

II. *Explanation of an Essay on the Use of the Bile in the Animal Oeconomy, by Alexander Stuart, M. D. Physician in Ordinary to her Majesty, F. R. S. and of the College of Physicians. Vide N<sup>o</sup>. 414.*

**I**N that short Essay on the Use of the *Bile* in the *Animal Oeconomy*, N<sup>o</sup>. 414, of the *Transactions* of this Society, some Points, which required a farther Illustration, having been there, for the sake of Brevity, only hinted at; it is necessary, and I hope may be of some Use, to set these Points in a clearer Light: Which I shall endeavour to do, by solving such Difficulties, and answering such Remarks, as have occurred in Conversation and Correspondence on that Subject.

The first Remark which deserves Regard is, that I take no Notice of the Effect of the *Gall* spilt upon the external Coat of the *Intestines* from the Wound in the *Gall-Bladder*, whose *Stimulus* on the Outside is supposed sufficient to have produced, and to have solved all the *Phænomena*, or Symptoms observed and related in the Case: So that all the Symptoms which I attribute to a Want of the *Stimulus* of the *Gall* on the Inside of the *Intestines*, might have been more properly ascribed to the same *Stimulus*, acting upon the Outside of the uppermost *Guts*, situated nearest to the *Gall-Bladder*, whose compleat Contraction by the Force of that *Stimulus*,  
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expelling the Air out of their Cavity, and forcing it into the inferiour *Guts* (as in windy *Cholics*) would have distended them to the Pitch mentioned in that Essay. At the same time it is acknowledged, that had the Gall been carried clean out of the Body by any Vent, so as that no *Stimulus* had remained to act either upon the Inside or the Outside of the *Intestines*, then my Way of accounting for the Symptoms had been good, and the Conclusions just.

I acknowledge that there is some Appearance of Reason for this Remark, and the Objection which it implies ; but the whole Strength of the Argument lies in a Supposition that a *Stimulus* on the Outside of the *Intestines*, is capable of exciting a Contraction, supplying the Want of that *Stimulus* on the Inside, and also of causing a preternatural Distension of the whole Canal. The Contrary of all which I shall endeavour to prove.

In order to this it is necessary to premise, what perhaps may not have been universally adverted to, yet can be no sooner proposed than acknowledged.

1. That the whole Action of the *Nerves*, whether in Sensation or in Muscular Motion, is exerted at their Extremities only.

2. That the Sides of the *Nerves* every where along their whole Tracts, are entirely insensible, and serve neither for Sensation nor Motion.

The *Apparatus* of Nature towards both these Actions makes this plain. Towards Sensation we see, that the *medullary* Substance of the *Nerves* at their Extremities is divested of its Coverings, which are Processes of the *Dura* and *Pia Mater*, and ends bare

bare in the Form of small soft *Papillæ*, from their Figure, called by *Anatomists Pyramidales*, on the Surface of the *Cutis*, covered over with the *Cuticula*, where they act their Part in Sensation, or Feeling, Tasting, and Smelling. The soft denudated Branches of the *Optic Nerve* which compose the *Retina*, and what for the same Reason is called the *Portio Mollis* of the Auditory *Nerve*, the immediate Instruments of Seeing and Hearing, prove the same.

Again, it is the Extremities of the *Nerves* that enter with their Coverings into the *Muscle*, and into each *Fibre* of the *Muscle* to which they belong ; where they deposit their Contents, or act their Part in muscular Motion.

But the Sides of the *Nerves* along their whole Tracts, are insensible or void of Feeling, because their *medullary* Substance, and its Contents, which are the only immediate Instruments of Sensation in them, are here covered with the *Pia* and *Dura Mater*, the last of which is the strongest, denfest, and most impenetrable Membrane of the whole Body, capable of defending and conveying the tender *medullary* Substance of the *Nerves* and its Contents, safe, unhurt, and undissipated to the several Organs of Sensation and Motion, at their Extremities the Seats of their Action.

A further Confirmation of this from Experience, is the Insensibility of the Side of a large visible Branch of a *Nerve*, which sometimes happens to lie bare and exposed in a Wound or Ulcer, where it will bear the Touch of the Probe without feeling, and occasions no more Pain than in Wounds and Ulcers  
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of the same kind, where the *Nerves* are not exposed, unless the investing Membranes, the *Dura* and *Pia Mater*, be by any Accident wounded, lacerated or corroded; in which Case, the *medullary* Substance being laid bare, exquisite Pain is felt, and very severe Symptoms ensue, which are hardly to be overcome, or never so easily as by cutting the *Nerve* quite through, so as that the Extremity may retire within the Flesh, and the *medullary* Substance be protected by it.

By which it appears, that the Sides of the *Nerves* are insensible or void of Feeling, and that the Extremity of the *medullary* Substance, either by Nature, or by some Accident, laid bare, is the only immediate Instrument of Sensation.

This being premised, the Structure of the *Intestines*, the Parts in Question in the Case before us, comes to be considered.

The *Intestines* are made up of four *Tunics*, or Coats.

The first, or external Coat, is a common membranous Covering, borrowed of the *Peritonæum*.

The second is composed of their annular, contractile, muscular *Fibres*, the immediate Instruments of their peristaltic Motion.

The third is the nervous Coat, a reticular *Plexus* of *Nerves* intermixed with *Blood-Vessels* and *Glands*, plac'd immediately under the muscular, and over the villous Coat.

The fourth is the villous or innermost Coat, on the concave Side, rightly called villous, as it appears view'd through a Microscope; tho' from its Appearance to the naked Eye, it be erroneously call'd the mucous

cous Coat. This is generally allowed to consist of the capillary Extremities, or rather Roots of the *Lacteals*, and the excretory *Ducts* of the *Glands*, which together form these *Villi* that are seen in it. Among these, suitable to Analogy in all other Parts of the Body, the *Papillæ Pyramidales*, or Extremities of the *Nerves*, are lodg'd under the *Cuticula* of the *nervous* Coat, for the Uses of Sensation, so necessary for the Purposes of Nature, in this very sensible Part the Inside of the *Guts*, which is known to be so quickly and necessarily affected by the Qualities of their Contents.

The proper *Nerves* of the first or outward Coat, are those of the *Peritonæum*, of which it is a Part, arising from the *Medulla Spinalis* of the Loins and *Os Sacrum*: Whereas the *Nerves* proper to the *Guts*, are of the *Par Vagum*, and *mesenteric Plexus*: Therefore as there is no Communication of *Nerves* between this external Coat or Covering, and the proper Substance of the *Intestines* themselves, a *Stimulus* acting upon this external Coat only, would not affect the *Guts* so as to excite any considerable Degree, either of Sensation or Motion in them.

Again the proper *Nerves* of the *Intestines*, whose Origin, Disposition, and Situation have been already described, terminate either in the muscular contractile *Fibres* of the Coat immediately above them, or carry their Extremities to the Inside, where they terminate under the *Cuticula*, for the use of Sensation: so that a *Stimulus* on the outside of the *Intestines*, besides the Difficulty of passing through the two external Coats, before it could reach the proper *Nerves*

of the *Guts*, would at last only irritate their Sides, where they are insensible, because covered with the *Dura Mater*: And if it might be supposed, that such a *Stimulus* as is in Question, to wit, the *Gall*, could have penetrated through these Coats into the Cavity, where the sensible Extremities of the proper *Nerves* of the *Guts* lie exposed to it, yet such a Filtration through all these Coats, as it could not be performed soon, nor in great Quantity, so it would enter at last, divested in a great Measure of its grosser, saline, oleaginous, and pungent Parts, by the Filtration, and thereby lose the Power of a *Stimulus* on the Inside; as the Situation of the Parts, and Disposition of the *Nerves* above described, made it an ineffectual one on the Outside, as much as if it had been carried quite out of the Body.

To conclude, if the *Gall* split on the Outside of the *Guts*, had been capable of exciting a Contraction in any Part of them, so soon as it came to cover the whole Surface, it must have had the same Effect equally every where, and the whole Canal should have been found contracted to its smallest Diameter: Whereas it was found every where distended to a great Pitch.

It is therefore plain, that a *Stimulus* on the outside of the *Intestines*, has not the Effect of such a *Stimulus* on the Inside. It can neither excite them to a Contraction; promote their peristaltic Motion; nor supply the Defect or Want of such a *Stimulus* on the Inside, much less occasion such an universal Distention, or account for the Symptoms arising from it, which is what I undertook to prove.

It was for these Reasons, and to avoid Prolixity, that the *Gall* spilt on the outside of the *Intestines*, was not taken Notice of in that Essay.

The second Difficulty is how a fresh Recruit of *Chyle* should be a Cause of Sleep.

The Experiments which I made before this *Society*, as printed in *Transact.* N<sup>o</sup>. 424, I hope may serve to justify what I shall here assume, concerning the Nature and Existence of the *nervous Fluid*, or animal Spirits, in the Solution of this second Difficulty.

The Argument which has been offer'd, runs thus: It is well known that People after eating plentifully are often inclined to Sleep, long before the *Chyle* can be supposed to be got into the Blood; therefore a fresh Recruit of *Chyle* cannot be the Cause of Sleep; but there must be some other Cause, at least at that time.

Which Cause is assigned by supposing, that after a plentiful Meal the distended Stomach will load and oppress the descending *Aorta*, so as to hinder the *Blood* in its Descent, and thereby force a greater Quantity than usual into the *Aorta Ascendens*, which by its distended Branches in the Brain will obstruct the Secretion of the Animal Spirits through the *Glands* of the cortical Substance into the Origin of the *Nerves*, and thereby produce Sleep.

This being generally esteemed a mechanical Account of the Cause of Sleep after Meals, deserves the greater Attention.

In answer to which, if such was the true Cause of Sleep after Meals, it ought to have the same Effect upon the *Cerebellum*, from whence most of the *Nerves*, that serve in the natural and vital Functions,

arise; and so would hinder these Functions, to wit Digestion, the peristaltic Motion, Respiration, and the Circulation of the *Blood*, all which, on the contrary, are observed to be more regular and stronger in Sleep, than when we are awake; at least in a healthy and temperate Person, who has used moderate Exercise.

Again, Gluttony, Drunkenness, and Flatulences, which overload the *Stomach*, and therefore, according to this *Hypothesis*, ought to produce the quietest and most serene Repose in Sleep, do, on the contrary, bring Inquietude, or broken and interrupted Rest; and when to the greatest Excess, a lethargic Sleep, which is a Disease for the Time, and sometimes terminates in Death.

The *Incubus* also, which is justly supposed to arise from an Inflation or Distention of the *Stomach*, in a supine Posture in Bed, oppressing the *Aorta Descendens*, ought to produce quiet Rest; whereas nothing disturbs more, as it first brings the Person out of quiet Sleep into a sort of waking Dream, with a Sense of Oppression, and at last awakes him quite, in a kind of Terror, with Palpitation of the Heart.

And indeed as nothing contributes more to sound and quiet Rest than an easy Digestion and Respiration, a sedate, equal and regular Circulation of the *Blood*; that is, an uninterrupted Function of all the natural and vital Parts; the Reverse of these, and particularly an interrupted or difficult Circulation, if to any considerable Pitch, must produce the contrary Effects, to wit, Restlessness or Inquietude of some Kind or Degree; as in Fevers and other Distempers attended with such Irregularities of the *Animal Oeconomy*.

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The Difficulty which is suggested about the *Chyle's* not getting soon enough into the *Blood*, by the Way of the *Lacteals*, to produce this Effect in such as sleep immediately after a plentiful Meal, vanisheth when we consider, that this very rarely happens, at least never attends temperate People, in perfect Health, and in a temperate Climate ; but such as are gross Feeders, Drunkards, Corpulent, Short-neck'd, by Constitution or Make liable to Apoplexy or Palsy, or have formerly suffered by such Distempers, or live in a hot Country.

In gross Feeders, Drunkards, and such as are Corpulent, from these Causes the *Lacteals* are never quite empty ; in such the Food of the present Meal, by exciting the peristaltic Motion, will, in a few Minutes, press forward the *Chyle* of the preceeding Meal into the *Blood*. In full Vessels or *Tubes* the Reception and Discharge will be instantaneous, or nearly such ; because supposing the Appertures to be free or unobstructed, as much precisely will issue at one Extremity of a full Vessel or *Tube*, as is forced into it at the opposite Extremity ; and that instantaneously, because of the Contiguity of the *Globules*, or Particles of the *Fluid* it contains.

In Short-neck'd People the Passage between the *Heart* and the *Brain* being proportionally short, the Force or *Momentum* of the Circulation in the *Brain*, is by so much the greater ; but a strong and swift Circulation is an Enemy to all Secretions, as is evident in *Fevers*, and mechanically demonstrable ; for all the Secretions being by lateral Branches going off at or near to right Angles (which is very remarkable in the *Brain*) a swift Circulation or Motion along or parallel  
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to the Axis, carries along with it what should be laterally fecerned. Hence a Paucity of Animal Spirits in Short-neck'd People, who by this Make are liable to Apoplexies, Palfies, Coma's, Lethargies, a Listlessness, Inactivity, and Drowfiness, especially after Meals, when the fresh *Chyle* has got Admission, to absorb a Part of the already few remaining Spirits, which must be recruited in Sleep.

Again in hot Climates, a continual Waste or Diffipation of the Spirits by Heat, makes the Inhabitants generally lazy and unactive : In such the recent *Chyle*, the grossest circulating *Fluid* of the whole Body, will quickly absorb the few remaining Spirits, and dispose them to sleep after every Meal: Except when the Cool of the Evening checks Perspiration and the Evaporation of those Spirits, which were recruited by Sleep in the Day-time, and therefore remain plentiful enough to support their Activity after Supper, when the Business of the Meaner, and Diversions of the richer Sort begin; which, in colder Climates, is the Case after Breakfast and Dinner.

For a farther Confirmation of this, Brandy, and the Spirits of fermented Liquors, are known to produce a drousy Stupidity in such as drink them to any Pitch, and an habitual Dulness in habitual Drinkers of them ; and, when drank to Excess, throw the Drunken into a kind of lethargic Sleep for some time. Yet the Quantity taken down, sufficient to produce these Effects, is never so much as to load or distend the *Stomach*, so as to oppress the *Aorta Descendens*, or to hinder the Circulation downwards ; and therefore cannot be supposed to produce Sleep or  
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Sleepiness in that Manner, but in a different Way, which shall be described in the Sequel of this Discourse.

Thus this Position concerning what has been generally esteemed a mechanical Cause of Sleep after Meals, being, I think, sufficiently refuted, it remains that I endeavour to establish such a general Cause of Sleep, as may be conformable to what is advanced in the Essay under Consideration.

I believe it will hardly be denied, that the Cause of Sleep in general is a Want of a sufficient Quantity of animal Spirits for the Use and Exercise of the animal Functions: Therefore whatever prevents their Recruit ; hinders or impedes their Secretion ; absorbs or fetters them when produced ; and whatever exhausts or evaporates them, by occasioning a Paucity of Spirits, will, in a healthy Person, produce a Lethargy, Laziness, a Tendency to Sleep, or Sleep itself, in Proportion to that Paucity of the remaining Spirits.

If we enumerate all the known remote Causes of Sleep or Sleepiness, we shall find that in some one or other of the Ways above set down, they do all of them tend to produce this immediate or proximate Cause, to wit, an Impairment of the nervous *Fluid*, or animal Spirits, and thereby bring on these several Dispositions to Sleep, or Sleep itself.

All the remote Causes of Sleep, or Sleepiness, I think may be fully comprehended in the four following Particulars, and considered in the following Order.

## I. Exer-

I. Exercise.

II. A too plentiful Meal.

III. Drunkenness, or a too great Quantity of fermented Liquors, or of their distilled Spirits.

IV. The whole Tribe of *Narcotics*, or *Soporifics*, of which *Opium*, and its several Preparations, are the chief.

I. Exercise appears to waste all the *Fluids*, and particularly the animal Spirits, the active Instruments of all Motion ; so that the Remains are not sufficient for the Exigencies of the natural and vital Functions; and also to supply the Demands of voluntary Motion, and to assist in Sensation, and the Operations of the Mind.

And here it is proper to shew how this Waste necessarily brings on Sleep in a healthy Person, and how the natural and vital Motions, and Functions of Digestion, Respiration, and Circulation, notwithstanding this Waste, do necessarily go on in Sleep, leading the Remains of the Spirits to their Assistance, and making the Deficiency fall to the Share of the animal or voluntary Motions and Organs of Sensation.

In order to shew this, let us observe what is very obvious, that when any *Muscle* is brought into Action against our Will by a superior Force, as when a stronger Man bends or extends my Arm contrary to my Will or Inclination, the Benders or Extensers of my Arm swell and contract in the same manner, and the Afflux of the Blood and Spirits to the contracting Muscles,

Muscles, is the same as when I do it voluntarily: Therefore by any external or adventitious Force, the Blood and Spirits will be derived upon the Part thus forced into Action.

But all the natural and vital Parts have such an external or adventitious Force continually acting upon them. In the *Primæ Viæ* the Weight and other Qualities of our Food and Drink, mixed with Air and *Bile*, excite the peristaltic Motion, as necessarily as the Weight of a Clock, or Spring of a Watch wound up, keeps the Wheels and Pendulum, &c. in Motion.

The *Chyle* forced from thence, together with the *Blood* returning into the *Heart*, as necessarily set its elastic Springs at work, and the same *Blood* and *Chyle* forced into the *Arteries* by it, make their *Diastole* and following *Systole* inavoidable.

The Air by its Elasticity, and the whole Weight of the Atmosphere, forceth itself into the elastic Pipes and Vesicles of the *Lungs*, and dilates them; which by their Elasticity and Mechanism, assisted by various *Muscles*, and the Ribs and Cartilages of the *Thorax*, as necessarily repel it in Expiration.

It is therefore evident, that all these natural and vital Parts are acted upon, and set at Work by an external adventitious and irresistible Force, continually exciting them whether we will or not, whether awake or asleep; therefore the *Blood* and remaining Spirits after Labour, will be mechanically and necessarily led to all these Parts that are thus forced into Action at all times, but especially most regularly and copiously in Sleep, when all external Objects

cease to sollicit our Senses, and the Will does no longer determine the Spirits into the *Muscles* of voluntary Motion; which two Kind of Actions, as well as the Operations and Passions of our Mind, do, in the Day-time, make strong Derivations of the Spirits from the natural and vital Functions; which, for that reason, are never so perfect as in sound and undisturbed Sleep.

Those who are acquainted with the Doctrine of Derivations and Revulsions, founded upon innumerable Observations in the *Animal Oeconomy* and Practice of Physick, do know, that a Flux of any of the animal *Fluids* arising from Nature, or from a Disease, or provoked by Art to any one or more Parts of the Body, or to any Organ of Secretion or Excretion, will cause a sensible proportional Diminution of the Afflux to, and of the Secretion and Excretion by the other Parts and Organs.

Therefore so soon as a Deficiency of animal Spirits happens by Labour, or from any other Cause whatever, that Defect will be first felt in the Organs of Sensation, the Muscles of voluntary Motion, and the Operations of our Mind; because these are not acted upon by such powerful and irresistible Agents, as the Organs of the natural and vital Functions are in perfect Health; for the Mind being sensible of the Defect of Spirits for its Actions and Operations, chooseth to forbear; we retire from external Objects, and then the Whole of the remaining Spirits are led to the natural and vital Organs, by the Mechanism above described; and the Organs of Sensation and voluntary Motion must be entirely deserted by them for that time; which is the State of Sleep, and  
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which will continue until a greater Quantity of Spirits be recruited, than is consumed in the natural and vital Functions ; at which time the Redundancy or Overplus begins again to be fecerned into the other deserted *Nerves*, to wir, into those of Sensation and voluntary Motion ; which, flowing now copiously into the relaxed *Muscles*, excites Stretching, Yawning, &c. and at last rouseth out of Sleep.

II. A too plentiful Meal is known to cause a Heaviness, Inactivity, Listlessness, an Aversion to Motion or Action, a Drowsiness, Sleepiness, and in some Sleep itself, soon after eating.

It has been prov'd above, that this cannot proceed from a Distention of the *Stomach* ; I have also endeavoured to prove, that in such the *Lacteals* are never empty, and that the *Chyle* of the preceding Meal is forced through them into the *Blood* by the succeeding, almost instantaneously, or so soon as the peristaltic Motion is excited or encreased by the Food taken down, which must be during the time of such a Meal, or very soon after, according to the Degree of Fullness of the *Lacteals* before that Meal. What Change then can we imagine to have happened to the Body in this time of a Meal so remarkable, and so likely to affect the *Oeconomy*, as that of the Admission of a *Fluid* into the *Blood*, much grosser and less fluid than itself ? Such a Mixture must render the whole Mass grosser, or of a thicker Consistence than before, as it quickly mixeth with the finer, and absorbs its most fluid Parts ; but it will hardly be denied, that if there is such a *Fluid* as animal Spirits, they must be the finest and most depurated *Fluid* of the *Blood* : These therefore will be absorbed, and

mixed with this grosser crude *Fluid* the *Chyle*, and therefore will be diminished by it ; and being thus intangled, will be more difficultly secreted, and in less Quantity: Hence that Paucity of Spirits, which will dispose to sleep in the manner above-described, in speaking of a Paucity of Spirits after Labour or Exercise.

III. How far strong fermented vegetable Juices or Liquors, and their distill'd Spirits drank to any Pitch of Excess, do bring on Sleep, or some Degrees of it, has already been said.

The distilled Spirits of fermented Liquors, are known to lessen all the Secretions and Excretions, and therefore are of use in *Diarrhæas*, in excessive and colliquative Sweatings ; and I have known *French Brandy*, taken incautiously, to have put a Stop to a Sweat procur'd by *Sudorifics*. In habitual Drinkers of them, they gradually lessen the Secretion of the *Bile*, and insensible Perspiration, and thereby bring them at last into the Jaundice and Dropsy.

Spirituous Liquors, and particularly *French Brandy* in the most remarkable Manner, being mixed with the *Blood* as it flows from a Vein into a Porringer, unites the serous with the globular red Part of the *Blood*, to such a Degree, as that no *Serum* separates from it in many Hours, and in some not at all ; an Experiment which may be easily made ; which shews in what manner it hinders the Secretions in the Body, these being all of them of the serous Kind: Hence that great Impurity of the *Blood* arising from a Restraint of the Secretions in such People ; and also that Paucity of Spirits, the general Cause of Sleep and Dulness, very different from the Alacrity and Vivacity of the Temperate, and even of Water-drinkers.

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That therefore which fetters or binds up all the *Serofities*, or most fluid Parts of the *Blood*, and proves a strong *Copula* between them and the red *Globules* thereof, may be reasonably supposed to fetter or tye up the finest *Fluid* of all, to wit, the animal Spirits with the rest, and in the same manner to hinder their Secretion, and thereby produce Sleep, or some such Degree of it as is above-mention'd.

IV. As to *Opium*, and all the Class of *Soporifics*, if we compare the visible Effects of them with what has been said above of *Brandy*, or Spirits of fermented Liquors, we shall find them much the same. *Opium* is known to lessen or suppress all the Secretions and Excretions, and is therefore of such remarkable use in *Fluxes*, *Rheums*, *Catarrhs*, &c. it has indeed been conceived to be a *Sudorific*, but that only in Composition with *Aromatics*, as in *Venice* or *London Treacle*; or with *saline* Bodies, as the *Sapo Tartareus* in the *Pil. Matthæi* or *Starkij*; and that too assisted by plentiful Dilution with warm Sack-Whey, or such like Liquors, and the Addition of Volatile Spirits of *Hart's-Horn*, &c. which are known to thin the Blood, as Mr. *Leeuwenboeck's* Microscopical Observations, and the mixing of these volatile saline Spirits with *Blood*, as it runs out of the Vein into a Porringer, do sufficiently evince. Which shews, that these Volatile Salts are good Correctors of *Opium*, as they break down and colliquate the *Blood*, and therefore tend to promote the ferous Secretions, which *Opium* by itself, and all distill'd Spirits of fermented Liquors do retain, or restrain for some time, incorporating the *Serofities* with the  
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red *Globules* of the *Blood*, as has been observed before.

In hot Countries, where large Doses of *Opium* are taken, the Effects are nearly the same with what we observe in Drinkers of distill'd Spirits of fermented Liquors; to wit, a small Dose exhilarates, a greater brings on some Degree of Drunkenness, or temporary Madness; this encreas'd will lay to Sleep, and a very great Dose will kill.

In this Comparison therefore, may we not justly conclude a Parity in the Causes, from the Similitude of the Effects; though all the secondary Qualities of such Causes, which offer themselves outwardly to our Senses, be apparently very different; thus Gun-powder is as much a latent Fire as Brandy, and will exert itself in that Shape to a far greater Degree than it, in equal Circumstances, that is, by the least Contact of Fire; therefore, I say, that though *Brandy* and *Opium* shew no outward Resemblance to our Senses in Smell, Taste, Colour, Consistence, and such like secondary Qualities, no more than *Brandy* and *Gun-powder*; yet if in proper and equal Circumstances, that is, in Contact and Mixture with the *Blood*, they produce the same, or nearly the same Effects, we may justly conclude, that there is a latent Similitude of primary Qualities in their Natures, which they make manifest in proper and equal Circumstances, in producing the same or parallel Effects.

But it has been shewn above, how, and in what manner *Brandy* fetters and intangles the animal Spirits, and other *Fluids* of the *Blood*, uniting them too intimately with the grosser Parts, and thereby hin-

hindering their due Secretion for some time ; whence a Paucity of Spirits, which discovers itself by an Inequality and Irregularity of their Distribution in Drunkenness ; a still greater Defect in Dulness and Drowsiness ; yet more in Sleep, and a total Suppression of their Secretion, as well to the natural and vital as to the animal Organs, which is Death, the Effect of the greatest Doses either of such distill'd Spirits or of *Opium*.

From what has been said on this Subject, it seems as plain as the Nature of such a Physical Demonstration will admit of.

I. That the universal Cause of Sleep is a Paucity of animal Spirits.

II. That this Defect will arise from whatever exhausts, wastes or evaporates them when produced, as Labour or Exercise ; or from whatever absorbs them, as a great Quantity of crude *Chyle*, recently and suddenly admitted into the *Blood*, in the Time of, or soon after, a plentiful Meal ; or whatever can fetter or re-unite them with the grosser Parts of the *Blood*, as much as Brandy or spiritous fermented Liquors and *Opiates*. All these either by evaporating and wasting them, or by hindering their Production or Secretion, do bring on that Paucity of Spirits spoken of, and Sleep or some Degree of Sleepiness, as a necessary Consequence.

Yet it will be still true upon the same Foot of Reasoning, that where the *Blood* is extremely depurated, and the Secretions and Excretions from it already perfectly performed, as in long Fasting the whole Mass of *Blood* is become only fit for the Secretion of Spirits ; has no Crudity or Impurity in it, to absorb or  
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fetter the Spirits already produced; and no crude *Chyle* admitted to answer that End; in such a Case *Opiats* can have no Effect, the Spirits cannot be absorb'd, fetter'd or restrained, where the Qualities of the Mass of *Blood* do not concur to that Effect.

Another concurring Cause of the Inefficacy of *Opiats* in the Case of Fasting, is, that all the natural Parts, those, to wit, of the *Primæ Viæ*, which serve for Digestion, are at Rest, for want of the Weight and *Stimulus* of Food, and also of the *Gall* in the Case referred to, to keep up their peristaltic Motion; therefore few or none of the Spirits being spent on those Parts, there is a greater Supply sent to the animal Organs of Sensation and voluntary Motion; and indeed in such a Case even the vital Parts for Respiration and Circulation do act but very sluggishly for want of a Recruit of *Blood* and *Fluids* proper to excite their Functions: Hence also the Supply of Spirits to the Organs of Sensation and voluntary Motion, is by so much the greater; and the Possibility of restraining their Secretion, for the Reasons above assigned, impracticable by any Power of *Opi-um*, without the Accession of a fresh Recruit of *Chyle*.

Hence also those who have any considerable Defect in the natural and vital Functions, or in either of them, by Obstructions of the *Viscera*, are generally bad Sleepers, or Watchful; and in such *Opiats* have but little Effect to procure Rest; with this great Disadvantage, that by impeding the Secretions, they increase the Obstructions; though in many Cases, where the *Viscera* are sound, they must be acknowledged to be excellent Medicines.

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What has been said, will also sufficiently account for the anodine Power of *Opium* ; for if it impedes the Secretion of the animal Spirits, the immediate active Instruments of all Sensation, it must certainly obtund or abolish for that Time the disagreeable Sensation of Pain.

The third Difficulty is, how *Pus* should be the Product of *Chyle*, and not of the *Blood* or *Serum*. As to which, I think it would not be difficult to prove that all the gross Secretions are from the *Chyle* ; these being only the Depurations of it in *Sanguification*, or in order to bring that crude and gross *Fluid* the *Chyle* into pure and defecated *Blood*, from which no Secretion can afterwards be made, but of that purest *Fluid*, which it secretes into the *Nerves* for the Use of the whole *Oeconomy*.

If this be true, then *Pus* in a Wound, Ulcer, or Impostume, being a very gross feculent Humour, is likelier to issue from the *Chyle* than from the purer and more defecated Part of the Mass; but the farther Proof of this would be too tedious for this Place.

N. B. *The Reader will be pleased to excuse an Omission in § VII, of Symptoms in the Essay here referred to, N° 414, p. 344, relating to the Quantity of Urine, where the following Words ought to have been added, [Not exceeding 3, or at most 4 Ounces in 24 Hours, so far as I was able to judge without measuring it.]*