now when I speak of the subtile fluids to be insinuated into our Nerves and applied to the elastic fluid there, I can concieve how both the operations of Stimulant and Sedative may be extended. Most Vapours or volatile Bodies, are most active, and most poisons are Volatile Bodies. In their liquid state they are perfectly mild and bland, but in Vapours most acred and active. Most poisons and their phenomena, then depend upon a very volatile part. We commonly observe that fixd Salts and analogous Bodies, in operating upon the organ of Taste, are most generally topical and stimulant, unless they have the effect of the modification of pain or pleasure, wheras volatile Bodies are both more considerable and extensive in their effects. And this leads to point at an experiment that has so often deceived us; we most frequently judge of the qualities of Bodies by our taste, but this in other parts may not be active, and converted into a vapour may be remarkably sedative. As for example Camphor to the taste is stimulant but its effects on the Body are refrigerating and sedative and so of some other substances.

Lect. XXXIX. Jan.y 12 th.

I said that chemical impressions acted only in a fluid state, that of vapour and liquid; that those which acted by the former were more powerfull. I took occasion to give a new Idea of impressions, which is, that not only, bodies in motion may be acting both upon the solids and fluids of our bodies, but that the elastic fluid in our bodies may be affected in its mixture, and that in that way such things produce sedative effects.——

What sort of Motion the several impressions, distinguished by perception, depend. There is an elastic fluid in our bodies, capable of impulse and vibrations. The impressions in seeing are no other than the vibrations of light communicated to our Nerves. The only difficulty is whether light is communicated by vibrations as the Cartesians say, and not by emanations as the Newtonians insist. However every day the doctrine of Vibrations prevail more & more, and I adopt it the more readily because the Phaenomina of Heat and colours are better explained by it than by emanation. But why is not heat produced by the same means? because the vibrations admited are too rare to produce

heat, as the light of the moon can not for the same reason do it on this Globe. Now the reason why heat may not be produced, may be because the fluid in the extremities of the optic nerve propagates its impressions to the origin of the nerves, and its vibrations applied to such a long surface, are too rare to excite heat as well as light. The focus of a Burning-Glass thrown into the air is not perceived & when taken away leaves no heat because the vibrations are distributed over a large space, and not returned soon enough to produce heat whereas applied to a Body in one point it instantaniously consumes it by burning. Hence hearing it appears that the oscillation is not applied to the fluid of the Nerves alone, but to the solid part of the Nerves, since hearing is performed or assisted by the Vibration of solid Bodies. The sound is transmited thro' the air, applied to the membrana Tympani and is much assisted by the Bones of the Ear, which last circumstance appears in a deaf person to whom speaking over the top of the head, and producing an oscillation in the Bones of the branium, gives hearing; and by taking the end of a Tong, rod in your teeth you hear a sound at the other end which otherwise you would not perceive. Lect.

212 Shaw has published among other things the
tremors of solid bodies communicated to his Body
and giving him (tho' deaf) perception of sound.
By laying his finger on a violin or harpsich-
ord, he could distinguish the musick so as to be
able to put it down in writing. Now the objec-
tion taken from the soft and pulpy nature
of the Nerves seems to be not without foun-
dation; but still that may be an analogy not
sufficiently understood, there may be soft
bodies capable of oscillations, and certainly li-
quids do propagate sound. The phaenomena of
hearing seems to prove our nerves to be capable of
vibrations. As the vibrations of the air being
being communicated to the Aether in our Bodies,
it is so far a peculiarly modified vibration as
to correspond to that performed by solid Bodies.
as to what depends on bodies in the state
of vapour, whether you suppose them taken
up and deposited in the air, or whether you
consider them as elastic vapours distinct from
it, you may consider them as constantly oc-
casioning fluids varied by the subtility of the
matter of which they consist. Now here is an oc-
casion of an elastic fluid, to be communicated

to that of our Nerves. But if it not motion only 212
that is communicated, it is commonly some effect
in the way of mixture. First in the case of many
bodies that act upon our organ of smell the per-
ception is often inconsiderable while the effects are
very great. Very frequently sedative effects are pro-
duced by odorous Bodies. To shew that Bodies act
in the way of mixture I reserved an argument for
this place. The gentlemen of the Academy of Bo-
logne have made some experiments on this sub-
ject and found the doses very exactly corresponding
to the bulk of the animals respectively. We find the
smallest portion of the tongue is sufficient for
taste. But what depends upon mixture is ve-
ry much in proportion to the extent of surface of
the mass to which it is applied, and this is probably
because they operate in some measure in the
way of mixture. Doors may be inveloped in air but
they are not very miscible in it, and they appear
to be more disposed to unite with the Aether. Hence
it is that they continue so long adhering to the
surface of bodies, and some will remain of
not washed away, for ages, and yet the air must
have been changed a thousand times. There has
been another account of this matter taken from

the prodigious divisibility of Bodies, but it is not merely from the divisibility of Bodies that they act. Next I proceed to the consideration of taste in the chymical alcomi, as they are called, viz. salts, which are known especially to act, but it is false to suppose them only the objects of taste. All of them must be in a fluid, and they are commonly in a liquid state; they act as fluids are enabled to do on other Bodies; they give an opportunity to elective attraction which produces the motion or action of Bodies on one another. It is in the case of mixture that the operation of elective attraction takes place, hence it needs hardly any assistance of agitation; whereas solution does. Now many of the objects of taste are truly menstrua of salts. In a small quantity they excite a motion in our nervous fluid. But I own that tastes are by no means exactly corresponding to the action of solvent Bodies, the force of impression in taste is not in proportion to the solvent action of these Bodies. The properly solvent and antizymic Bodies are contrary to one another, the latter check the former give motions that would otherwise not

occur. as the operation of heat is directly the motion of a fluid acting upon ours. I say whether or not are antizymics fitted to receive & not retain the motion of surrounding Bodies the analogy may be admitted with regard to taste. And in this way does cold act. Another theory for the impressions of taste is this. It is now admited that we consider every mass of matter as inert, and surrounded in an elastic sphere. It has a particular relation to heat but we know the oscillations of heat, are in no part of the matter, entirely extinguished. I have said that odour depends upon elastic vapour flying off from the surface of Bodies, and that every mass of matter sends off such odour, tho many of them are not perceived by us. There is probably a particularity in this matter, and perhaps it is the case of elective attraction accompanying every peculiar mixture. If we admit this we admit that there is an Aether which is the foundation of mixture, and it may be communicated to our Tongues. &c.

Lect XL. Jan^{y} 16

In the ear the vibrations of the air are excited by an oscillatory motion in the small parts of bodies

and making impressions on the organs of hearing or even impressions made upon masses of solid Bodies affect our organs of hearing. I am ready to conclude that in smelling not only vibratory impression but mixture with our nervous fluid takes place, and the extent of surface is to be taken in. Two Hypothises are made use of here; the first, is, that there is a subtile fluid in all Bodies an that they discover their elective attraction by that fluid, and that it is in consequence of hithe motion that our organ of taste receives impression. The other Hypothesis is that the subtile fluid is different in every different Body, that is so far as they are different mixts. And here as I alledged of the vapour that gave odour, they are diversified by their mixture, so must their action, and the modification of impression be diversified. You must admit these two Hypotheses from the analogy of all nature, and as in smelling so in taste you must conclude for a mixture. The analogy of perceiving the oscilation of subtile fluids does confirm the whole. I make an application of that they seem to depend upon the oscillations of the small parts of Bodies

independent of any motion of the masses of Bodies. We do not perceive the motion of the whole mass nor do we perceive any thing but the oscillations of subtile fluids in our nerves.

But different from these are the motions of touch or what is by way of eminence called feeling. It dependes upon motions of the whole mass producing corresponding motions in our nerves. The several modifications of it are difficultly kept seperate from one another and explained. And first there is the perception of the roughness or smoothness of Bodies, which is performed by a motion of the surface of our Bodies upon that of others, and the sense of asperity depends upon frequent alternate impulse on our Body, and smoothness upon an uniformity of impulse in the whole. The extremities of our nerves are divided and extended to give the same impression of inequality there. Next is the perception of figure that of sharp or blunt, angular or round, which depends not only on a single impulse, but a number that are simultaneous by which we grash it about to measure it. A third perception is that of hard or soft, and of the same kind is the perception of flexible or rigid. These are

very nearly in common to all the several parts of our Body, some parts may from their shape of Epidermis be less sensible of them. And here something as particularly the last; the sense of resistance is rather a perception of the motion of our own Bodies. Our perception of extension and what attends it, several modes of figures, are procured by merely the extent of surface of our Body occupied by impression and more commonly by extending our fingers. Or again we judge of the whole of figure by the successive motions and different directions our hands make around them. You see this is a sense of motion in our Bodies with resistance. The sense of pressure gives a perception of motion first but after that it is only a change in the state of our own hands. More particularly our perception of it by the effort we make to overcome it, & our sense of gravity is entirely of this kind. Now you will observe that these are called the more obviously mechanical impressions, depending upon the motions of sensible bodies on ours. But they are analogous to what happens to their elastic Bodies the motion of whose parts in compression, extension, &c excites a motion in them so in our nervous fluid is a motion excited. — Tebellation is owing to some parts of the Body being more sensible than others, and to alternate motion of other Bodies upon ours. It would appear to happen from its being more by an oscillatory motion that it moves our whole Body. Now we approach to perception, and in touch, I must anticipate part of what belongs to it by giving this general proposition, that in most cases of sensation or perception, the thought has no obvious or manifest connection with impression (see Haller Vol. DLVI.) in doing this I say, I must anticipate part of what I am to say on perception. But in the case of touch a perception of the motion, force & figure that produces is inseperable from the Body perceived. It is then the perception of touch that gives us the notion of external existance and gives us a sense of what are called the primary qualities or extension &c. In the rest we can abstract but with regard to extension, without an Idea of it we can have no Idea of Body. I observe that tho' this is the case yet touch does not always refer to ex-

tional resistance. We may have a concious[ness] of a change of the state of motion without sens[e] of the external cold. Hence a sense of dry and wet, hot and cold, which are commonly called the cardinal qualities, and it is more evident in the perception of hot and cold. When the percussion is accompanied with motion as that of the air upon our face, we are apt to refer it to another Body; but in innumerable instances it is a sense of motion in our Bodies without any Idea of an Object and often without which the motion is produced as in case of the manner. The only exception is that which takes place in hair. A strong sound gives an uneasiness which refers to the ear but this does not happen in the most cases. So hot and cold refer us to parts or the whole of our Body so affected. And you see that the manner is not attended to except in the hair communicated to our Body. Another application is, if the perception of impression of heat and cold is referd to touch, it has no more connection with A than there is between those mentiond before we came to this sense. I have referd the rest to mechanical impressions but smell and taste remain still

the object of chemical impression and that 221 whether you refer this meaning of chemical impression to the motion being least understood and therefore for distinction so called, or to the motion taking place being that excited by chemical Bodies. I must now say that touch in its full extent is a subject of chemical impression. You know

take notice that the tongue has the sense of touch in common with the rest of the Body. Many Bodies act there as they do upon other sentient parts, and more strongly, as acting upon a part of more sensibility. And it is certain that many of these tastes we call acrid are effected by touch upon the Tongue and Fauces. When we we can perceive such impression we may conclude that they are all impressions of touch and not of taste and would have analogous impressions on other parts of the Body. Also the internal nose is an exquisite organ of touch; hence the pungent & acrid bodies that produce sneezing act more by touch than smell. In the Eye and Ear there is a peculiar sensibility of touch; the eye is sensible to the touch of acrid Bodies; and the Meatus audi-

torius has a very peculiar sense of touch, and the Chinese from that give the sense of titillation, pleasure, and the most violent convulsive motion by subtile touches. It leads to a curious question to wit that of specifick stimuli. but this belongs to the operation of medicines, and there I shall speak of it; Here I say only that tho' I shall refer it to the operation of medicines yet as it distinguishes the senses &c. I shall allow it in the ordinary animal Oeconomy. Thus I have taken notice of the external corporal impressions; I come now to the other, the internal, to wit those that arise from the Body it self. I here still consider the action of matter upon matter, and not the sensus interni of Haller.—

Lect. XLI. Jan^{y}. 14th

Haller's chapter of sensus interni comprehends perception. I am here to treat of perceptions of the state of the Body, but which are produced always by, and relative to the Body it self. But it will be difficult to distinguish them from the internal corporal last spoke of. It will be difficult to distinguish, flatus generated in the stomach, borborygmi introduced into it, and acids generated, from acid regue. It will be more properly our Business in the Pathology to enquire into the various causes of internal impressions. We often know the internal impressions by the perceptions they produce; We are extremely apt to refer impression to the parts of the Body diseasedly affected. So sickness tho' difficult to say where the seat of it is we refer to the part we feel most affected; and we generally refer to touch; Yet this sense of touch is not one, but fifty different impressions. Next with regard to internal impressions, as in the other called external, the relation is quite arbitrary, so it is with regard to the internal. Many impressions give no sense of impulse or motion or any modification of it but a want of it. So want of light, or of noise at times give uneasiness, as is clear by this viz: the uneasiness we feel from the want of usual impressions. Hence the uneasiness of created apetites, when the impressions made by their gratification cease, as appears in opium when its action is over in such as are accustomed to it. I now speak more particularly. The first internal perception is the most general, to wit a consciousness of self; It is what Haller and other

224 Physiologists call the adperceptio. Whether we have apperception along with it of the general perception may be doubted. Concious sum, ergo sum. But this I think is certain that we are concious of our ordenary existance, and have the Idea of Identity from a full exercise of perception in our following our ordinary train of thinking. And this has the Idea of Coherence or existance. — Hence we distenguish between our waking and sleeping thoughts. When a man has been under the impresions of a Dream, some of the circumstances of that may shake off sleep; when waked he calls for light, sees if it be his own Chamber, he finds that it is and that the perceptions of this Dream were incoherent. We judge whether other people are in their senses or mad, from this same coherence of perceptions in them. One chief mark of the adperceptio is alledged our perception of time and duration. Our ordenary train of thinking gives us our conciousness of existance, by giveing us conciousness of time. Fits of madness we forget and hardly refer to our being. The common people think they can recollect Dreams, if no waking impresion intervene between the Dream and the recollection. How this is connected with our present subject will appear presently. We have so much of it as extends to a general manner of our existence: We are concious of lively perception, ready memory, and clear judgement at one time, and the reverse at another. Also in all our actions we are sometimes concious of dangour and dibility, and at others, of alacrity and vigour. Now that these are not confined to the mind appear from this that all our impresions arise from corporeal ones, internal or external. Too much or too little Blood will produce the difference of the state of thinking. I must observe to illustrate this, that when we come to perception we take a view of our mind as liable to emotions & passions, and I mention it because it is there we can best perceive. Take the example of the effects of different states of the weather; sadness at one time and alacrity at another; doubt, despair, fear & irresolution are the result of one state of the Atmosphere; so another state of it gives alacrity, easy satisfaction, complacency, gaiety, & gentleness, and inspires hope, Courage and determined Resolution. 225

All these are pursued by us as the most general cause of internal impression; and it gives character to different temperaments. To some it applies for life to others by the day and by the hour, and depends not only on the state of the atmosphere, but upon various other causes, as the different state of our stomach and genitals affect the general tone of our mind and body. I go on now to speak of internal impressions that depend more upon the state of particular Viscera. They are internal, disagreable or agreable. The agreable are very few; they are taste &c. A second mode of the agreable is a relief from uneasiness of any standing; the third is internal gratification.— All the other much more numerous, are disagreable, but which may be reduced to the painfull & uneasy. These terms are considered as synonemous; But I appeal to common experience of propriety; Sickness of stomach is uneasy, and pungency of pain in the same part ought to be called painfull. "It is uneasy, it is almost painfull" is a mode of expression that explains the difference between them. Again, Pain may be more confined to the Body uneasiness to the mind. Pain in all its Variety is in common to every sentient part of our Body, and exactly

refer'd to the place where the impression is made; & when it arises from internal causes they are an effect of the force of impression, and more particularly arise from the mechanical impression; It is then proper that I am chiefly to consider the uneasy impressions. Under the sense of uneasiness there is great variety from a great variety of causes or states. First it arises from want of full, distinct impressions; Darkness is hardly so disagreable as imperfect light. Secondly it arises from want of usual impressions; and thirdly from an interruption of our ordinary or usual train of them. fourthly a sense of debility or of resistance between which it is plain that we do not always exactly distinguish. As to them all it is to be observed that they are attended with anxiety or a desire of relief. Whether it be a desire of the removal of the uneasy sensation, or of the resistance to motion. Now as impressions are often observed by the perception they produce, so these uneasinesses are often only known by an anxiety. From sighing we distinguish the uneasy state of the mind; sickness from a Volition to vomit

In many cases the seperation is not distinct the Italians would say that it is always followd by particular motion, as a fuller inspiration takes off the stagnation of Blood in the lungs, and the sense of uneasiness in the stomach. But often we are not conscious of the volition or motion. There is at randome a constant shifting of the motions of the Body. It is likewise founded that Gaubius under ansulas has ranged all the several uneasinesses that I am to take notice of with regard to the several parts of the Body. Amongst these is a sense of uneasiness that produces apetite. It is true that Hunger is often accompanied by a very general tho' undetermined impression, to wit a general desire to eat; and where it is carried to a hight we have a sense of more particular pain, but in general there is no pain nor sense of motion.—

Lect. XLII. Jan^{y} 15th

What else I have to say of the causes of impressions shall refer to the Pathology when I shall enter upon that consideration. I shall enumerate impressions themselves. There is some dangers of confusion in the use of terms on this head. As every impression that has perception is not seperable from it, so no wonder of I run into some ambiguity in taking one for the other. Every perception I dare venture to say, has its correspondeng impression, and in many cases where I cannot point it out, you may still understand that to be the fact, & my reason for using the one term for the other.

The first impression I shall speak of is Stupor, a dull perception, which we refer to the head. Or to what we call confusion of head, which is attended with a peculiar anxiety. Somnolentia is similar to both him & perhaps a part of both; It is particularly distinguished from them, that it is ambiguous between agreable and disagreable perception. Whether from it arise volition to stop or aversion to continue the effort of waking shall be afterwards inquired into. I might refer thither to those for like reasons; it is properly a mode of vesion, but it arises from impressions elsewhere made, as on the internal head & the motions of Blood. It is an instance of a false immagination. The tinnitus aurium does not so often accompany it. I shall speak of both afterwards.—

Incubus is an internal impression, but doubtful whether referable to the head or thorax. It is a general sense of immobility; chiefly & commonly depending on the circulation in the Basis of the Brain. The gravelas capitis or dolor capitis gravativus we refer to the external parts of the Head. We are uncertain whether it is an uneasiness, or arrives to the full degree of pain. Next to these is Thirst. Situs it in the Fauces tho' it arises from a variety of states of the System, and several of these making their impressions on the Fauces. Yet all of them are either directly on the Fauces, or communicated to them. Next is Dyspnoea. It is very often attended with a sense of infarction, and consists in an anxiety that we feel chiefly at the end of respiration. The last is Difficultly settled in our perception or distinguished from the sense of infarction. It is between this last & the anxiety that first interrupts the course of the Blood. Another Dyspnoea attends laborious respiration. We employ the muscles betwixt the scapulae and Lungs and betwixt the Scapulae & Vertebrae to relieve it. It communicates a sense of debility to the whole system. The instance of this is that an uneasy and laborious respiration occurs in a warm air.

There is an uneasiness produced in the beginning of Biliary fevers, viz. Sighing. It is difficult in theory to explain the cause of it. I mention only one other article of enquiry; The pumpations of Coughing; where they act is not sustained in our Pathology, when we shall speak of it. Many of the fulness of the Thorax belong to the heart. Tho' we are not conscious of willing the action of the Heart, yet we are sensible of its manner of action; we are sensible of the palpitations and more ordinary motions of it, we are sensible particularly to the interruption made by its evacuations, and therefore of the uneasiness just now spoke of. The same uneasiness arise from Polipuses or Aneurisms obstruding the Blood in the left Ventricle, and from infarction in the lungs giving obstruction to the right. At the coming on of Syncope, but more at the recovery from it, there is great uneasiness; But syncope itself is not disagreable. There is in it a peculiar agreeable depending upon resistance to the motions of the Heart. Next are the impressions in the abdominal Viscera. In these there is a sense of anxiety

also arising from interruption of the motion of the Blood. But we never refer it to particular Viscera. I can not help observing how industrious we are in referring pains to their seats. Take the instance of the Liver, the Biliary duct, and the Flexure of the Colon, which are contiguous to one another, and you will see the difficulty of referring to any particular one of them when any are affected. It is most necessary to enquire into the alimentary canal. In perception we are rather limited to formal causes, than that we can come at the efficient ones. This applies to the Stomach, and as the Stomach first receives the aliment it is particularly sensible. This is the foundation of the operation of medicine, and of Matter acting upon the most distant parts. All the perceptions here, belong to external corporeal impressions. But there is no use in distinguishing these from internal. Here I mention it as a foundation to the impression that may arise. Secondly the Stomach is the seat of the apetite of hunger. The state of the System is communicated to the Stomach, and the tension of the Stomach corresponds to the whole of the System. The Stomach is more nicely sensible of its own tension than any other part of the Body; by this it

measures the quantity to be taken in. Also the Stomach is sensible of the state of its own motions, hence various perceptions. Lastly with regard to perception of the stomach it is so framed as to affect & be affected by the whole of the System. It is the source of more perceptions than any other organ and gives more application of sympathy than any. The sense of smelling &c and these states that are called Idiosyncrasies. I could wish to enumerate these impressions more particularly. We have a sense of emptiness or fullness, hence debility of the system and the apetite of hunger; not noticable when it begins but after becomes an actual pain in the manus tenticuli. On the other hand a sense of pain is attended with a sense of fulness often from over quantity of contents & from

and between liquid solid and vapour we do not always clearly distinguish: There is also a sense of want of apetite and when food is presented it rises to nausea or loathing. These higher degrees of aversion are attended with a peculiar sense of uneasiness or anxiety that in english we call Sickness. The gradations are aversion, horror, nausea and vomiting. You will find it interesting to enquire into the causes. The intestines have a share of the same sensi-

lubility and consent, but it is only a share. We are sensible of this emptiness and fulness. The anxiety & uneasiness that precedes the operation of a purgative is known. It is often attended with gripings, as to impressions made here observe the colon particularly; the beginning is liable to particular impressions. The extremity of the rectum has a particular sense that is communicated to the system, hence the uneasiness after evacuations by stool. The same thing may be said of the evacuation by the neck of the Bladder, the different state of the genitals, their emptiness gives Languor and Irritableness, their fulness, rage, Courage & Strength. The human species are exposed to other impressions that modifie and counterbalance these. In the female sex beside those connected with the abstitute there are a variety connected with the uterus; thus in pregnancy, Labour &c &c

Lect. XLIII. Jan.y 16th

In the extremities is it that we feel both solidity or lassitude, as well as alacrity and strength. We often do not distinguish the weight of the extremities, whether the weight is in our own limbs or added to them by external bodies. It is these impressions of the different state of volatile motions that we chiefly impute to our extremities. If it only the case of acute pain that we refer to deeper parts; till the other we refer to the skin, as the sense of numbedness or stupor and the case of increased sensibility. If our Body is for some time without motion, it can not be without the pressure of the whole Body, or its particular parts pressing it to the part it rests on. A certain degree of that is not at all perceived. But it is often equal whether the pressure be greater or our skin be more sensible. Time in many states of our Body such a continuation of rest and pressure gives a paralegia. Frequently the sense of lassitude ensues here, and in that case no posture can long be easy; and therefore paralegia arises from both. A man will fall often as if his head was all made of a quantity of sand was in it. Under the title of the "anxietas Tibiarum" mentioned by Sydenham which we call the fidgets in this country. The principal impression is the sense of heat and cold which best of all gives the distinction of internal and external impressions. It may arise from my Body without external heat or from the fire. Nature had placed the sense in the skin, as necessary with regard to external Bodies. I immagine it is only felt in the skin and not in the internal parts, unless such as are ex-

posed to external Bodies, as the glasses. I believe sense of heat exists no where else. Also sense of cold sometimes affects the Stomach, but I believe, no other internal part. In the surface of the Body there is often flushing which signifies heat or horror. Why Horror begins in the Back and from thence as a cold air brushing to the extremities, is often variously modified, sometimes like one, sometimes like many streams? It is to be enquired into whether it is not accompanied with real motion, that is whether the cutis anserina does not accompany it. There are two other impressions to be mentioned, the Pruritus and Formicales. The last is a sense of motion sometimes with heat some times with cold as if small insects crept along the skin, and hence called Formicatio; with pringlenz as we call it and what you call tingling with a sense of the pricking of a number of fine pointed needles. As to the Pruritus it affects the division I formerly made of the internal impressions giving pain or uneasiness. I did not overlook it unwittingly but left it to be considered here: I am at a loss to which to refer it: This often ambiguous, believe it the too. It often arises from the slightest uneasiness to higher degrees of pain, In some of which (as the English observe) it affords a very high gratification. When I spoke of Formicalia I should have said there is in it a sense of aura or vapours arising from some parts of the extremities & mounting upwards to the head; attending the coming on of Epilepsy, and some other states of the Body. We think it to be a nervous affection. It affords one of the strongest proofs of impressions being communicated to the organ of the nerves in a similar motion. It will be readily perceived that we have presented you some difficulties in pursuing this subject, and have failed from the difficulty of separating these internal impressions from the mental. But as the mental impressions depend upon perception, I must speak of them under it. That is to say after I have added that there are two impressions which are ambiguous, between the two of corporal and mental. They are certainly corporeal but in their causes and effects, as certainly mental. Such are the impressions occasioning visage and gesture. Now there is an image produced and perceived by my eyes which produce the like motions, passions and expressions. This is the foundation of Language, & has been explained as the entire foundation of moral sentiments

It was necessary to remark it as a very governing impression in the system. Next secondly most of the actions of a man not only belonging to emotion and passion, but those belonging to effort or struggle, produce in others an imitation, as appears in endeavoring, coughing, breathing, yawning. We have a singular instance from Donald Monro, of an Doctor used to perform every violence he saw ~~in~~ any other person. There is probably a curious Law with regard to our system, that is that all our Ideas arise originally from corporal impression, and hence the Idea remains when the cause of the perception is entirely removed. Now I take this to be a Law. That any Idea renewed has the effect of renewing the corporal state that was originally produced by the external Body. One proof of many is that tickling about the upper lip with a feather will give a convulsion; and threatning to do the same thing after will give the same feeling & the same convulsions, without your touching the lip at all. I imagine there are many other instances of this. So the sight of a nauseous medicine included in a well corked Phial, will renew the nausea which the taking it, at first occasion. There

is no other explication of imitation than that it produces corresponding motions in our Bodies. This observation has pleased the Malabrians, that the soul was present in every organ of sense. It will admit of no such application; for this does not always take place with regard to seeing & hearing. When I recall to my memory an object I saw yesterday the image is not renewed to day.

Lect. XLIV. spent in recapidulating the proceedings — — — — —

Lect. XLV. Jan. 20th.

Of Perception.

Perceptions are various according to the variety of impressions, or the organs impressed, and therefore thoughts may be innumerable. What is here under perception to be added is in some measure common to all. We can distinguish between simple & variously modified ~~impress~~ Perceptions. Under this title we shall mention all the modifications of thought, between impression & contraction and form the connection between these. This is the same with the sensus interni of Haller. Boerhaave has a section under the same title so far as it goes much

more simple and clear. I am to consider the more general impression and Contraction that I spoke upon thought. Almost the whole history of the human mind, as I have said before enters into our subject; or at least it is difficult to say what parts do not relate to it. Then I may to many seem superfluous, I shall however avoid that as much as I can & expect indulgence from my philosophers. —

There are two different series's of Phaenomina here. The first is the thought arising from the impression of an external body present; This I shall call strictly Sensation. When that object is removed there are various occasions on which such sensations are renewed without the object. I would distinguish this by the name Idea. Memory is the renewal of Ideas. Renewal more strictly in the sense of the original is imagination. We compare two things together and perceive various relations; The observation of relations is otherwise to be called Judgement, or it is reasoning. These various modifications of thought are all applicable to the most simple sensations. Sensation is attended with a reflex sense of agreeable, or disagreable, other wise pain or pleasure. From this may be again distinguished Approbation or Dislike; from these, Desire or aversion; and this renews various

modifications called volition, instincts, apprehension &c. These different operations of the mind have been distinguished by what belongs to the understanding and what to the will. It is the first that we would most readily think of under perception, and we may in general distinguish between these two; and therefore the term of Gaubius as comprehending both is wrong. I believe Gaubius did not view the matter so largely, and only thought of perception, conceiving volition as a part of his third title of contraction. I go on now to consider these series's of Phaenomina separately. I shall meet with the same difficulty to separate these, here as before on the head of impression, and will be obliged often to speak of volition. —

Sensation

I employ as of the same import as David Humes term impression; that of perception is in opposition to Idea, which last is a thought from an object not present. Now the sensations have no obvious connexion with impression, but seem to be arbitrary. So the impression of sound might as well for any thing we know or can see have given the perception of Colour, and colour might as well have given a perception of sound. But I must grant what is allowd

Immaterialists; yet I must say that all thought arises directly or indirectly from impression. A blind man can not have an Idea of colour, nor a deaf man of sound, nihil in intellectu quod non prius fuerit in sensu. Next it is presumed a law that like impressions produce like sensations, that is comprehending all that is in impression's viz: the action of bodies external and the state of the organ itself. So Boerhaave expresses it "

" eadem Idea organ"

Indeed the proposition is otherwise rendered sensible; that like causes produce like effects, and we must reject all separate laws from the soul as altering this Law. But when the cause is complicated it is the action of external Bodies concurring with our organs, which last will vary the action of the external Body. I must observe that sensation is very rare, generally the cause is obvious as in the case of Jaundice, when while appears yellow. Such is the state of the coats or humours of the eye to transmit only yellow rays. M. Buffon mentions under the Coelum occidentale when one looks first at the sun, turning to a while wall finds it to be red

an impression remaining in the organ after the Body external is removed is here the cause of this. A third cause is where different sensations arise from individually the same external action. But it is a difference in the degree of external action; & such is the state of our Bodies that that will give us to tally a different sensation; as in heat and cold where the difference lies only in the degree of heat. A combination of our organs give different degrees of sensation. If irritability or the organization suited to it be different in different cases, the sensation will be different. But irritability we cannot perceive is different from a different degree of sensation, or sensibility. This confusion may often enter into this subject, & so we must avoid it as well as we can; & we must likewise examine what are the different degrees of sensation. And first we must judge from the stronger or weaker impulse of external Bodies. This is illustrated by the case of heat or cold, either of them being given the degrees exactly correspond to the Thermometer; and the same in the general perception of light, and what is more, of colour. We take sensation of light in the order of the different degrees of refrangibility of rays, that is in the order of the oscillations. And the same thing may

be said of sound. Light is according to its concentration;
the force with which sound affects our organs is accor=
ding to the tone that is the frequency of vibrations with
which it affects them in a given time. In taste and
odour we percieve something similar. The sensati=
on is as the force of impression taken by the con=
centrations; this applies in odour taste and touch.
But in a variety of all these we cannot discern the con=
nection. It is true we can reduce pain or pleasure
to degree of force in the impulse, but we can not
say that the oscillations of a heated body give a stron=
ger impulse than those of the frozen. But we may
at least be able to view this subject in a nother light
if we can ever arrive at a theory of electrive attractions.
Next the degree of sensation depends on the organ im=
prest. First we are lead to perceive a different con=
dition according as organs are suited to be impressed
by external Bodies. A variety of these I mentioned;
so we find a peculiar sense of acrimony in the
Fauces, the sense of acrimony and every thing else
but air in the Glottis, and the sense of acrimony
in the Bronchia. These are so many organs of
sense; and how the nerves are suited to them we
know not; how the Retina vibrates with the vi=
brations of light, and the Nerves of the ear with their

of sound; but they likewise modify the degree of sen=
sation. With regard to all of these we have shown
their receiving impressions that excite sensations de=
pends upon the Brain; and perhaps the condition of
the sentient extremity contributes to the diversity
of each respective sensation. Now there is afforded a
fluid distributed to our ~~many~~ organs that may be
in more or less quantity whence the sensation will be
proportionably varied as in the Hydrophobia the
whole organs of sense acquire a different degree of sen=
sibility. Next you may view this condition as propor=
tionably belonging to the Sensorium. Whatever relates to
by belonging to the Sensorium. What soever relates to
that seems to belong here to the different conditions
of the percieving organ. As to the apparatus of organs
there are provisions for shutting out impressions. Thus
our sensations of touch are varied by the thickness
of the cuticula. There is one other modification of
our organs independant of the Brain viz: inflam=
mation; We know in several instances, an inflam=
matory state in the eye gives an exquesite sensibility
to that organ so that the light becomes an intolera=
ble pain. Our Eyelids shut out a strong degree of
light and give almost absolute darkness, but yet
the direct rays of the sun will affect them. And I
have seen even Cloaths laid above the eyelids were

not sufficient to prevent the impression of light and its effects, and upon the least opening of the curtains, window shutters &c which were kept constantly closed the Pt would perceive the impression. Probably in this case the the dilatation of the blood vessels touching the nervous fibrils might give the pain; and there may be a variety of other causes. ——

—— Lect: XLVI. Jan.y 21st ——

Tho I am ready to allow the connection between impression and sensation is quite arbitrary just as all sensations arise either directly or indirectly from impression. It is then a fixed law that similar impressions give similar sensations. But these conditions are not always evident, and sometimes the same impressions produce different sensations that is in dizees. I enquired whence this difference in dizee proceeded. I said the difference was first from the force of impulse: for where we can measure the force of impulse, we find our sensations to correspond to it, as in the case of heat where we have standard, and something like this Tallidge occurs in taste odour and sound, but here we want a proper measure. I shall by and by give a reason for believing that even in these the dizee of sensation

may depend upon the force of impulse, and if we shall ever get an elective allevation of these we may be able to ascertain it. Next the dizee of sensation depends upon the constitution of the organs many of which receive impressions of certain kinds and they give sensations different in kind; How far that may depend on difference in dizee is doubtful. I believe there is something like it depending on force of impulse. It is difficult to say why the membrane of the glands should be sensible to the mildest fluid, and the tickling of a feather should produce the strongest convulsions; It is possible we may find something in the constitution of the nerve that disposes it to some impressions more than others. But if we take organ as not only consisting in the sentient extremity of the nerve, but also in the apparatus, we will see there is much in the apparatus that determines the dizee of force at different times. But I allege there may be one source of different dizees of sensibility in the sentient extremity. An elastic fluid is distributed in different quantities at different times, and there is sometimes analogous to what we call the tonic Power which

will make a difference at different times. But further we have still more distinct proof of the sentient extremity of the nerves giving a difference viz: in the Blood vessels mixd with the sentient extremities. The inflamatory states may be supposed to give a greater degree of tension; and the effects of general inanition, and the vessels being more flaxed from a less quantity of Blood in them may diminish our sensibility. I think this is pointed out in several instances in the Nathology. Next this difference depends upon conditions in the state of the whole cause of the nerve up to its common origin. When compression has taken away feeling the compression being itself taken away the sensation returns, but gradually, and from absolute stupor thro' all the degrees of sensibility till it returns to its natural feeling. Besides there may be more partial obstructions, which we are not acquainted with, producing the same differences. It is proper to refer to this the state of the Nerves at their origin as compressed from blood or other fluids depending upon them. Fourthly our sense depends on the state of the sensorium commune. Now here is always the consideration of the immaterial being to be attended to. But of the state of the organs of the sensorium we have imperfect and gross notions when we come to look for the corporal causes of diseases, in this they evade us for want of the anatomy of this organ. But the state of compression from various causes differing in its manner and gives different effects in sensation. Besides it there are certainly other states of the Brain that we can understand affecting sensation, such as stagnation or regurgitation of the Venous blood; and much depends upon the state of impulse of the arterial blood. Sense is as much destroyed in Deliquia animi as in apoplexy. But a certain impulse of the arteries is necessary to sensation so the increase of that impulse is an obvious cause of increased sensibility. Paralytic affections hence are well known. We commonly overlook a compression from excess of dilatation of the arterial vessels. Hence Amaurosis from dilatation of the retinal, & the same thing may happen in the Vessels of the Brain, hence coma & stupor. I must now add that there are constitutions of that kind to be taken notice of such as the different degrees of sensibility depending upon sleep and waking. We can all sleep in various degrees between being fast asleep and quite awake. So much for the state of the sensorium. I add

here two other Cases that of attention & habit. Attention is the tendency of the mind to rest longer or shorter upon the perception of any one impression The mind can not attend but to one perception or Idea at once; hence the mind occupied by a strong impression is quite insensible to many other at the same time: and it seems to be a Law that an impression must act for a certain time, to have its full force. Therefore if another impression succeeds too soon, the former passes away almost unperceived: and therefore you will see a sensation arising depends much upon its being long perceived. Now this resting of the mind for a necessary length of time, to give impressions their full effect, is attention. It is in some measure voluntary and therefore the causes of attention depend upon these circumstances that more & less determine the inclination. The first of these is the novelty of the impression. Our minds are seldom bend to extend and accumulate knowledge: that merely the novelty engages attention. But in the Case of impressions that are not new, the engaging the attention seems to depend upon the force of the impressions, or rather that is to be rated by force

and external impulse or in proportion to it. That it commands attention. But while our minds particularly perceive the relations of objects, the perception of relation particularly engages attention. With regard to Relation. There is a relation of all our perceptions to our selves, to the pleasure or pain they give us; This I call interesting relation; and our attention is more or less according to it. And as relation has such power over the attention; imperfect perception of relation engages our attention; & nothing engages us more than that attention which arises to anxiety. On the other hand attention is interrupted by the various causes of insensibility of the organs. We are inattentive to all weak impressions; and we turn the mind from all painfull impressions if they are not interested to engage us. Also the mind already occupied with a strong interested impression will not attend to any other: hence the hearing of a blind man is remarkably improved because the mind can not admit of one impression at once. Next habit gives different degrees of relation. All of our senses are very much, the most part of them all together relative to the Oeconomy of our own Body. In short

we have no judgement of the degree of heat in other Bodies but from their exceeding or falling short of our own, and so it happens with regard to a variety of our other sensations, and hence the same impression necessarily gives various degrees of perception but different in kind. That this day may be cold tomorrow, and also in light what appears stronger or weaker depends upon the condition of our organs. A single candle will offend me after I come out of darkness: What we call darkness has a good deal of light, and suffices to affect the eyes of some animals. Body to discover objects.

In the history of the Du Faw of the french academy he perceived that all diamonds had the property of the Bolognian Phosphorous. He made a number of experiments, and soon there might be a deception. If the Diamond was brought to him in the dark he saw the light, but if he carried it out of the light himself into a dark place he did not perceive it. If tied up his eyes and in the dark, perceived the light of the diamond with that which had been tied up, but not with the other.

Upon the different degrees of sensation after mentioning the foundation of it in the elasticity of the Nerves, in its course to and in the Sensorium communis. I had to add more purely mental Laws, these two are attention and Habit. Impression must be applied for a certain length of time to have its full effect, and this is what we call attention; which is as the novelty and force of impression, and as these give occasion to relation, especially of the last is intermitted & as the perception is attended with uneasiness or indistinctness which tho' weak in their nature excite strong attention. On the other hand attention is interrupted by all those things which diminish sensibility. All weak and disagreable ones turn off the attention and prior occupation has the same effect. Such is the nature of impressions that the sense remains when the object is removed. Habit is the other operation when the impression has subsisted for any length of time, is frequently repeated or gives a new Law. And our perceptions are relative to the state of our own Body. This is illustrated in the case of that Light and Sound, and in all these that admit of de-

 grees. We do not always distinguish impression at different degrees; But things that are opposite heighten one another, as sweet & bitter. One application is that it explains as juxta se posita magis elucescunt, why so much of our knowledge depends upon comparison; so we only know degrees. Newton has discovered various degrees in the same colour. He has a red of the 1st 2d 3d 4th 5th & 6th order. If he was presented with a red of the third order he would think it the brightest till he saw the second & first. So the fourth order he would call dull and weak if seen by itself but compared with the fifth or sixth he found it not so dull as as it had appeard before. These explain habit. All our impressions repeated grow weaker and weaker. The same degree of light we perceive less and less from being more accustomed to it. The theory of this is untouched. The fact is in general certain. There may be some doubt as to the extent of it. This law partly takes place with regard to indifferent perceptions; that a man up with a moderate degree of light, he would not see less at the end of the fourth hour; But it applies to all our perceptions of pleasure and pain, as also to the impressions being pleasant at one time that were disagreable at another

and we can shew that pain and pleasure are
strictly connected with the force of impression. To bring down pain it becomes pleasurable, and bring down pleasure it becomes painfull. Now the present case of law of impressions becoming weaker in consequence of repetition, applies in the case of medicines operating upon the nerves especially without perception, or if attended with pleasure or pain. It applies equally to sedative impressions, and it furnishes a strong objection to sedatives acting by mixture. In other cases of mixture we know nothing analogous to this. If sedatives then act by mixture the effects should be constant and steady. I own it is a strong objection but to me not insurmountable. As sedatives and stimulants are often combined the latter may modifie the former in quality as well as in their effects. But supposing this not the case this mixture takes place in a small portion of the nerves, and may produce its sedative effects by modifieing the motion in the rest of the nerve. This doctrine gives occasion to many instructions both as to morals & medicine. I shall speak of the latter hereafter.

The mind perceives but one thing at once. If two impressions are made at the same time one only should be perceived. However several simultaneous impressions do operate on our systems; but it is only where they can unite in making one single impression, which they often do. We now have learned to distinguish the colours of the prism: blue and yellow are considered as simple ones; if they be so blended in such small portions that the eye does not distinguish them they produce the compound colour of green; the same thing takes place in sound, and hence we can distinguish the difference of simple and compound impressions; nor does this contradict the law of perceiving but one thing at once. Further, sensation is not strictly confined to the presence of the object. But the same lively perception that came from the present object often remains for some time after the object is removed. While it remains so another impression that would have united with it will unite with it still remaining, only a certain quickness of succession is here necessary. Hence this is proved in the motion of a Body appearing continued tho' it be a discrete one.

such is the apparent continuation of the flame of a burning stick whirled round. By a device of Dalencius C— — we have learned to ascertain the shades of colours precisely without the use of words; We distinguished Insects by the various shades of the same colour. Instead of words he fell upon this contrivance of producing the Colour: He got as steady colours as could be contrived; he then measured the quantity of these by the space they occupied. In forming a circle he made one half of it alternately blue the other yellow, and made them unite in one by putting the circle into motion. Suppose in the whole, eight parts of green three of yellow and five of blue made a certain shade; & so of the rest. It is to be observed that the union of our perception seems to be limited to perceptions of the same kind. So there is reunion between colour & sound. They produce no mutual sensations; this mixture of sensations is more or less accurate; it is hard to properly so with regard to blue and red, where we will have more perception of the distinct parts of which the colour is composed. There are certain sounds or tones uniting more perfectly and producing the pleasure of harmony. In like manner odour unites with odour but not with colour. A

while or red rose gives no Idea of the smell of it. There are perceptions of touch that manifestly blend with both taste and odours, such are the acids. Heat and cold do also blend with these perceptions of touch; these are still ambiguous between the chemical and mechanical, But impressions made with small points will imitate those of heat. These views very strongly combine the analogy of the manner of operating explained before; and apply very probably in the operation of medicines either with or without perception to be considered in another place. —

Lett: XLVIII. Jan.y 29.th —

I was yesterday upon consulting from compound impressions, I go on now to shew on what reputed sensations are simple or compound. Most of them suppose external existences and we seperate ourselves from other Bodies. We consider them as seperate Bodies in so far as they appear detached. We seldom take one body from a meagre impression. But we receive a variety of impressions from it & entertain a number of sensations; this is their qualities. Since the human understanding and in consequence volition. Most of our sensations may be renewed by memory without a renewal of impressions. This gives the formation of one principal complex Idea: This is properly consciousness. Upon it it depends that we have a consciousness of our own Identity, and also that of objects perceived at different times. Next, the mind in passing from one sensation to another, has a new perception arising from the two considered together; this is what we call relation; and it seems to be infinitely diversified but may be reduced to a few general heads; I think to three. First to that of coexistence in place and time; Hence the relation of above and below, hither and thither; first and last and every consideration of motion. The second head is that of resemblance or dissimilitude of other qualities, wherein particularly we observe degrees, and comprehend every thing of propriety or diversity. The third head is that of cause & effect: It arises from observation of space & time but occurs wherever we observe a complication of new existence and new qualities. I am inclined to mention two relations more particularly belonging to one of the three former heads but requiring to be mentioned seperately. The first is the relation of qualities to their subject. Whether we be right or wrong in our perception of objects, we take all their qualities in by referring them to one thing. Ano-

this particular thing is the relation of all other bodies to ourselves, but in especial manner as giving pleasure or pain. We necessarily perceive the pleasure and pain of other men and of all animals, and we extend this perception to others in proportion as we may have sympathy for them. It is not I call interesting relation. It is in this that what we call judgement, chiefly consists. All intuitive judgements are nomore than perceptions of relation perhaps. But of it I shall say more hereafter. ——

I go on next to speak of memory; having hitherto spoke more strictly of sensation.

It is a law that two Ideas, being so connected that when one of them is renewed the other is necessarily renewed also at the same time. And it extends further, for that Idea renews a third and so on ad infinitum almost. We can perceive plainly on what it depends, viz: the relations just now marked. It is only related Ideas that are thus associated in the memory. In the first place the relation of space and time, but more certainly the relation of resemblance at the same time; and still further when cause and effect are added. Also the relation of qualities to the subject afford a particular foundation of association; and still more re-

markably all interested relations afford it. A most curious particular is that we not only associate one sensation with the last, but upon any sensation occurring, we compare it with one laid up in the memory long ago & indeed with everything formerly laid up: Hence you see how relations come to be; and hence the arrangement upon which depends the whole of our knowledge. The memory is in this respect a common place Book, according very much with that, which, I formerly laid down in my chemical Class where every impression is set down without order, and afterwards arranged by reminiscence. I observe further that the power of memory, or firmness of these associations depends upon various circumstances. First upon the nature of original impressions whether dependency upon attention or not, being given, depending upon the force of original impressions; and that again being given the memory depends upon repetitions. We distinguish between sensation arising from the object and the renewal of it by memory. Our Ideas become weaker in the last case than in the former;

fainter & fainter the greater the distance of the time from the presence of the object. Next the Power of the memory depends upon the distinctness of our complex sensations; for tho' these consist of different parts, we readily refer them to one and take little notice of the rest of the ingredients. We have an Idea of a thousand faces in their absence; but we would give an indistinct and imperfect account of the features. Yet they are more durable in the memory in proportion as they are more distinct. Another is the perception of the relation of one body to another; the better this is marked the better do we remember it. Pain or sensation, pleasure, or pain and connected relation or occasion that their objects are more distinctly retained than many others. There are likewise foundations of memory; I have mentioned in what manner it is lost; first from length of time and want of repetition; for want of various relations; that is the exercise of them from want of the exercise of association; and the circumstances point out how much the same faculty must strengthen by exercise. The memory is different at different times of human life according to the state of the sensorium commune. If we reach infirm and becomes stronger with age, Memory is considerably different at the same period in different persons; this may depend upon the state of the organization. I only mention one or two general distinctions in our memory. The first is that some people's memory is founded in the sensual or arbitrary associations of perception only. Upon this it is established that the most arbitrary signs may be agreed upon among men as marks of Ideas. We agree upon sounds or figures if these are but connected by time; they come to be ever after, of power enough to renew the Idea by observing that figure or repeating that sound. This is the foundation of Language & writing; which have no other relation but merely the most simple one of place & time which unites them forever after. It is not necessary that one figure should appear, but any other figure presented along with that animal will answer equally

264 well as its own: Now the use of this is that some have a memory depending upon place and time, which is a memory without judgement. The memory of others again is most disposed to observe the resemblance of cause & effect. And no great judgement can be without a great memory. It is this last memory that in its diversity gives all the difference of humane genius. A great deal might be said in explaining that general portion, but I must pass it over as less concerning my subject. But it is of the utmost importance to observe that memory depending upon association is faithfull to portion, order &c. The sensations are recalled in the order of time. Hence an ordinary train of thinking that must be spontaneous. It is here that to a certain degree we have the power of diversifying this, while our organs remain in their healthy condition. ——

Let. XLIX. Jan. 24 ——

Tho' the objects of our attention are prodigiously varied, yet the heads of Relations are but few: and with regard to one particular relation its heads 268 are not many. We find a spontaneous and almost absolutely necessary train of thinking. One man will mark relations not common such as the foundations of wit, but they must be natural and obviously just; and as the eye passes from one object to another so does the mind from one train of thinking to another; and here too is a foundation of difference of judgement. When a man acts and thinks consistently with the surrounding objects he is said to be possessed of common sense; he follows a common & ordinary train of thinking. It is by the contrary inconsistency that we distinguish between madness and soundness, dreaming and waking thoughts. There is an intermediate degree in this respect. On different occasions in different men we perceive more or less promptness or attention, and if for various purposes on life that be interrupted it must be renewed again. And this in a person capable of it we properly call presence of mind. Some cannot bear an interruption without being thrown into confusion. The chief circumstances of interruption are all those that are attended

with passions which threw him into a flut-
ter. Further memory is exercised two ways sum-
ming by different. The most ordinary is where sen-
sations are only renewed. And some times memory
renews it with all the force of the first object
which made the impression; In that case I
call it imagination. I go on now to observe
that the ordinary case of memory is that some
external impression first causes a sensation, &
the mind passes to some Idea relating to it &
the whole can be traced back to some external
impression. In delirium the Idea is renewed
without the external impression. Its diffi-
cult however to say when the cause of Dreams
or delirium is placed in the mind, and not in
external impression, such as uneasy posture
&c. The action of the internal may be doubted.
But as we perceive that the internal sensations
can be excited by the beating of an Artery in the
Ear &c when the eyes are shut; and as we see
in so many instances Ideas excited without
being able to trace the external impression,
there is no doubt but that Ideas may be re-

newed from internal impressions. If they act
upon the extremity of the Nerves, I call the cause
internal corporal. In delirium & dreaming two
things are to be observed, that the Ideas are near
to sensation, & are therefore more Imagenation
than memory. In some measure they are actual
impressions & therefore tho' made on the senso-
rium they may have the same effects as if made
first on the extremity of the nerves & afterwards
propagated to the sensorium: & hence we judge
of Delirium in proportion to the force of sen-
sation. Another circumstance is that the Ideas
are incoherent and inconsistent. I shall give a
theory to explain that. As our waking thinking
can be interrupted by impressions supervening
so it is probable that impressions are made in
different portions of the sensorium exciting Ideas
mutually interrupting each other. There is but one
law of association which operates the same as
in our waking thinking; And if it was not
for the interruption of different internal im-
pressions the Brain would be consistant: Pro-
bably it is owing to the sensorium resisting the

passage from one Idea to another; probably to the sensorium's being blocked up to a certain degree not allowing this passage of or from one Idea to another. The whole business of memory is connected with a particular state of organization, and being open in one place and shut in another, it produces incoherence in dreaming. A greater frequency of dreams is to be considered as the first step to delirium. But when I said that dreams might be some times coherent, I did it to observe further that their force is more or less according to the more or less freedom of the sensorium, which in some places is very free and gives an easy train. But without violent & strong impressions the chance is in favour of connection; hence the somnolenti will get out of their bed and walk with more steadiness than when waking. This foundation of what they perform is either founded in passion or in which may be considered as a passion. Most of those people that doze set up generally beat those who are sleeping with them. A

physician beat his comrade in this manner, & 269 was afterwards cured of rising in sleep by his companion keeping him inside and making application to it when ever he attempted to rise. A man sleeping will walk with steadiness and safely along the ridge of a house top; which is not surprising. We could do that as well waking (as we can walk along a line on the ground) were it not prevented by fear and attention to surrounding objects. It has been a question to what degree the eyes are open, in such case it might be supposed the attention would be called off. Certain it is that in many cases it happens with the eyes open, and yet the attention is still confined to one train and what relates to that. You will, from all that we have said readily understand why in running over a myriad of relations, we can hardly avoid interruptions from occasional impressions. Silence and darkness are favourable to thinking. We are prevented consistant by surrounding objects, and the concealment of our own Identity; and when we are in danger

of losing sight of that in Delerium and dreams, it is only to be remidied by presenting to us the impressions of objects and those most familiar to us. Chaucer gives us a story of a stupor from a fall; the man at length recovered, and first of all had a perception of sounds & voices; he heard them speak of a wound, but never applied it to himself, till the return of more of his sensesenable him understand that he was spoke of. The sensorium is shut up to a greater or lesser degree; In a stupor the eyes are closed before we lose our sensibility, & the ears are open; and so when patients thus affected recover, their ears are opend which they may exercise for a long time while the portion of the sensorium, that should allow the opening of these relations is still shut up. The ears may be awake without giving that sensation that will restore us to our own Identity, and therefore the eyes must be open. We may conclude that in recovering Ideas we are limited to the objects of sight & hearing. We do not observe that signs preceded answ the purpose both of our intellectual and moral operations. It limits our pleasure but it prevents the

imagination of pain, the sense of which we can not recall. Yet it is to be noticed that the fainter impressions of the agreable or disagreable are all easily renewable; but what is more to our purpose is that tho' we do not renew the Ideas or sensations of the Body without their signs. We can renew our irritability though not our sensibility, as when we are hungry, in the case of victuals and so also in medicines. A sight of Ipecacuanha will renew the motions which the former exhibition of it occasioned, tho the exact sensation of its taste is not renewed. —

Lect: L. Jan^{y}. 28th. —

Yesterday I forgot some particular applications as for instance, that there is a curious law in our memory, as to signs which tho' not sufficient to renew sensations or reflex ones of pain or pleasure, yet oft renew desires. I forgot altogether that as the memory is a renewal of signs and Ideas, there is something which we call reminiscence. If I see a single object I have seen before

I immidiately recollect I have seen it before. We first lose our memory of signs, next that of things, and last of all, that of reminiscence, or recalling the former seeing of an object from a second sight. I divided this subject into two: the one sensation the other reflex sensation such as pleasure & pain which is will or volition. Hence desire & aversion. All this which belongs to the will is divided into agreable and disagreable. Authors have made a third head, of Indifference or indifferent, whether this third is real or not may be difficult to say. It is certain that many things may be such, as very little or not at all to concern us.

Pleasure

is not to be defined. The pleasure of Colour & sound give so many specific sensations as I can not attend to now. Common language has given us no steady foundation of difference between agreable and pleasant, disagreable & painfull, but there is a difference: every body knows the difference betwixt the agreableness of Colour & the disagreableness of the tickling of a feather. We call these pleasures that are received by the

eye the Pleasures of Imagination & therefore mental. We perceive a gradation in our different sensations, as for instance the pleasures of imagination hardly seem to make any impression on the Body. Next to these are the pleasures of sound which are more evidently corporeal; but from their harmony and lasting impression on the mind they are considered also as mental. Those of smell which without the object are not to be renewed are purely corporeal. Taste is a corporeal pleasure which depends upon a nearer contact of external bodies, and which we refer to external Bodies or our own; and of this there is no memory, it depends always upon present impression. But as to thirst and hunger their degrees higher and they are reckoned among the corporeal or sensual. The other as connected with the appetite of Lust are more powerfull in agitating the whole frame and are considered in the highest light of corporeal & sensual, & give the greatest pleasure. In distinguishing these, to the first we would apply the term agreable to the last that of pleasure. In

274 this gradation there is something very consonant to the theory I spoke of before. I also view the matter on the other side. The disagreable[ness] of a trapizium compared with a square is considered as quite different from the cutting of a knife; the last we refer to the body and call Bodily pain. All sensations of touch are more properly painfull; also perceptions of sound are painfull, but they are a communicated sense of touch; All the other modifications of these senses that are not pleasant we call disagreablings. And here is a gradation. In passing from the ugliness of form to the harshness of discord the horrour of putrid and nauseous, these are degrees of sensation of which the last approaches to painfull. But among the disagreable sensations there is a kind distinct both from the painfull & disagreable strictly so called. These arise from a perception of the different state of our own functions, and which we distinguish under the title of uneasiness. Our sensations of touch are often our sensations of the state of our Body. And accordingly disagreable taste often with the state of our Bodies, and you can hardly

distinguish them. Among st the uneasy is first the want of impressions, the want of new impressions, the sense of debility, torpor and langour, of interrupted thinking, confusion of head; the sense of interrupted circulations, of interrupted digestion, evacuations & ungratified appetites. I have subdivided the agreable into the agreable & pleasant; the disagreable into the uneasy disagreable & painfull; to the first of which I can give no relatives: yet the pleasure of motion as that of sailing, of riding in a machine & flying which we have not thought of; and skating which I have liked because it approached to flying, may be considered as corresponding to uneasiness. There is a pleasure from facility, alacrity, and rejoicing in bodily exercise, and lastly in the gratification of pleasure & apetite, which last tho' it approaches to pleasure, yet we distinguish between the indulging in these, and the pleasure we receive. Now all these may be considered as corresponding to what I call uneasiness. The application will certainly come afterwards. Now I would wish to consider the degrees of both these

general heads. I will attempt arrangement.—

On the side of the agreable is first sensation; next new sensations to be considered as diaphorous; next perception of relation that amounts to the perception of truth, and in a great measure that of ability; and the perception of truth will run very high if our own invention; next is gesticulation, then bodily exercise with facility, alacrity and vigour. The pleasure of strong drink is of a mixed kind; the effects of it may be to give facility, alacrity and vigour in acting and thinking; therefore it belongs to the head of easy thinking or of easy motion. In the more specific sensations depending upon particular organs, we put as the lowest, perception of beauty abstracting from motion, & the sense of the beauty of the sex. next to figure and colour are the perceptions of melody and harmony, which too, are to be abstracted from motion, next is taste without apetite. then I put as in a higher degree of corporeal pleasure that of fragrant odours. Next comes the sense of titillation without apetite: Next pleasure in the cessation from fatigue: next indulging our propensity. Our yielding to sleep and fainting. But there is likewise a propensity various and not to be limited here. First titillation with apetite; next the pleasure of taste associated with its gratification of apetite; and last of all, the gratification of passions.— the gratification of some apetites may be in a higher degree than that of some passions. It depends upon the greater or lesser degree of sensibility.—

A scale of disagreable sensations.—

First is want of impressions: next is want of new impressions; next want of accumulated impressions. Often habit introduces artificial apetites the want of which is often attended with a very high degree of uneasiness. Next the cessations of pleasures in their nature not satiate, as in the case of taste and smell which are soon satiated: then of the ear which are much longer, & of the sight which as scarce at all satiable. Next the perception of interruption or confusion of head. Next follows sense of interrupted motion, in stupor, torpor, Languor & debility. Next occurs a sensation of deformity providing it is not an object of fear. Next harshness

of discord. With music in exciting an uneasy passion is ever to be considered as disagreable may be a question. But I deny it because while the pleasure of commiseration we willingly indulge them; therefore I mention simple discord. Next a general sense of disagreable feeling takes place as more strong than the sensation of deformity or discord. So when I touch a woollen cloth, & more so when I touch velvet or plush, it throws me almost into a convulsion. Next nauseous taste and foetid odour, as in very different degrees, it may be doubtfull which should be put first. Next these is lassitude. Of a higher degree is what we call sickness; and still higher is anxiety. Next is the restraint of propensity; than that of apetite, and lastly bodily pain. With regard to these three last your experience will determine you to estimate them very variously; and your estimate upon the whole may be disturbed. Nor will I answer that it is right; different constitutions and Idiosyncrasies may vary the matter. But still an apetite to accuracy tho' we do not exactly come up to it is usefull.

It is necessary to mark out so many kinds of organity. I have avoided species & reduced them to genera. The disagreable I said belonged to external objects the uneasy to the state of our own members, the Painfull to . On the other side between the agreable & pleasant I can only find different degree. Next I attempted to distinguish the degrees of the different kinds. It is but an approach towards accuracy; it naturally has me to some arrangment in the different degrees I said it might be usefull on various occasions. I would wish to enquire upon what corporal state are founded the different degrees of pleasure & pain. I said that with regard to species they were in a sort of compound ratio of the degree of impulse & sensibility taken together. It is more doubtfull whether that applies to the different kinds. The effects of kind as well as species depend upon age, temperament &c. Mere sense or pain very often depend upon a succession of impressions as is evident in the affair of melody. Something of the effect of sensation seems to constitute the whole of titillation and there is something like this in taste & smell. Odours

that compound impressions were more obstinate, perfect, perfect in green, less so in purple. And from that perfection or imperfection an agreable or disagreable sensation arises: It is evident in sound and in the case of smell. All this may apply in the case of the species tolerably well. But genus can not on many occasions be referred to force or impulse. We are equally frezzled by a white ghost or sheet as by a black dead. The modifications of the mind occasions this. This consideration of pleasure or pain is part of a large system which I can only sketch here in the way of enquiry.

In what conditions or circumstances the perceptions of *Pleasure* or *Pain* found our moral volitions. —— We call this desire or aversion. Hutcheson says the one is what we will and the other what we avoid. And others go on to obtain good or evil from that: But their words communicate no Idea. I can not explain it: for it is enough that they produce this new motion in the mind. Next I observe that the sensations of pleasure or pain, when they give motion do it always with a volition, a propensity or inclination. The power of breathing mind is not voluntary

we can not excite it without a particular feeling in our intestines. But yet the effect is often restrained by decency or good manners. But it prevails seemingly against our determination and therefore is called involuntary: But I believe we are actuated between contrary motions of which the stronger prevails. However I know no involuntary motions but when we are not conscious of the impression or motion following. Inclination, propensity or will always prevail. I would willingly yield this to the opinion of a certain principle, because we know that by habit any motion may be inlarged or restrained. Tho we have a general propensity to yield to motions on cases of uneasiness yet we do not know what sort of motion shall follow, nor to repeat the same motion by any effort of our will unless the original sensation is renewed. We make a number of random motions because we are acquainted with their fitness; such is the motion of yawning, hiccup, stretching, sneezing, coughing, vomiting or stool; they can be in a certain degree restrained by a contrary motive; a man when he would cough may be hindered by a pain in his side, and like instances will apply to the rest. When sud-

when are under the operation of a vomit; they certainly hesitate between the propensity excited and the pain of the motion: it is at length determined by the motive that preponderates. All these are the motions then with propensity. There are others that arise from an uneasy sensation, with a particular propensity. The first time a man enages he doesnot know the action to follow. That action so intended and fitted to that purpose is unknown to us before experienced. In this case the particular action is with a blend propensity: and the will can not excite that action with out the state of the Body is actually renewed. These are the several apetites. Biting, chewing, swallowing, are determined by the apetite of hunger without our knowing their fitness. These last are without regard to end and purposes. A child has no apprehension that Victuals nourish his Body. I need not say that the Animal purpose in affairs of venery hardly enter into our thoughts. Particularly I must observe the power of the will in exciting these motions. In the case of the apetites these are founded in a particular state of our Bodies, but are connected with

external impressions that prove incentives to them, and that will affect them differently. Thus when a man is satiated he is difficultly excited to chew or swallow by the Odour even of the most savory meat or the pleasure of taste; But when he is less satiated it is certain that these external incentives will renew the desire. Every body knows how long the morsel will be lurked in the mouth before it can be thrust over the fauces; A circumvention is given of this by Oldanies; A man with an ulcer in his throat refused food because he had no apetite & had it not in his power to swallow; but an apetite arising spontaneously he could swallow easily and swallow a rough morsel without that pain which he had felt before on the slightest trial. In general with regard to all our apetites that of hunger in this respect is the most resolute. We can the least command the motions of that apetite; As the taking of drink is adapted to a greater variety of purposes so we have it more in our power. And last of all are we restrained in the apetite of Lust. Now having observed how far the motions of apetite are in the power of the will, let me observe that even the propensities and

often be in our power to remove. If I can call to my mind a very nauseous draught by merely the recollection of that I can excite vomition, which many people in fact can do; and by looking at a badly picture we acquire a power of the will to remove. In our appetites tho' we do not feel it there is a pleasure to be obtained by the final gratification of the appetite, separate from that of the gratification itself. This leads to

Design

Now we have instance in all our other emotions and passions that consist in a desire of producing actions. Many call that will, only a desire and a propensity to obtain a good, or avoid an evil. With respect to will I do not perceive the difference, unless in the will there is no propensity. The perception of this end and purpose is not the effect of the volition but the cause of it. I think that human will is of two sorts it is in the choice of motives, which last being determined the will and the actions are also determined; in many cases the passion when violent admits of a balancing of motives and we

call that reason. And it is reason too when there is room for a choice of means. But I look all reason, to me only differ as the different shades of the same colour. If you chose only to call that voluntary where there is an end and purpose, you must still attend that these are determined by perception and the will accompanying, and in either case the propensity is the same. Volition does not always determine the external actions; these are produced by a volition to the effect. I stretch my Body to throw a stone and am very little attentive to the mode of action by which I throw it. These actions are purely the effect of imagination without our being attentive to them. It is nearly the external action of the body, that is, will; we are not conscious of the internal motions of the body. I shall state this more fully hereafter. Under repetition of action the external body becomes much more pliable to it's but it is not from conscious reflection if it is without mechanicks. In any one action more or fewer muscles concur; this admits of a particular application that I have not time for just now. I am next to connect volition with contraction which I owe as much to the mechanism of the Body—

Lect: LII. Feb. 2d

We are to proceed next to contraction or muscular motion. To enquire to what degree the mechanism takes place I am to connect it with all impression & sensation on the nerves. From our being able, more or less nearly to trace nerves, to every sentient part we conclude this; and when that can not be done analogy allows us to make the application. As the extremities of the nerves are the organs of sense, they are such in so far as they are connected with the origin of the nerves. so what destroys that connection destroys all sense. Let us see how far it depends upon a continuity of the same substance from the nervous extremity to the common origin. It has been supposed that nerves are only a continuation of the medullary substance; and comprehens of the medullary substance constantly affluent, the nerves arising from that portion, proves this. It is joined to this that from a great number of experiments it appears that the medullary substance of the Brain is exquisitely sensible. But the continuity of this medullary substance is absolutely necessary to every sentient part. We now return to explain upon what parts more especially do impressions excite sensations. It has been thought that the soul immediately takes up the motion in the extremity; others are of opinion that that motion is communicated from the extremity to the origin. This question affects our system very materially in another place and has been agitated for a thousand years. The supposition of the soul is very agreable to the human heart, but it has on many occasions suspended, interrupted & disturbed our theory. I am cautious of admitting it because I do not know its operations; and I am for admitting mechanism as far as it will go. I think then that the motion is communicated and propagated to the Brain. I say then that there is a continuity of substance and that very uniform, and that is enough for the possibility. But that continuity of substance is equally sensible in every part of its course. Indeed the strictest Stahlians will not refuse that a motion

is recivd in the extremity, and that it is recivd in a part of singular mobility & therefore it is difficult to suppose that, without propagation of motion. You know a maxim that no body can act but where it is. Communication of motion is made where there are contiguous bodies or continuous ones. Thus light falling on the surface of bodies is from thence reflected, and returned [illegible] some distance from that solid matter of bodies. We suppose then that there is a subtile fluid by means of which the impression takes place, or that there is an immaterial agent that takes up that & returns it again. Now we must take up one or other of those suppositions. It is enough that the soul perceives on the nose & acts upon the diaphragm and muscles of the abdomen producing sneezing. If there are communications of motion without intervention, they must be by being made to a common origin. Further it is rendered highly probable by compression, ligature &

in interrupting all sensation and impression. The Italians say though the communication be necessary it may be for other purposes than a communication of motion; and they say that ligatures do not destroy communication from the extremity to the origin, but by preventing some thing coming to it from the origin. This opinion then of mine is most simple and highly probable as supported by other arguments. May we often sensible of it as in the aura of Epileptics & hysterics that attend sensations, as in deliquia animi &c. perceive as of a somewhat moved along our limbs we trace it till it comes near the head & by arriving at the origin all sense is destroyed, and only very irregular motions produced. A motion also arises along the intestines to the stomach and then to the lungs and last of all suffocates us. Now it is not enough that we perceive that but we know that a light ligature prevents its further progress towards the origin. This has at all times been admited as a proof of what I have advanced. Another argument

is the singular phaenomenon of a frequent sensation which a man refers to a formerly received foot or hand, as if it were still there. Now these feelings shew that that part of our sensations, referring us to a part imprest is no proof that the impression is truely made there; and proves that the impressions are made upon one place and the sensations on another. So many reasons are given for perceptions arising only in the common origin and the sensation being in the extremity of the nerve.—

Sensorium Commune.

It is fully manifest that all our perceptions are strictly perceivd in the sensorium. I say first that the whole of memory, the simplest act of reminiscence depends upon the origin of the nerves. Innumerable histories shew that memory is impaird or destroyd by various morbid affusions of the Brain. And there are others that prove that the diminishing of the memory depends upon the affusions of the Brain only. The liver may be schirrous and yet the memory remain perfectly intire. But on the other hand almost always when the

memory is destroyd we can presume a particular change in the structure of the Brain. By the Brain I shall always mean the common origin of the nerves. The proofs have gone so far that many have supposd a particular mechanism in the Brain, as D.r Bloch — Astruc in France, & D.r Bonni have all offerd to explain it. But they have not done it so as to supersede a sentient principle. I will adduce two proofs; the first is that our sensations or ideas may be renewed by impressions made directly on the Brain independant of the external organs from whence they are commonly derived, and that these sensations are in the same condition as formerly they had been perceivd by impressions on the nerves. With regard to these, I observe in delirium when there has been no corresponding external impression made, it is not easy to suppose that they happen from motion directly excited in the Brain. In many instances we can find the change of external conformation, and a fuller impulse of the Blood may be excited as in delirium and dreams.

But I observe that they are only renewals of impressions that at first had arrisen in the usual way. Dreams have most usually a connection with the actions of the preceding day, as is illustrated in Shronicles and Spencers fairy queen. Now complex Ideas are formed as in imagenation, but whatever novelity attends them they are always such as have been received from various external impressions. Now it gives the strongest presumption that there is a mechanism & that there are motions excited. These Ideas are renewed by internal causes, but say they they are renewed by impressions upon the organs of sense not the common origen, as in the rubbing of the Eye. This evasion does not answer. If there be a mechanism, it is owing to a mechanism in the commonoria gin of the nerves. D^r. Haw when deaf retained all his former Ideas receaved by the Ears, and he could renew them. and so a blind man can retain the Ideas of Colour. and nothing can take place here but a decay of memory for want of repetition. When we touch a top side with a stick, we may as well suppose the power of the soul in the extremity of the stick as in extreme parts of the Body, and we must extend the mechanism as far as possible. —

Lect. LIII. Sept. 3? ——.

We must now come to amend in our chain of cause and effect. Newtons Aether was supposed to be the last cause and the energy of the Creator But if I should push that still further I shall will not be thought to hurt religion. We are in no danger of thrusting a Deity out of the Universe, nor a soul out of the system of Beings. The memory I said before was not only fundamental, but carried on the whole train of the operations of the mind. It seems then to be connected with a certain fabrication of the Brain; and morbid affections of it impair or destroy the intellectual faculties. Nor even the destruction of the medulla Oblongata seems to affect our mental operations, tho it be a sensorium in some operations and a source of motions in others, and when it is affected the constantia mentis continues still intire.

This then shews that the several operations depend upon the Brain. Now the operations of volition are equally connected with the Brain. The soul is not totum in toto & totum in quaelibet parte, according to the unintelligable cant of the schools; we must not talk so vaguely. If there is then such a seat of our mental operations external ones must be communicated to the extremity of the nerve, and from thence propagated to the sensorium commune. Others have placed the soul in the glandula pinealis but without authority. This I wanted to settle as a source of muscular motion. All this is a commentary upon the 365 & 366 paragraphs of Haller to whom I must now return and follow closer hereafter. N. 372 "De anima vide &c" I hope I have given them under an order that will contribute to our understanding them better. Now as to muscular motion small elasticity seems to take place; in the one hand loose cohesion appears, such as in the medullary substance of the Brain, and on the other the hardness of bones precludes our conception of elasticity. we call this elasticity. The extremity of the

nerve on which this experiment is made must be fed otherwise it can not be elevated. This is in common with vegetables & in the contractility that Haller calls the vis motrix as in the 333 & 334th he explains, nam & a frigore &c. Result of that belongs to the vis motrix: At the same time in several parts of the living animal Body, there is a contractile power very different from this elasticity, when it is excited by stretching, however its contraction is much greater than the force of the stretching power. No body can find that the contraction of expeling the blood from the heart is in any proportion to the force of the venous Blood, and it takes place without the extremities of the part being fixed, as in the unloading of any part cut out of the Body; thirdly it is excited by various applications that have no such analogous effects on other elastic bodies; thus the pricking of a needle will produce convulsions in several parts of animal Bodies. Also the stretching power produces contractions in very different circumstances, from those in which it produces them in other elastic Bodies. This contractile power is vested in the organs of life, &c

called Irritability, & by Haller *vis insita*. Look at his 4000 P. & following one, where he distinguishes three different powers. "Vires manifestæ" and as to the particular application he supposed). I say this contractile power, vis relativa or vivax, of Haubolds is peculiar to muscular fibres. It is in them, especially the fibres in the middles & softer parts that have this contractile power; and we speak of muscular fibres in seemingly very different circumstances. And we discover them by their irritability and contractility; altho' there should be a difference in their colour and appearance. Forshaw says this power is not every where the same; It is however difficult to say this; for we have not yet perceived any different grounds for thinking of a different organ of motion. There may be a difference of organization that deserves to be distinguished by the degree of irritability. So in tendinous and muscular fibres it is a dispute whether the latter is not a continuation of the same structure, the difference being in the cellular membrane being diminished in the tendons. Others say they are not a continuation.

Haller discusses this point pretty fully, without a certain conclusion; tho he leans towards the side of denying tendinous fibres to be a continuation of the muscular. But in 339 P. of his last work he is still less confident, he puts it by way of question. Anatomists are by no means agreed in this point, but it is enough for me that the term stands for the continuation I speak of. If there is a continuation here, and the arguments adduced in favour of it be true, viz: that the tendinous fibres hardly appear in the Foetus & are constantly growing: If this be so I say there is a gradual passage of fleshy muscular fibre into tendon; in this last we find the continuity entirely disappears. Having explained what Irritability is and shewn its seat, I proceed to say that muscular fibres are the fibræ motrices of Baglivi. The ultimate fibre of a muscle is so extremely minute that we have had no possibility of arriving at its structure. M^r Muiral has resolved the whole into this that they are perfectly uniform cylindrical figures; but we must still think they have a peculiar organization. You must know that many of the various conjectures on this

head are founded upon false or doubtfull facts & such as do not solve the Phanomena. All the that are founded upon the motion of the heart are not to be so derived because many of them are without the hearts action. Give the heart any xplant that any body has conceived; the mechanism of muscular fibre goes as far beyond that, that we must say it is beyond the hearts action. The arteries then are not concerned and muscular motion is independant of these. see 339 just now spoke of; he also 341, where he shews, that muscles may have their arteries tied without affecting them, unless after a long time by putrefaction & gangrene. If there is the xperiment of the inferiour extremities becoming paralytic he has in another place shewn it to be false & inaccurate. Next they have had recourse to a fluid derived from the nerves for the cause of muscular motion. The proof is in short this; that every muscle we can examine has a large proportion of nerve, a very moderate muscle say they has a much larger proportion than that bulky viscus of the liver. Thirdly every means of destroying continuity destroys the contractile power immediately in part, and a little after wholy. Thirdly applications to the Brain have the power of exciting or suppressing, or intirely destroying muscular action. If a muscle is taken out of the Body & a portion of its nerve along with it; it is equal whether you make your application to the Body of the muscle itself, or to the extremity of the nerve; you can by the prick of a needle equally excite contraction in both. Here I must add that as the whole operations of thinking are in the brain & dependent it; so I think that every modification of thought, suppressing muscular motion desist by some thing propagated to the Brain from the extremity of the Nerve. If there is any such communication of motions as is independant of perception, it applies equally well to that motion being brought back to the extremity of the Nerve. If I provide a motion from the sentient extremity to the common origin and that that excited motion on the muscle, the communication must be allowed

Lect: LIV. Feby. 4th.

Having talked of the contractility common to other Bodies, & that peculiar to living animals

300 I called this last Irritability, and said that it depended on muscular motion), which depends on a particular organization. There have been two opinions concerning this; the first is that muscular motion depends upon the force of the heart, and that I refused; the other depends upon this power being derived from the Brain. The first presumption arises from every muscle having a Nerve; and it would be a further proof if we could shew that tendons are condensations of Muscles. There is a presumption arising from the continuity of the whole course of the nerve: for the extirpation of the nerve separate from its origin seems to destroy every effect of the muscles. Further as various modes of thought act on muscles they are thought to do so by propagating a motion to the extremity of the nerve or Muscle. Impressions made in the organs of sense excite the action of muscles with which they have no other contiguity than what is thro' the common origin; and we will allow that the motion may be continued thro' the Brain to the motory extremity. But the Stahlians evade all

those arguments, and transport the soul to 301
the motory extremity, there to act. It was observed that on tying an artery the irritability of the muscle might be excited by applying a ligature between the muscle and the ligature; shrinking it down-ward excited motion & a contrary application had no effect; but this is not true see Hallers 377 P. 11

N. This has the appearance if the reasoning was fair; but I do not see that it is conclusive. While the muscles receiving nerves from another branch of a common trunk are not affected, in answer, in answer to this I say the muscles proceed distinct & seperate from the common origins; If an impression was communicated to every nerve of the same trunk we should have very indistinct impressions. No wonder then if their motion is not produced upwards along the same Branches of a common trunk. There is no distinction between motory and sentient Nerves; and every nerve is sensible to sentient impressions; for particular impressions there must be a particular apparatus; as in the Eye and Ear; but whether of a per-

cular or common organization, all this will be sensible to the pricking of a needle. According then as the extremities of the nerves are drawn their motion may be upwards or downwards.— However tho' in these two views we fail of our proof we have it in another way. We said yesterday that communication might be avoided. Here all suspicion of the souls action is removed in a cut out part, no volition here has the least effect and therefore the soul is out of the question in nerves tied or cut through. But the same stimulus that would have excited contraction in the entire nerve excites it in its tied or cut state, & therefore I think it is even more clear than in the former case, that there is a muscular motion from the common origin along the course of the Nerves. See V. 367; 368, & 369, of Haller where he forms this conclusion"

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" and adds a singular exception "nique aliter
" comprobari". This comprobation will offset his own doctrine in another place; in the 403 V.— Now we have shewn

that a nervous power depends upon a motion propagated from the common origin along the the course of the nerve, but this does not go far to explain muscular motion; the motion is still in the organized fibre. Haller spoke of the Laquei of nerves surrounding the blood-vessels, but he himself and all others have described that opinion, therefore nothing needs be said of it. There is a peculiar organization which by the assistance of the nervous power exhibit these phenomena. Haller is of opinion that it may be independent of the nervous power though excited by it. This last he calls the vis inerta of muscles, and he supposes this to be something residing in the gluten; I find no other foundation than one set of experiments to support this opinion, that muscular fibres seperated from the stock of the Brain, have still their irritability not depending upon the common laws of irritability, See V. 400 & 404. I say this opinion is chiefly founded on these facts I mentioned that it may be some thing belonging to the muscle itself. We can not only form another supposition

but one very admisable. If then there is a nervous power that excites muscular motion it adheres to the nervous matter while the conditions of heat & remain the same and it is highly probable that the muscles are always filled with this power derived from the Brain to a certain degree; All the different impressions mentiond before, are constantly acting, and on a matter of the greatest mobility, and therefore there must be a constand determination from the origin to the extremity, giving them their common power; and a presumption is that of such a power be destroyed muscular contraction ceases, and that even tho the heat, humidity, and other necessary conditions remain. We say the nervous power is constantly diminishing, therefore it may for some time remain to shew the Phenomena of irritability. This last, as I have said, goes on constantly diminishing & therefore wants the constant supply. And still further there actual proofs of nervous power acting even in seperate muscles. If we have a portion of the Nerve and hurting it is all one whether we apply stimule to the portion

of the muscle or the cut of extremity of the nerve. Will any body doubt then whether or not excite this motion by an impulse communicated or will any body seek any other impulse than that derivd from the Brain? This at last takes off all the proof of a vis insita which is an opinion depending upon excluding one other cause. Also if we acknowledge that the nervous power acts occasionally it especially arises from hence that the same impressions that produce irritability are all such as act upon the nervous power and produce sensations, therefore the contractile power of muscles depends intirely on the nervous power, and there arise no other proofs of a vis insita. And yet in the P. 402 Haller has two other arguments "

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" "Ubi nihil valde" I must refuse. He goes on "

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" From what appears

in insects and plants" says he" it must depend upon their structure. I acknowledge that irritability with all its circumstances appears in plants, and I own it to be a like irritability to that of animals, tho' there may be a difference in the stimuli: but as see how it affects our question. There is some thing in plants that seems to be very analogous to the system of animals; there are distinct fibres proceeding from a common origin; as in the nervious system: You will se a ramification exactly resembling the vessels in an animal. But now we know that that is a seperate connection and that each of them is a bundle of fibres distinct. Further late experiments shew that these distinct fibres of vegitables are not tubular or hollow cylinders, as we supposed and that they are spongy humours filtering along them. Now let us see if this irritability is a vis insita residing in the seperate parts & un connected with the whole. We find them in the most sensative plant that when a part is seperated it is no longer

sensative; it depends upon a principle of life diffused over the whole, and every part supported by a communication with the rest. Whether there is a Brain in Plants is very uncertain, but granting that there is no such thing, can we limit the operations of nature & say that a subtile fluid is not contained in a common origin. It was made an universal axiom that love animals of different sexes were necessary to generation but Reaumur has shown that a single animal can propagate the species; It was also a universal persuasion that only vegitables could be propagated by cuttings, but we now see that Polypi can be propagated by this means as well as vegitables. Now there may be an irritability depending upon the nervous power diffused over the whole system. As to insects his arguments are falacious. We have found several insects possessed of a Brain which we thought to be without; and we may find the same thing in the rest. We may be too limited in our notion of Brain; it may be in different shapes in different animals; still exist-

ing through it escapes us and answering the purpose of a common origin. As to nerves not being discovered I answer if a Brain escapes us so may Nerves. There are animals that seem to approach to a vegetables in having a nervous structure without a Brain. Natura non facit saltum. It is probable that there are on the one hand, animals that approach, in small reptiles to vegitables, & on the other there may be vegitables that have a vascular system & approach nearer to the animals. Therefore still there is no presumption of a vis insita. It depends upon a nervous power concurring no doubt, also with the assistance of the organization of muscular fibre. —

Lect: LV. July 4th. — . —

We shall reap no small advantage if we can reject several errors that have crept into this subject. So I have rejected the vis insita of Haller. Having done so and confined muscular contractility to the nervous power as one necessary circumstance, we ought next to say what further is necessary from organization.

As to the nervous power there are two opinions. The one is what we have excerpted by an inelastic fluid moving through the tubes of the nerves; The other is that it is by an elastic fluid adhering to the nerves. We reject the first of these opinions, as an inelastic fluid can not account for the velocity or force excited in nervous motions. The other seems at present grounded and is resolved again into two opinions: The first is the motion of such a fluid as we know to be the foundation of tremors of elastic chords; the other supposes it to be an elastic fluid but such as may be propagated along soft chords. Again we reject the first of these opinions which turns upon elasticity and tension, as there is not tension enough to support the opinion of the motions depending on elasticity. I therefore embrace the last. There is difficulty in admitting even this opinion which would have been greater 100 years ago. But since Newton established an Aether as the foundation of attraction of cohesion; and since, the Phenomena of Electricity and magnetism have both presumed as with

310 different species of subtile elastic fluids, we can have less difficulty in admitting it in animal Nerves; and the Phenomena of the nervous System such as that of titillation confirm this; and further the several impressions upon our organs of sense producing all these make for the opinion of a nervous elastic Power. And if the motions consist in an oscillatory motion, the probability is that it is performed by an oscillatory fluid. However to say of what nature it is more particularly, we shall find it difficult to say. It has been common to suppose the nervous fluid of an electrical nature; but I must own I find no proper foundation for this supposition. With regard to all of these elastic fluids it is manifestly related to them all, as all of them are remarkably related to each other. But they may all be considered as distinct & the elastic fluid of the nerves may be looked on as one. Before I leave the subject I must take notice of what Haller says on it in the P. 379. "

" tamen ". In P. 308. he says

" orirunde ".

These are all the several proofs of it's being a liquid or elastic fluid; only adding to it that there is supposed a suction of it, and the nerves considered as the excretory organs. Haller puts by way of question "

" by this last paragraph it is the Phenomenon of the hydroanatomicus by which any single drop of water may be made to move any given weight. The force by which nervous motions are performed may be explained by it. But the celerity by which they are performed and which shows the inverse proportion of the cause to the effect serves to refute it. Balexus goes on in the next paragraph to add "

" habere ". In that we perfectly agree with

him and what he further adds "that it is a very subtile and absolutely invisibles without taste and smell" this is probable; but with regard to his other conjecture we meet with considerable difficulties "& irreparabil" we shall take up this when we talk of the laws of this fluid. It is more probable that like electricity, magnetism or election of cohesion, it depends upon mixture and state of aggregation, & always the same when that mixture or aggregation is found in vegetables or in animals to be the same. I say that that being given, it is always the same. I have a word or two more to remark on Doct Haller where he seems to favour its being of the electric nature "electrica materia"

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" vi sua rezunt". Whether electrical matter penetrates the whole substance of Bodies or only enters their surface may be a question. He concludes "aperiet adeo

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cumstance that I would willingly dispute, that it confined within hollow tubes, We can not conceive how it should be otherwise & therefore fixes upon this opinion. But the circumstance of electricity, & claims that, which will without hollow tubes, be propagated 1000 miles of the surface is homogeneous; That there are circumstances which determine electric matter to adhere to the surface of bodies is what we may admit, and like the Author it may be confined to form an atmosphere around the Nerves only; and I think the nervous fluid is an elastic fluid peculiar to the nerves, having a free oscillation to any part of them under modifications. The first modification is, that it suffers in muscular structure & excites muscles into contraction. supposing the fibres a continuation of the medullary fibres of nerves, we can see; it should produce no contraction while involeped in the membranes, because there would not be that room for a circulation that would bring the muscular parts nearer together; And as we maintain the equable continuity of

medullary fibre, there is no occasion for accumulation; & the propagation should be from one end to the other. But we can suppose that muscular fibre acts like electricity per se, and confines the propagation of the fluid; We can go so far and find that the nervous power may be stopt at the two extremities of the muscular fibre, and is accumulated about it. If the circumstances are such as admit of it. You understand how the action of a subtile fluid upon the vibrating of elastic chords, has the power of making them contract, and of bringing them into their former situation. It is but supposing that the muscular fibre has its parts at some distance from one another & that the accumulation is around the parts; and we may only suppose that there is some other state of organization, that is little more favourable to giving the contraction I speak of. I go on to consider the various modifications of this nervous power; It may be excited by various causes, applications, impressions, perceptions, and with various circumstances which may call stimuli. The most remarkable are impressions of external bodies. And as I

have said there may be impressions made upon the Nerves that do not excite perception, so now I mention it to be the case. I need not say we have no perception without consciousness; also that consciousness may be intirely obliterated. And accordingly with regard to many impressions that just now are not attended to with any consciousness, I must say that they never were with consciousness. There was a time in the progress of life when impressions giving perceptions existed before there was any memory, which happens at a certain time of infancy. Haller has even condescended on the time when memory begins; which I would find more difficult. I can conceive that all impressions made at that period may be obliterated since. But when our memory is in full vigour and also our sensibility, If then and in that case there are impressions made without consciousness, I must say that as often as that happens, so often there is no perception. A purgative may operate without giving consciousness till it comes to the rectum. Griping is not a perception of the operation of

 the purgative), it is merely the perception of a spasm producing pain. Therefore I conclude that there are impressions which excite various motions in all the different parts of our system without our being conscious of them. Now all that I say is, that sensibility only takes place when we have been originally or are at present conscious of impressions. But some have extended the term sensibility to every impression made on the nervous power. They may do if they please and look to nervous power & sentient principle being the same. In a cut out part if I touch the body of the muscle so as to cause contraction some will call that irritability & some sensibility. But if I touch the extremity of the adhering nerve I think it would be improper to call it sensibility. And to apply the sentient principle cut out of the body as White does is highly improper. Now all the different causes exciting the action of muscles may be reduced to four Heads. First the purely mechanical stimulis; they are the effects of impulse of motion communicated from one part of matter to another. The second is where there is volition, propensity

 without any consciousness of the action produced, as in sneezing. Thirdly when they are accompanied with propensity and determination to particular action without any view of the end. Fourthly when there is propensity to action but with a view of the end; to this last the Physiologists have confined the signification of voluntary.

End of the first Volume