

Haller 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 Dissolution; he reduces every part of Animal substance to an Earth, & employs Arguments here & else where 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. Haller says by the affusion of Water or of Oil that Solid Bodies after losing their cohesion become firm, & lastly by a gluten that these parts in the Body are united into Fibre, Plate, or unorganized part, all this we owe to Boerhaave, who has been followed by De Forest, Gaubius, & others as well as by Haller. This Doctrine leads to the Notion that Animal Solids are an heterogeneous Aggregate, and that their Parts lay separate, as in a Table or Chair the parts are mechanically united. But every part

of the Animal Solid leads us to think it an homogeneous 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 Matters in the form of Bone, are first a gelatinous fluid. In the Spider web, as an illustration of this, is a subtle 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. It is said to form every Animal in its first & Original state. Haller's reason for distinguishing solids into gluten & Earth, is their separating 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 intimated parts. His experiments of restoring consistency

76 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 Digestible cohesion; besides it applies to no purpose in Medicine 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 farther & 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 perfectly a Homogeneous Aggregate. Were 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-

signing gluten, the Reason is no better than 77 the old Gabbardish 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 propensity of all the Parts. We know nothing of the real mixture of Animal Parts. We know an Acid & Alkali make a Neutral & so on; and the Chemists will venture to trace this question, but it is well known they do so upon the most slight Foundations. I refer the Consideration of this to Chemistry & to another part of our Course, under Gaubius'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 Hays, taken up by Dr. Mebraud, & very fully treated in Haller's great work. Air does enter into the composition of Animal solids & gives us reason to suppose, there may be still other Ingredients, nor is it any more to be con- sidered

78 does as an Ingredient than Dr. Haller's Ele-
ments. Perhaps it being there is a mark
of the Cohesion of the substance, & when it is
removed perhaps the consistency is dimin-
ished. And all the Objections to the common The-
ory 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 Arrangement of all their Parts. If we admit
a Cement to account for Cohesion we shall
have no end of Hypotheses; accordingly Hales
gives, air, Haller, Gluten (this consisting of Oyl
& Water) and else where Iron as a Cement. Brian
Robinson in the second Edition of his Work
intitl'd Animal Economy, with the Addi-
tions that make it a third Edition, has con-
triv'd an elegant & accurate apparatus, to as-
certain the Cause & Principle of Cohesion. His
experiments deserve to be consulted, but must
be divers sever'd if you would receive real Proofs

large from them, from his third to his seventh
observation.

Lect. 10th. Decr. 2^d.

What has been said of the Gluten as a cohes-
ing 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 Degree of cohesion in
Animal Bodies; he has contriv'd a very elegant
and accurate Apparatus, as I have said, to as-
certain it; he has given the various relax-
ing proportions of different Bodies, and
also two Tables giving the relative Powers
of these different matters in this respect. I will
point out some of the more remarkable par-
ticulars on this Head, as I am not to take
up your time with them all. He finds that
upon the Application of any Fluid whatsoever,
Hair seems to admit some Degree of Exten-
sion. And those Powers that do not relax so
much, he calls strengthening. But first Oils
of any kind have very little effect upon Hair,

80 nor does it follow from such an Assertion
that Oils are useful as we employ them in
Medicine & common life; But Hairs from
their polished surface have mislead 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 Alkali would
seem to have extremely little Power. A strong
solution of Salt of Tartar gives an extension
as 20, whereas the Lixivium Tartaricum
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 Pro-
portion of 84, warm water to 80. All vegetable

Acids relax more than the others saline 81
matters, but still less than Cold Water. Two
Oils then have more power of relaxing than
Water. The Juice of Sellaery, of Water Crooked
& that of Scurvy Grass, relax more than water.
The volatile Salt of Sal Ammoniac gives an Extension
of 72, more than the Double of water but
the salt itself does not go so far as Water. Great
We might be got by repeating his Experiments,
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 de-
pend upon different Proportions of Water; those
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
by defer it.

82nd in the VI. "Fibrae vero — scilicet fuerit"
he mentions two kinds of Solids, and speaks
more particularly of Fibre and in the VII &
VIII, of the "Primum & aliis Genus" a
Distinction which I think, evidently impro-
per. The Universality of Fibre in the ani-
mal Structure is not pushed 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 Discussion 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 referred 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 composed of
these (see Hallers Physiology Page 237). The Notion
of Membrane has been that of a Web consisting
of so many Vessels interwoven, as of a Weave

should weave a Cloth of glass Tubes, as you will 83
see at the end of the XIIth Par. "Membranæ vero
— — — — — induruntur". He does not allow
his lineal Fibre to enter into the Structure of
Membranes. Boerhaave said that Membranes
consist of Fibres laid parallel to one another
in cylindrical sinuous convolutions, 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, form a second order, & these
a third, & so on. Dr. Haller has declared against
this as False P. XII "Vasa quæ tunicae
— — — — — super adducuntur" and he explains him-
self by saying that when the vascular coat is too
roughly impacted, that the cellular is by far the
most considerable Part & therefore chiefly con-
stitutes 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 formed to give a
Membrane of second or third Order. In the

86 larger Membranes, the Plexus's of Vessels appear of a larger size, but that is owing to a Bulk of Vessels being necessary. 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.

R. 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 Haller's own confession are not so. But whether the Membranes of the Dura Mater, and Tunica Musculorum are entirely so is the question. P. XI. gives the Foundation of Haller's Opinion "Tunicas autem externa cellulosa fieri demonstrat Oculus". and afterwards

Parti & Membrane Nervi Intestini 85
facilis per flatum in cellulosa mutatur. 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 small, and when the Membrane is filled up with Water or pulled up as he would have it, there is no wonder if they entirely disappear under such Experiments, and elude the sight. —

Lect. 18th Dec. 3^d —

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 doubted as in what are called the Membranes of the Body. Haller says from Maceration they appear entirely cellular and another Argument for him, on the other hand, is that dissections turn evident cellular

86 Membrane into that sort of Membranous texture. But the Fibres are manifestly resolvable into still smaller Threads than it consists of; therefore this Texture may really & truly 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 disappeared in Maceration & all the coats put on the appearance of cellular Membrane: therefore we cannot trust those 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 in this last. And if Du Hamel's 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 87 most 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 thickness be divisible into layers. The Experiments made by the Syphoctonomicus, which is an Hydraulic application of Walfs to anatomy, is the strongest proof of this, by means of which such layers are evidently discovered. However Du Hamel found the Periosteum turned by Disease, he found also layers. The Pleuro-peritoneum, Pericardium, Dura Mater & inner coat of the Arteries,

88 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, & lastly 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 this
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 species 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} ~~human~~
Body. I shall divide it into four Heads; The
Vessels, thro' which the Blood passes; 2^{dly} The course
it observes in passing thro' these Vessels, or what we
call the Circulation 3^{dly} The Powers by which it is
moved in them, & lastly we shall speak of the
Laws of the Circulation. I would have begun with

the Heart, but can not do that without departing 89
too far from Dr. Haller
Vasa.

I shall begin with the Arteries & shall first
consider the substance of them 2^{dly} the various
density & strength of them 3^{dly} their Figure
taken in its circular section, & the proportions of
Arteries to one another. 4^{thly} their course & Ramifi-
cations, 5^{thly} their communications, 6^{thly}
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 membrane.

The true state as in Pl. XXIX. Duo interior &
Arteria propria, eo haec cellulosa densior solidior,
& villos magis est stipata. The external, more
loose till you come to a more dense. There
is no tendinous coat, as by Maceration
the inner part of the cellular which has
been called so, is easily reduced to a cellular
substance, and here Hallers Experiment is
fairer than before, and yet he errs heavily

30 that in this Membrane Fibre is frequently
to be seen, Monsieur de Foe, in the Mem-
oirs of the French Academy in brute Ani-
mals says that he found this cellular Coat
appear thicker than in the Human Body
and thicker in men than in Women. —
2^d of the Muscular Coat in P. XXX. "Intestini
luminique propior ——— exprime-
re". has been of late disputed; It has Fibres
very much arrayed like other Muscular Fi-
bres especially these in hollow Cavities, but
it differs from Muscular structure in
being much more compact. The Mus-
cular Coat of the Intestines is also much
more lax tho' however it is analogous to
it. The same Fibres are soled "Solidatis
satis conspicua" and as it discovers con-
siderable britability it has given great Doubt
whether it be really Muscular or not.
He says "a minorum Animalium Arteris
abscise 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 Senuity 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 Arterio-
rum satis magnum est" Mintringham Ju-
nior, making experiments upon the Arteries
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 Anu-
rism. 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 their
muscular Coat that gives way and occasions
the failure. The Muscular Coat has Resistibility,
and the Extent that it admits of is much more

32 limited, there hardly being any limits to that of cellular Membranes, and particularly in the Vines "Non difficiatime rupturæ, & facile us ferè quam Venarum Tunica" P. XXXIV. but this must be imputed to the want of Muscular Coat in Vines, but it is the internal coat that gives way. So Winteringham found only the internal coat to give way, and not the whole history. 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 mean- 93
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 P. XXXIV.

"ut fluidi Impetus — — — — — minimum"

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 directed 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. Hence too 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 Winteringham's experiments have been made by himself alone, and not repeated or verified by others