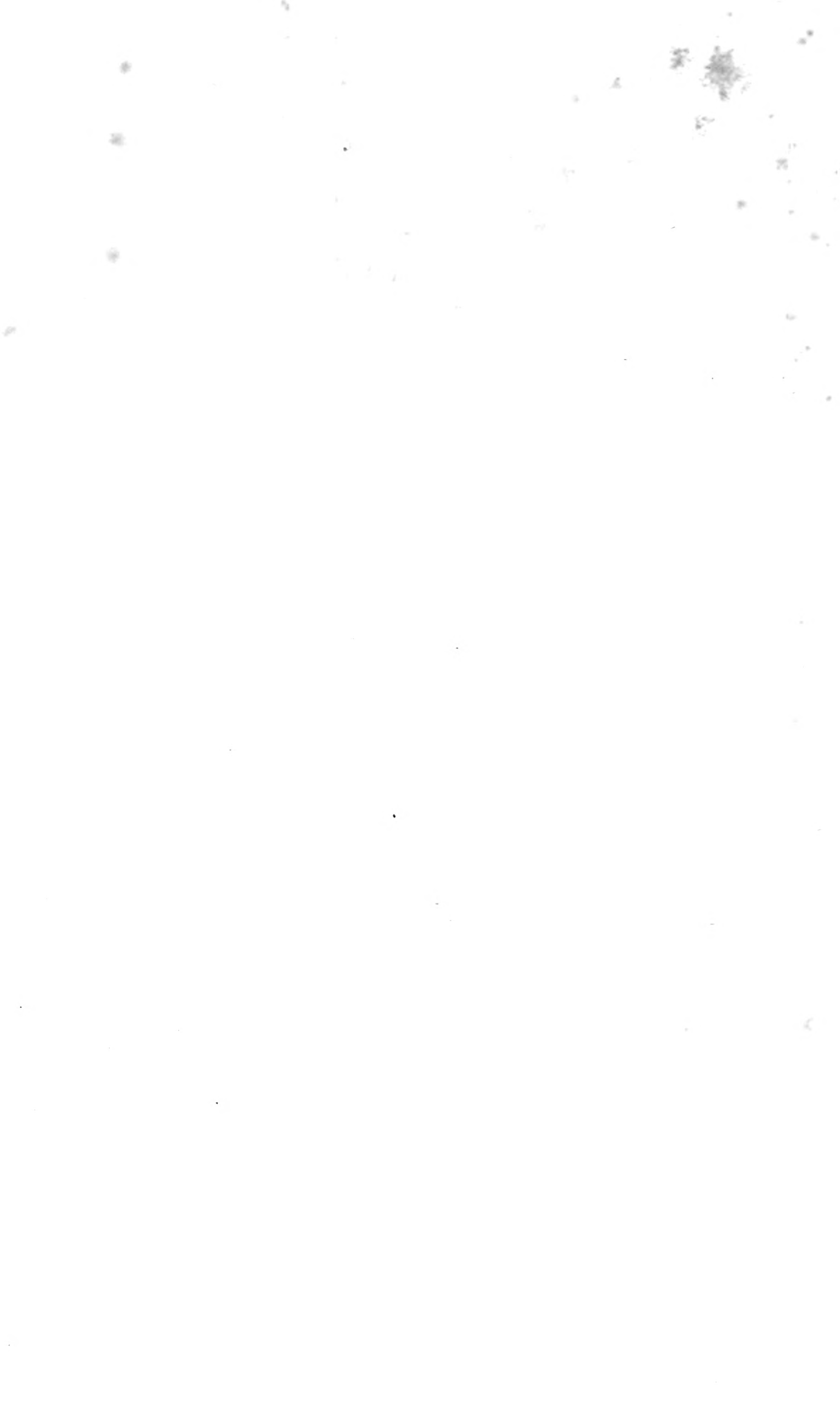


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THE ECONOMY  
OF  
THE ANIMAL KINGDOM.

LONDON :  
PRINTED BY WALTON AND MITCHELL,  
Wardour-street, Oxford-street.

THE  
ECONOMY  
OF THE  
ANIMAL KINGDOM,

CONSIDERED

ANATOMICALLY, PHYSICALLY, AND PHILOSOPHICALLY.

BY

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TRANSLATED FROM THE LATIN

BY

THE REV. AUGUSTUS CLISSOLD, M.A.

VOLUME II.

LONDON :

W. NEWBERY, 6, KING STREET, HOLBORN ;

H. BAILLIÈRE, 219, REGENT STREET ;

OTIS CLAPP, SCHOOL STREET, BOSTON, UNITED STATES.

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1846.

“ PAUCIS NATUS EST, QUI POPULUM ÆTATIS SUE COGITAT : MULTA ANNORUM  
MILLIA, MULTA POPULORUM SUPERVENIENT : AD ILLA RESPICE, ETIAMSI OMNIBUS  
TECUM VIVENTIBUS SILENTIUM . . . [ALIQUA CAUSA] INDIXERIT : VENIENT, QUI  
SINE OFFENSA, SINE GRATIA JUDICENT.”—SENECA, EPIST. LXXIX.

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THE  
ECONOMY  
OF THE  
ANIMAL KINGDOM,  
CONSIDERED  
ANATOMICALLY, PHYSICALLY, AND PHILOSOPHICALLY.

PART I.—*continued.*

AN INTRODUCTION TO RATIONAL PSYCHOLOGY.





THE ECONOMY  
OF  
THE ANIMAL KINGDOM.

CHAPTER VIII.

AN INTRODUCTION TO RATIONAL PSYCHOLOGY.

579. PSYCHOLOGY is the science which treats of the essence and nature of the soul, and of the mode in which she flows into the actions of her body; consequently it is the first and last of those sciences which lead to the knowledge of the animal economy. But whereas the soul has her residence in a place so sublime and eminent (n. 270), that we cannot ascend to her, and attain to the knowledge of her, except by a particular and general investigation of the lower and accessible things of her kingdom; or whereas she lives withdrawn so far within, that she cannot be exposed to view until the coverings under which she is hidden are unfolded and removed in order: it hence becomes necessary that we ascend to her by the same steps or degrees, and the same ladder, by which her nature, in the formation of the things of her kingdom, descends into her body. By way therefore of an Introduction to Rational Psychology, I will premise THE DOCTRINE OF SERIES AND DEGREES, (a doctrine, of which, in the preceding chapters, I have made such frequent mention,) the design of which is, to teach the nature of Order and its rules as observed and prescribed in the succession of things: for the rational mind, in its analytical enquiry into causes from effects, nowhere discovers them, except in the Subordination of things, and the Coördination of subordinates;

wherefore, if we would advance from the sphere of effects to that of causes, we must proceed by Orders and Degrees; agreeably to what rational analysis\* itself both approves and advises (n. 67, 161). The rational mind also, by means of this doctrine carefully investigated and established, will see opened to its view a broad and even path leading to the principles of causes, and will behold the dissipation of those occult qualities, which, like the shadows of a thicket, deepen at every step so as to shut out all further prospect and progress: for as often as nature betakes herself upwards from visible phenomena, or, in other words, withdraws herself inwards, she instantly as it were disappears, while no one knows what is become of her, or whither she is gone, so that it is necessary to take science as a guide to attend us in pursuing her steps. Without a guide of this kind, moreover, we shall have a tendency to fall into various premature opinions; we shall be apt to think, for instance, that the soul, either from principles proper to herself, or from such as are above herself, flows immediately into the effects of her own body; whence, it necessarily follows, that the communication of operations between the soul and the body must be explained either by *Physical Influx*,† or by *Occasional Causes*;‡ or if by neither of these, a third is assumed, as the only alternative, namely, that of *Preëstablished Harmony*.§ Thus the one or other system flows as a consequence from our want of knowledge respecting the subordination of things, and the connection of things subordinate; even supposing the most accurate examination and the most profound judgment to have been exercised upon the phenomena: for reasonings naturally follow the course of their principles. But whereas all things in succeeding each other follow one another in order, and whereas in the whole circle of things, from first to last, there is not a single one which is altogether unconnected or detached from the rest; I am therefore compelled, as I said, previous to developing the subject of Rational Psychology, to take into consideration this doctrine concerning order and connection, so remarkably conspicuous in the animal kingdom. In the meanwhile, whether there be truth in what has been said, and what remains to be

\* An analysis proceeding by ratios. (*Tr.*) † The doctrine of the Aristotelians. (*Tr.*)

‡ The doctrine of Des Cartes.—(*Tr.*) § The doctrine of Leibnitz.—(*Tr.*)

said, may be easily ascertained from the four following considerations. *First*, In case the truth spontaneously manifests itself, and as it were establishes a belief in its presence, without requiring any support from far-fetched arguments; for we often, by a common notion, and, as it were, by a rational instinct, comprehend a thing to be true, which afterwards, by a multiplicity of reasonings drawn from a confused perception of particulars unarranged and unconnected with others which are more remote from our notice, is brought into obscurity, called in question, and at last denied. *Secondly*, In case all experience, both particular and general, spontaneously favors it. *Thirdly*, In case the rules and maxims of rational philosophy do the same. *Lastly*, In case the proposed view makes the different hypotheses, which have been advanced on the subject, to coincide, supplying us with the proper condition, or common principle, which brings them into order and connection, so that, contemplated in this manner, they are agreeable to the truth. We may remark that a system constructed on the ground of such an agreement, merits the title of ESTABLISHED HARMONY. But to proceed to the Doctrine of Series and Degrees.

---

## I.

580. By the doctrine of series and degrees we mean that doctrine which teaches the mode observed by nature in the subordination and coördination of things, and which in acting she has prescribed for herself. Series are what successively and simultaneously comprise things subordinate and coördinate. But degrees are distinct progressions, such as when we find one thing is subordinated under another, and when one thing is coördinated in juxtaposition with another: in this sense there are degrees of determination and degrees of composition. In the mundane system there are several series, both universal and less universal, each of which contains under it several series proper and essential to itself, while each of these again contains

series of its own ; so that there is nothing in the visible world, which is not a series, and in a series. Consequently, the science of natural things depends on a distinct notion of series and degrees, and of their subordination and coördination.

581. *By the doctrine of series and degrees we mean that doctrine which teaches the mode observed by nature in the subordination and coördination of things, and which in acting she has prescribed for herself.* This doctrine constitutes a principal part of the natural sciences ; for everywhere in nature there is order, and everywhere the rules of order. It is a doctrine which expounds the nature of the veriest form itself, without which nothing which is predicable of anything can occur. If the form of which we may be treating be the veriest form itself, and things be regarded as the subject-matter, in this case the subject-matter joined to the form perfects the science ; thus, for instance, in the anatomy of the animal body, everything we meet with is a subject-matter of science, while notwithstanding if the veriest form of the whole and of every part be not known, the science is not perfected. The most perfect order in the mundane system is that which reigns in the animal kingdom ; so perfect, indeed, that it may be considered as the living exemplar of all other things in the world which observe any order. Consequently the doctrine of series and degrees ought to teach, not only in what manner things are successively subordinated and coördinated, and in what manner they coexist simultaneously in subordination and coördination, but also, in what manner they are successively and simultaneously determined according to the order thus impressed, that they may produce actions, in which may be causes, between which actions and causes there may be a connection, so that a judgment may be formed respecting causes from the order in which they exist.

582. *Series are what successively and simultaneously comprise things subordinate and coördinate.* Subordination indeed and coördination properly have respect to order in causes, of which also they are commonly predicated : but whereas there is nothing in the animal kingdom, which does not, in some way, act as a cause, it is all the same, whether we call the several

things in this kingdom successive and coexisting or simultaneous, or whether we call them subordinate and coördinate. When the things themselves are subordinate and coördinate, and thereby distinct from other things, their whole complex, in such case, is called a series, which, to the end that it may coexist, must exist successively; for nothing in nature can become what it is at once, or simultaneously: since nature, without degrees and moments, whether of time, velocity, succession, or determination, and consequently without a complex and series of things, is not nature.

583. *But degrees are distinct progressions, such as we find when one thing is subordinated under another, and when one thing is coördinated in juxtaposition with another; in this sense there are degrees of determination, and degrees of composition.* With philosophers, degrees are quantities of qualities; as degrees of heat, of gravity, of colors, and of many other things; thus they constitute relations. But degrees are properly progressions and determinate steps; thus, for instance, in the case of ourselves, when we walk forward, we measure out with our feet determinate distances, and not only so, but in climbing a ladder, the very ladder itself has its separate steps or gradations. Hence it is that degrees never exist but in things successive. In things coexisting they are conceived to exist, for which reason they may also be predicated of them; since upon reflection we perceive that they exist within them, because without succession, and thus without degrees, they could not have coexisted (n. 582). Hence we say that a series, or coördination of several things, is to be considered as distinguished into its degrees; for we do not, because it coexists, deprive the mind of its idea, that it existed or came into existence; since otherwise there would be no distinct perception of the efficient cause, and of its effect.

584. *In the mundane system there are several series, both universal and less universal.* These series, the instant they are determined, or viewed as determinate, are usually arranged into genera and species, whence arise superior and inferior genera, and in like manner species, which acknowledge degrees of universality; wherefore species, and occasionally even individuals, are considered as a genus; and *vice versá*, when compared with genera more universal. The most universal series is the uni-

verse, or the system of the world, which contains within itself several series. The world or universe, according to the celebrated Wolff, is a series of finite entities connected with each other, consequently it is one entity; but this system comprises many simultaneous and many successive things. (*Cosmologia Generalis*, § 48, 51, 52, 60.) The series which the world comprises, are three superior, and three inferior. The superior series are those of the circumambient universe or world; the inferior are those of the earth. Of the circumambient universe or world, there is a series of substances simply derived from the first substance by the order of succession. The second series is that which the same substances constitute when left to themselves and their own nature, or when endowed with the liberty of gyrating, whence comes fire, both solar and inferior elementary fire (n. 84). The third series is that of the auras of the mundane system, arising from the combination of the two former, thus from their active and as it were passive principles: this latter series is that for the sake of which the former exist; it constitutes the circumambient world itself, and without it the three inferior series, which are those of the earth, cannot exist. The auras themselves, which constitute this series, when examined as to their causes by a rational analysis founded on facts, are four, which, as they succeed each other in order, decrease in simplicity, purity, universality, and perfection. These are the most perfect forms of active and passive nature, representing her forces brought into forms. The world itself confirms their existence; so that he who doubts it, precludes himself from the investigation of every phenomenon and from the discovery of causes in every effect (n. 53—58, 65—68).

The general series of the earth, which in relation to the former ought to be denominated inferior, are themselves also three, and are commonly called kingdoms; namely the mineral, vegetable, and animal kingdoms. The mineral kingdom contains several species; as metals, stones, salts, earths, liquids, in short, numerous inactive substances. The vegetable kingdom contains also various species, one under the other, such as trees, herbs, flowers, shrubs, and pulse. In like manner the animal kingdom contains its several species, which it would be tedious to enumerate. These kingdoms, or general terrestrial series, succeed



each other in time and in order. The first is the mineral kingdom, or the earth itself, the parent of the rest. The vegetable kingdom derives its existence from the minerals of the earth, in which also, as in a matrix and womb, it deposits its seed as often as it proceeds to renew its birth. After this follows the third general series, or the animal kingdom; for an animal requires for its existence and subsistence both the whole of nature and the whole of the world previously existing. The last of the series in the animal kingdom is the most perfect animal, or man, who is the complement of all things and of the whole, and the microcosm of the macrocosm. In these six series nature seems to have rested; for there is no seventh.

585. *Each of which contains under it several series proper and essential to itself, while each of these again contains series of its own.* This is the case, not only in the genera, but also in the species, and in the individuals of every species; and, since the animal kingdom is more immediately the subject of our present attention, we shall select for our example the human body, as anatomically and physically examined, in part, in our preceding chapters. Every individual animal is a series of several other series that are essential and proper to the general one. Its essential and proper series are the viscera: of which the higher series are the cerebrum, cerebellum, medulla oblongata and spinalis: the lower, or those of the body, are the lungs, stomach, liver, pancreas, spleen, womb, kidneys, and several others: for these, taken together, are constituent of the form. Each of these series contains other subject series which are essential and proper to it. The latter may be called partial series, and the former integral, or the former single and the latter common, all belonging to the whole series. Thus the liver, which is a large gland, includes in it a conglomeration of several glands, as do these again a conglomeration of their own most minute glands. The case is the same in the rest of the viscera which have reference to their integral series, in the same manner as the integral has reference to its common series, and so forth. A similar law prevails in the other kingdoms; as for instance, in the vegetable kingdom, in which a tree is one series comprising branches, which are its proper and essential series; whilst, in like manner, to these branches belong lesser ones,

twigs and leaves ; then finally fruits and seeds, which correspond to the generative members in an animal, only with this difference, that in the tree they are renewed every year, whereas in an animal they are permanent.

586. *So that there is nothing in the visible world, which is not a series, and in a series.* The first substance of the world is the only one which does not fall under the notice of the understanding as some kind of series : from this, as from the first determining substance, or the substantia prima, proceed all the rest, as series, and betake themselves within the sphere of nature. Thus, whithersoever we turn our attention, all things that we meet are merely series, originating in the first, and terminating in the first. Mere series, and series of series, constitute arithmetic, geometry, physics, physiology, nay, all philosophy. Even governments, both public and private, have respect to their forms and their subordinations ; and are consequently series of things. By series it is that we speak, reason, and act. Our sensations, too, are series of varieties, more or less harmonious, whence result agreement, imagery, idea, and reason. For where all is equality, or where there is no series, nature perishes.

587. *Consequently, the science of natural things depends on a distinct notion of series and degrees, and of their subordination and coördination.* The better a person knows how to arrange into order things which are to be determined into action, so that there may exist a series of effects flowing from their genuine causes, the more perfect is his genius. And inasmuch as an arrangement of this kind is prevalent throughout nature, so the faculty of arranging is perfected by observation and reflection on the objects of nature, by natural abilities, and by the assistance of those instructors whose minds are not too artificially moulded, or under the influence of prepossessions, but who claim to themselves a freedom in contemplating the objects of nature with a view to become instructed by things themselves, as they flow forth in their order.

## II.

588. To the intent that we may advance from the primary sources of existence, we shall begin with substances, which are

the subjects of accidents and qualities. These substances are manifold ; nevertheless, of all that are in the universe, there is only one from which the rest flow, and on which, as their first principle, the principles of natural things are impressed by the Deity. Each series has its first and proper substance, which substance nevertheless depends for its existence on the first substance of the world.

589. *To the intent that we may advance from the primary sources of existence, we shall begin with substances, which are the subjects of accidents and qualities.* A *subject* is that, in which are all things that can be predicated of it. *Accidents* are the things thus included ; such as form, figure, magnitude, determination in agreement with the form, active force, [*vis agendi*] &c. *Qualities* are predicated of substances considered as the subjects of accidents ; as the quality of form, figure, magnitude, intrinsic determination, force, &c. : all these things are sustained by the substance, as the subject. For if it be inquired, *What is there in a substance?* The reply is, accidents. If again, *What sort of things are accidents?* The reply is, They are determinable qualities. If again, *What is their quantity, or How much?* The reply is, They are quantities, which are also degrees of qualities. Aristotle defines substance to be an *ens* which subsists *per se*, and sustains accidents ; that is, to which the things within it are proper, or appropriately belong, so that they cannot be attributed to other things ; as essence, or form and nature, together with the rest of the particulars which flow from them. If it subsisted from other things, it would not have a distinct subsistence ; wherefore it must be said to subsist of itself, whence it derives the name of substance. For example : every compound substance, or one series, if the things contained in it were not proper to it, would not be a substance *per se*, consequently there would be no substance or universe. Nevertheless, there is a connexion of all things, in respect to existence, as also in respect to subsistence, so far as subsistence denotes perpetual existence. Wolff observes, that “ substance is the subject of intrinsic, constant and variable determinations,” and “ is that in which dwell the same essentials and attributes, while modes successively

vary." He, therefore, supposes that substance, without active force, is not conceivable (*Ontologia*, § 769, 770, 776); and hence he describes its accidents [forces?] as alive. (*Cosmologia*, § 378, 379.) But there are also inert substances.

590. *These substances are manifold; nevertheless, of all that are in the universe, there is only one from which the rest flow.* The reason is, that there is a connexion between all things in the world, and a mutual dependence on their first principles, since there is nothing which is not a series, or in a series (n. 586.) This transcendental truth is manifested only by contemplation of the various objects in the world; and is consequently not acknowledged except by a rational view of the facts presented by general experience. Nevertheless, that the truth is such, both reason and experience abundantly testify.

591. *And on which, as their first principle, the principles of natural things are impressed by the Deity.* Consequently, the above-mentioned substance is the first substance of nature, and the first of the mundane system. To this first substance are appropriated and attributed the things which are in it; thus it may be said to *subsist by itself*; but not to *sustain accidents*; for when we reflect on it abstractedly, we perceive that the idea of accidents, resulting from the forms and essences of finite things, is not in any wise adequate to it; since nothing can be categorically predicated of those things which are above nature, as are those which are in the first substance. Wherefore only half of the philosopher's definition of a substance, namely, that it is an entity which subsists by itself, and sustains accidents, applies to this first substance of the universe; but the whole to all other substances. The ancients therefore said with Plato, that the *materia prima* is a thing of abstruse and obscure consideration, and that it is impossible in the nature of things that any knowledge should be obtained of it, except such as is indirect; or, as Aristotle affirmed, except by way of analogy and similitude; and that it is to be considered as without form and accidents, &c. But so far as it contains the cause of the existence of all other substances, it is to be understood as their first principle; yet not a first principle of itself, because it was created by the Deity.

592. *Each series has its first and proper substance, which*

*substance nevertheless depends for its existence on the first substance of the world*;—as the first substance of the mineral kingdom, the first of the vegetable, and the first of the animal; or the first of every species, that is, of every individual of the respective kingdoms. These first and proper substances are what are called by some elements, monads, primitive and simple substances; not that they are absolutely primitive and simple, but that they are so in respect to the compound substances of their series; for if they were absolutely such, they would all differ from the first substance of the world as to essence, or as to form and nature; and would flow as differences immediately from the first substance; which nevertheless they cannot do but by an order of succession, from the most universal substance of nature. Consequently, we should then trace up nature to no higher an origin than nature, and should bound the rational analysis of the mind either in things already thus simultaneously created, or in things thus to be created, successively from one instant to another. Hence all irregularities and imperfections would be made to flow immediately from the first substance, or to be immediately created such, whereas they ought to be ascribed to nature alone. In a word, we should involve the causes of things in numberless occult principles, which the ancient philosophy involved only in a few. I would allow the first substance of any series to be absolutely primitive and simple, if any thing in nature would be thereby rendered capable of explanation; but since nothing whatever can be so explained, I think that I ought not to make the admission. Still less can I do so, if that substance is to be conceived as simple according to the usual description of a simple entity, viz. as destitute of parts, magnitude, figure, internal motion, divisibility; by which adjunct, substance would be deprived of the notion essential to it; as is done when a negative is associated with an affirmative, and a privative with a positive. I do not say that these things are to be affirmed of the first substance; but still, that for want of better terms, they are not absolutely to be denied (n. 650). Wherefore if the first substance of every series be assumed as depending for its existence on the first substance of the world, then, according to Wolff, “Every state of every element involves a relation to the whole world. In ele-

ments and simple substances are contained the ultimate causes of those things that are found in material things. The connection of material things depends on the connection of elements. Extension cannot originate from Zenonic or self-similar points." (*Cosmologia*, n. 213, 191, 192, 205, 218.)

### III.

593. The first substance of every series is its most simple and only substance, which reigns through the whole individual series. From it, and according to its nature, flow all things which have a visible determination in the entire series. For from it, by order of succession, and by connecting media, are derived substances more compounded, which are its vicegerents in the ultimates of the series, and thus give determination to the things existing in that series. By the determination of these substances are formed others more compounded, which may be called mediating and subdetermining substances; by which the essential and proper series, which constitute the entire series, are compacted and connected together. By determining substances, through the medium of such as are subdetermining, one thing is so perpetually connected with another, that an unconnected part is not proper to the same series; consequently, there is a coestablished harmony. The establishment of this harmony is the more perfect, in proportion as the more simple substances are more distinctly discriminated from the more compound, and substances of the same degree, from their associates, their essence and attributes remaining the same: consequently there exists a harmonious variety.

594. *The first substance of every series is its most simple and only substance, which reigns through the whole individual series.* Thus the spirituous fluid in every individual of the animal kingdom, is the only living substantial fluid, and the all in every part; by the operation of which, everything in that limited universe is continued, supplied with moisture, nourished, reno-

vated, formed, actuated, and vivified (n. 37, 38, 40, 41, 91, 97, 100, 101, 152—154, 177, 360, 361, 370, 556). The vegetable kingdom has also its own formative and plastic substance, diffused throughout the whole of every individual, and stored up in the inmost bosom of the seed. Every species, too, of the animal and vegetable kingdom, has its own proper substance, in respect to which all the other things which are in the compounds, are accidents. But this most simple substance is such only in regard to its own microcosm or little world, and is not the most simple of all, which latter is only in the macrocosm or world at large (n. 592).

595. *From it, and according to its nature, flow all things which have a visible determination in the entire series.* This I think is confirmed in Chapter III, On the Formation of the Chick in the Egg.

596. *For from it, by order of succession, and by connecting media, are derived substances more compounded, which are its vicegerents in the ultimates of the series.* Thus there is the purer or white blood consisting of plano-oval spherules; next to this follows the red blood, which is the third in order when the spirituous fluid is considered as the first. Wherefore the red blood is called the corporeal soul (n. 46, 102); and the spirituous fluid is called blood by way of eminence (n. 91—94, 100). The nature of the composition of each species of blood from its own spirituous fluid is explained in n. 91, 92, 95, 96, 108, 371. This composition is effected by saline connecting corpuscles taken from the family of such as are inert (n. 43—45, 50—57, 91, 92). These corpuscles act as concurrent and accessory causes; and being accessory, although they are such by virtue of an express provision, they are called contingent (n. 263). Thus the mineral and vegetable kingdoms concur to the existence of the animal kingdom, since without those kingdoms, the connecting, compounding, and perfecting elements would be wanting; and the spirituous fluid, being destitute of its auxiliaries, would in vain attempt to carry on its work of formation.

597. *And thus give determination to the things existing in that series.* To the intent that they may give this determination, it is requisite, 1. That they be fluids; for fluids, especially the



atmospheric fluids of the mundane system, and the living fluids of the animal kingdom, represent most perfectly the forces of active and passive nature in their form : since in these forces is contained the cause of the co-existence of things. It is requisite, 2. That they flow within their tunics or membranes, by which they receive their determination. Thus the spirituous fluid is determined by its tunics or membranes, whence arise fibres ; and both kinds of blood are determined by their tunics and membranes, whence arise vessels (n. 130). For a fluid un-circumscribed is only an indeterminate fluid. It is requisite, 3. That the fluid and its tunic act conjointly as one and the same determining cause ; thus will the one be in conformity to the other (n. 134, 135, 522).

598. *By the determination of these substances are formed others more compounded, which may be called mediating and subdetermining substances.* Such, for instance, are moving or muscular fibres, which are produced by the determination of their fluids in their fibres and vessels (n. 503, 510). For that fluids may put anything in motion, the little vessels containing them must be so arranged, as to possess the ability of moving, which is a consequence of determinations, or of subordinations and coördinations. Wherefore no part of the body is destitute of its motive fibre ; and whatever part becomes destitute, lives not in its entire series, in an active, but a passive character, or lives not in the particular, but in the general ; such as bones, cartilages, tendons, which yet originally were formed by the coalescence of moving fibres (n. 536). But motive fibres are not determining substances, because they are the fibres and vessels of those fluids which determine them ; neither are they, in respect to the members which are put in motion, substances determined, for they exercise a moving force ; wherefore they may properly be called subdetermining and mediating substances. To the subdetermining substances of the body correspond the subdetermining substances in the brain, which are its organic substances, spherules and cortical tori (n. 287, 505, 557, 561, 644, 647).

599. The little glands themselves, or congeries of most minute vesicles, may also, in some measure, be called mediating substances, since they are the first substances which are deter-

mined by the muscular fibre, so as to receive, secrete, dispense, and distribute, alimentary matter to the blood and viscera, and to cause them to exist perpetually such as they existed at first; consequently, they enter the animal economy as inferior sub-determining substances (n. 163—165, 205).

600. *By which the essential and proper series, which constitute the entire series, are compacted and connected together.* Such are all the viscera and members, and also the organs, which construct a series, and cause it to act according to its structure or form. Therefore the viscera and members themselves, as being substances determined, consist merely of muscles and glands; the muscles and glands consist merely of diminutive vessels, these diminutive vessels of mere fibres, and the fibres of a mere spirituous fluid, which is the all in every part. Consequently, the viscera and members consist of the same spirituous fluid, for which reason they are its essential and proper series (n. 585).

601. *By determining substances, through the medium of such as are subdetermining, one thing is so perpetually connected with another, that an unconnected part is not proper to the same series; consequently, there is a coestablished harmony.* This flows as a consequence from what has been said above, and from what remains to be said, without any further comment. In the mean time, the subject here principally treated of is the connection of the animal series, which being the most perfect of all in the system of the world, may be considered as the exemplar of the rest. For a similar order every where prevails; that is to say, there are determining substances, subdetermining substances, and things determined, where descent or ascent is made by three degrees; but in cases where there are only two degrees, there is no complete determination. For to every perfect determination there is required a threefold progression; since to the existence of an agent and a patient, there is requisite an intermediate having reference to both.

602. *The establishment of this harmony is the more perfect, in proportion as the more simple substances are more distinctly discriminated from the more compound.* This is the case more especially in the brains, although it is verified likewise in the body. For in the brains the spirituous fluid, with its fibres,

secretes and separates itself most distinctly from the blood or its vessels, inasmuch as the red blood, at the instant of its arrival at the cortical substance of the brain, ceases to be red, and enters into it as white blood, and hence again into the little fibres as pure blood, or spirituous fluid, yet still it is in perpetual continuity, and suffers no part of itself to be excluded from that continuity. The more distinctly therefore the fluid of one degree seerns itself from the fluid of another, whilst the continuity still remains unbroken, the more perfect is the harmony established. So likewise in the body; the more perfectly the vessels of the red blood distinguish themselves from the vessels of the white blood, and those of the white blood from the fibres, whilst the continuity still remains unbroken, the more perfect is the harmony (n. 91—94, 100, 149, 150, 158, 214—216, 371, 557). Hence the circulation of the blood is subtriplicate (n. 148). Thus one fluid in its place may act as a cause, and another in its place as another cause, and also all together conjointly as one cause (n. 147, 150).

603. *And substances of the same degree, from their associates, their essence and attributes remaining the same.* For throughout the whole body there is not a single artery, vein, or drop of blood, which, as to all its accidents and qualities, is exactly similar to another, there being a diversity in all (n. 97—99). Thus neither is there a single fibre altogether similar to another, as to its essence and attributes; consequently neither is there any fluid pervading them altogether similar to another: hence neither is there any fibre but has its own proper little heart prefixed to its origin in the brain (n. 177, 471). And if the fibres themselves, or their most slender matres or membranes, are formed and elicited out of their own fluid, by the privation in some degree of its forces and fluidity, it follows, that no individual thing can possibly be the subject of an exactly similar accidentality. Nevertheless, in each and all, there may be the same tendency conspiring to produce effects, of which the essence may be rendered the more perfect, in proportion as the substances from which they result, are distinguished from each other, and in proportion as the more simple are distinctly seerned from the more compound.

604. *Consequently there exists a harmonious variety.* By

harmonious variety we mean all that difference, taken collectively, which can exist between individuals of the same genus or species in their accidents and modes, while the common form and nature, or the essence and its attributes, remain the same. The title, harmonious variety, is the more applicable to these differences, inasmuch as they exist most perfectly in prior substances. As for example; they exist in the first aura, or inmost atmosphere; the individual parts of which we may conceive as nowhere equal to each other, but most distinctly various, according to their distance from the common centre of their activity, whence arises a variety, of which the most perfect harmony may be predicated. This however is imperceptible to the human understanding, since the differences, degrees, or moments, are inexpressible by common numbers. For an aura of this description, formed to receive the forces of the most perfect nature, possesses within it all possibility of applying itself to every inconceivable minutia of variety, and consequently, of concurring with every possible determination; so that there is nothing whatever within it that admits of any comparison with number, nor is there any surd or irrational, which it cannot supply with its own unit, degree, or moment. For it is well known that every number, whether integral or fractional, rational or irrational, has relation to its own units, and from these to its numbers and ratios, as homogeneous. It is well known that by the more simple units, a number of which either constitutes or proximately defines a given unit, we can approximate to a true ratio in an irrational quantity, and we arrive the nearer to it, in proportion as the simplicity of the said unit is more unassignable: thus we come very nearly to the proportion which the diameter bears to the circle, and the diagonal to the side of a square. Consequently, if the individual parts of this aura are susceptible of every variety, whilst its essence and attributes remain the same, then there never can be any disharmony in the derivatives and compounds, which they cannot render harmonious; and indeed in things absolutely irrational, they can approximate so nearly to a proportional, that the difference is of no account, or may be said to vanish; especially when this unassignable minimum, or least quantity, which has in potency all the units which it is to put on, is compared with its

unassignable maximum or greatest quantity, that is, the mundane system. Let us take our explanation of harmonious variety from a nearer object, and let the air serve as our example. No individual part of this air is equal to another. The parts of it which occupy the higher region, are more expanded, consequently lighter, and act less by their *vis inertiae* and more by their *vis activa*. Yet they are so conjoined with each other throughout the whole atmosphere by contiguity, that the result is harmonious variety.

605. From this aura we may now advance to the first substance of the mundane system, and enquire whether a similar harmonious variety may be attributed to this also. It seems indeed that this substance must be acknowledged to possess the highest degree of constancy and permanency in regard to its essence and attributes; and that in regard to its other faculties, which in the subsequent substances are called accidents and modes, it possesses the most perfect harmonious variety: otherwise we could not possibly understand anything to be contained in it beyond a most fixed oneness. This I believe to be the meaning of the celebrated Wolff, when he describes substance as the subject of intrinsic, constant and variable determinations, and as that in which dwell the same essentials and attributes, while modes successively vary (n. 589). By reason of the insufficiency of terms, instead of harmonious variety being predicated of this substance or first aura, harmony alone seems predicable of it, without the addition of variety; for although variety is not inconsistent with it, yet that term is not adequate to express the true idea.

The view of the subject developed both here and in the foregoing observations, seems to have been favored by some ancient philosophers; as by Anaximenes, and Diogenes of Apollonia, who held, that the first elements of all forms were susceptible and flexible. By Xenophanes of Colophon, and Melissus, (who was opposed by Aristotle,) who held, that one thing is infinite, one finite: where he seems to have used the term infinite, not instead of God, who impressed those principles on things, but instead of the terms indefinite and unassignable, for he does not specifically define what his infinite is. By Anaximander, who held that a certain infinite principle was founded on the infinity of things in the world, one of which

continually produced another. By Pythagoras, who held that there is harmony and agreement, and thus unity. By Archelaus, the Athenian, who held that there is an infinite aura, from which all things were brought forth. By Anaxagoras of Clazomene, who held that there are certain similar substances, by the composition of which all things are produced, &c. Thus the idea of them all seems to have been similar, although not expressed in similar terms; for it is only by a slow progress that names or terms attain their peculiar bearings, and are distinctly explained. The ancients, who lived nearer to the golden age of truths, seem to have been content simply to describe the bare thing itself, not to circumscribe it with any ornate investiture of words.

606. Thus in these respects, the animal microcosm, or little world, is similar to the macrocosm, or world at large; viz., its fluids, especially the purest, are in the most perfect harmonious variety; as are also the substances and auras of the mundane system, particularly the first and purest; the harmonious variety of which, in consequence of the defectiveness of language, cannot possibly be expressed in adequate terms (n. 650).

#### IV.

607. By this process the corporeal system is constructed and perfected; in which one thing remains fixed in such a state of subordination to, and coördination with, another, that all individually respect and depend upon each other; in such a manner, that the more simple substances are rendered conscious of every change which takes place in the compound series and substances; and whatever is determined into act, is effected by the more simple, either determining, or concurring, or consenting. Moreover this is accomplished according to natural order, proceeding from an inferior substance to one proximately superior, or from a superior to one proximately inferior; but not from the supreme to the ultimate except by intermediates.

608. *By this process the corporeal system is constructed and perfected; in which one thing remains fixed in such a state of subordination to, and coördination with, another, that all indi-*

*vidually respect and depend upon each other.* This law prevails universally and perpetually in the animal body ; as also, in the vegetable and mineral kingdoms, and in the world at large, as the complex of all. The first substance of every kingdom, species, and subject, is what gives being [*esse*] to the rest ; it is that, also, by which, and for the sake of which, the rest have existence, so that there is nothing in the whole series which has not respect to it, both as the beginning and end of the whole, and as that under which everything else exists in a state of subordination. Thus, there is nothing but what is an intermediate to some further use and end, in such a way, that, being placed between the things which precede and those which follow it, it both contains the relation of the things which follow it, and is itself in relation to those which precede it, on which it depends, and for the sake of which it exists in that and in no other manner (n. 252). See also n. 248—253, 257—298. Thus in every series there is established a kind of circle, in virtue of which the first thing can have reference to the last, and the last to the first. Thus in the human body it is the soul to which all things in the body refer as their first substance, by which, and for the sake of which, they exist. The purposes, state, and happiness, of the soul, therefore, are the objects which all these regard : and to the intent that its purposes may be carried on, there must be something which has precedence, or which is prior and superior, by which, and for the sake of which, the soul exists. Thus nothing terminates in the finite universe, but all things universally in the first Ens of created things, in respect to whom there is nothing in the whole compass of nature and of the mundane system, which is not a medium or intermediate, He being, preëminently, the Beginning and the End ; for which reason also all things flow, in a most wonderful manner, from an end, through ends, to an end (n. 296—298). Thus it is that even the universe itself is distinguished into its series (n. 584—586). And thus in every series there is a similar chain of subordination, order, and form of rule, so that each, whilst accomplishing, individually, its own purpose, is accomplishing, also, the common and hence the universal purpose of all.\*

\* Or, “ so that each while acting in its capacity of an individual cause, acts also in that of a common, and hence in that of a universal cause.”—(*Tr.*)



609. *In such a manner, that the more simple substances are rendered conscious of every change which takes place in the compound series and substances.* This follows as a consequence from the connection established between them, which is the more perfect, in proportion as the more simple substances are distinct from the more compound, both in the brains and in the body (n. 602); and in proportion as the substances of the same degree are distinct from their associates, their essence and attributes remain the same (n. 603, 604). To the intent that these effects may be secured, organs are provided, which may have a sense of all changes that take place out of the series, and of all things that are in contact with it. The tunic or membrane which is the clothing of the whole, is sensible of the more general impressions arising from the touch, appulse, and impact of external objects. The tongue is sensible of the forms of differently shaped bodies, and especially of those which are somewhat rough, or hard, and floating in aqueous fluids: the nostrils are sensible of similar purer bodies floating in the aërial fluid: the ear is sensible of the modulation of the atmospheric fluid; and the eye, of the modifications of the ethereal fluid; thus there is nothing in the earth which does not produce and induce some change with regard to some organ of sense. But in regard to changes of a higher order, such as those, for instance, which occur in the still more perfect auras, and which answer to the modification of the inferior auras, there are also more eminent organs within the series, which have a sense even of these, but in a more perfect manner according as the harmony established between them (n. 602—604) is the more perfect; and according as the compounds suffer themselves, without the intervention of mutable substances in the world and in the body, to be determined to a more orderly arrangement by their more simple substances. But in what manner the more simple substances and series are rendered conscious of what happens in such as are compound, can be known only from their connection, some idea of which is suggested in this Part, as in n. 216, 217, 234, 268, 287, 505, 557, 561, 574—576; also in the sequel, n. 641—647; and as respects the cerebellum, in n. 558—561, inclusive, where it is shewn that this organ is rendered conscious of the general changes existing in the body: but as those changes do

not come into the distinct perception of the cerebrum, they are generally supposed not to reach us.

610. *And whatever is determined into act, is effected by the more simple, either determining, or concurring, or consenting.* What the substances are, which give determination to the things existing in their series, may be seen in n. 597; and inasmuch as they are distinct from each other (n. 602), determination may be predicated of each. When, therefore, the determination comes from the more simple substances, it is according to natural order (n. 271—278); but when it comes from such as are compound, viz., when causes out of the body, or when causes within the body, are those which excite, then the more simple substances either *concur* (for to the intent that a full action may exist from sufficient causes, a concurrence of several things is requisite, with which the force of the more simple substances, being that which gives determination to all the rest, must concur); or else they *consent*, since without consent no action ensues. Even parts which are dissentient can enter into consent; but when the determination exists in act, the parts which had consented prevail over the rest.

Thus *freedom* is predicable of the will, when causes arising from the world, or the body, can be referred as exciting causes to the will of the superior faculties or powers, and when at the same time these latter concur or consent before they are determined into act: consequently to the freedom of the will, it is of no importance what has ingress, but what has egress, or not what excites, but what is determined. The freedom of the superior faculties of the same series therefore is the less, in proportion as they are the more drawn to that side of the question to which the inferior faculties are impelled; and, on the other hand, the freedom of the superior faculties is the greater in proportion as they are able to descend to that side of the question of their own accord; especially in proportion as they are more strongly induced to descend. In the meantime, when determination takes place, the inferior faculties can no longer be said to determine or act, but to be determined and acted upon; because they are under the superior, and are bound to comply, in order that what is determined may come into existence. For the existence of an action is owing to the principal cause; but

as to the quality of the action, we may observe, that those, or many of those things which are in the action, are either owing to the principal cause providing that such accessories shall attend it; or to some mediate or proximate cause doing the same, and hence to the principal cause which admits them into the action; or finally it is owing to a still higher cause, which provided them from a still earlier origin. Thus an action is endowed with qualities according as it derives them either from a more principal and hence a more perfect cause, or else from other causes. Now, so far as there is liberty of acting, so far also is there the liberty of suffering one's self to be acted upon by what is superior. And since, as already observed, liberty is predicable of the will, therefore when causes arising from the world, or the body, can be referred as exciting causes to the will of the superior faculties or forces, and these concur or consent, that is, condescend to them, it hence follows, that there is a liberty of so disposing one's self as to be in a state of suffering one's self to be acted upon; to form which state, things superior also concur, which provide for the accession of those things which qualify, or give the quality, as was said above. There is therefore a liberty of acting, relatively to things inferior; a liberty of suffering one's self to be acted upon, relatively to things superior; from both which results a liberty of disposing one's self to be acted upon.

611. *Moreover this is accomplished according to natural order, proceeding from an inferior substance to one proximately superior, or from a superior to one proximately inferior; but not from the supreme to the ultimate except by intermediates.* On this account subordination is distinguished into degrees, that all things may flow in due order. For a fibre cannot act except upon its own motive fibre, which is its mediating and subdetermining substance; nor can this latter act upon the fleshy moving fibre, except by an intermediate (n. 503—505, 510, 532, 557). The same law prevails with all other substances, whether existing in an animal (n. 571—578), vegetable, or mineral; for it is contrary to the nature of things, that a remote cause should be a proximate one, and that one prior in order should be the immediate cause of the one which is ultimate, or of the effect (n. 270). Thus the same law prevails, whether an inferior cause

act upon a superior, or a superior on an inferior, as in the cases mentioned in n. 609, 610.

## V.

612. Simple substances, and those which are less and more compound, which are the determining substances of the things in their own series, are, according to their degrees of simplicity or of composition, prior and posterior; superior and inferior; interior and exterior; more remote and more proximate; and, amongst each other, are as efficient causes and effects. Those which are prior are also more universal, and in every quality are more perfect than those which are posterior. The prior also can exist without the posterior, but not the posterior without the prior.

613. *Simple substances, and those which are less and more compound, which are the determining substances of the things in their own series, are, according to their degrees of simplicity or of composition, prior and posterior; superior and inferior; interior and exterior; more remote and more proximate; and, amongst each other, are as efficient causes and effects.* By simple substances I mean the first of every series, in respect of which those which follow are compound; such for instance is the spirituous fluid in the animal kingdom, after which follows in order the blood of each kind; next, the medullary or nervous fibril, which is only a most simple artery; then, the motive nervous fibre in the muscles; and so on (n. 115.) The substances, therefore, which are more simple, are also *prior*, both in order and time: they are *superior* in order with respect to degree, for the first holds the supreme station (n. 91—96, 100, 148—150, 158, 371); they are also *interior* (n. 216): and likewise *more remote* (n. 548, 549). Wherefore nature is said to ascend, and to betake herself inwards, and indeed the more highly and internally, in proportion as she approaches nearer to her simple substance, in regard to which, all the rest, which are compound, are posterior, inferior, and exterior. A simple substance may thus be considered a cause, since a prior, superior, and

interior substance continually operates as a cause to one which is posterior, inferior, and exterior. Hence arise the expressions of, *a priori* and *a posteriori*; of ascending, descending, and transcending in series; of numbers being raised to higher powers, and of nature retiring into herself, which she does when returning to prior causes, and more inwardly still, when returning to their first principle.

614. *Those which are prior are also more universal.* Thus the first substance of the mundane system is the most universal of substances, because the only one in compound substances. In like manner, the spirituous fluid is the most universal substance in the animal series, because it is the all in every part, and the only substance in the series that lives, or by which the rest live. The medullary or nervous fibre is the one only determined substance in the same kingdom, whence it is the most universal; and the nervous motive fibre is the one only determined substance in the muscle, because it rules universally in that kingdom. So likewise in all other cases. For according to Aristotle, that is a universal which is predicated of many things, and which naturally is in many things; for, as he says, the common essence or nature, which others call the universal principle in many things, is always preserved even during the perpetual and continued succession of individuals. Wherefore the philosophy of universals is that which contains the principles and elements of the things which follow from them. But a universal has respect not only to substances as giving determination, but also to series as receiving determination from them: hence it is usual to arrange things into genera, as also genera into species, and indeed into genera superior and inferior, the determinations of which, as being general, enter into the species, and into their particulars or individuals. Therefore, since there are degrees of universality, and there is nothing in the whole system of the world which has not respect to something more universal, a species is sometimes taken for a genus, either superior or inferior, according to its relation to the things which belong to it in order (n. 584).

615. *And in every quality are more perfect than those which are posterior.* In other words, prior substances, viewed in themselves and in their own nature, are more perfect than such as

are posterior viewed in themselves and their nature (n. 176). They are more perfect for instance, in regard to form, essence, attributes, accidents, and qualities; consequently they are more distinct, similar, unanimous, constant, and fluid; they are in the fuller enjoyment of all their virtue or force, just as active substances are in the fuller enjoyment of their elastic force; they are also more beautiful, and more disposed to agreement: hence also it follows, that they are less limited, more free, in greater potency, more sensible, more rational, more durable (n. 100—102, 115, 258, 259). For the smallest defect in the first determining substances would occasion the greatest in the substances determined; since error would increase according to descent in degrees (n. 248, 249, 251).

616. Order also itself exists in greater or less degrees of perfection: but the perfection of the order flows from the perfection of the first substance or first determining principle in every series; for the very determining principle itself is a series, because in the series of the universe (n. 586). Wherefore the order of the whole series depends on the order of the first substance, as being in itself and in its own nature the more perfect. The greatest perfection of any entire determined series, is, when it corresponds to the perfection of the determining series: yet the highest perfection cannot on this account be predicated of it, unless the perfection of its first determining series, from which a like determination flows, corresponds to the perfection of the first series in the mundane system. But that the order of derivatives may correspond to the perfection of primitives, we must suppose that all those things which are to enter into the derivation of things posterior, accede to it, either by express provision or contingently: they accede to it by express *provision* in the natural formation of every series, nay, even in what is thence formed, in order to its perpetual existence, that is, to its subsistence. Wherefore the series of the contingents are simultaneously included in the determination of the first substance of every series, which so arranges them as to cause them to accede\* (n. 263—265, &c.). If they accede *contingently*, they are provided either by some other superior

\* A quâ sic disponuntur ut accedant.

principle, whence comes a more perfect order; or by some inferior principle, whence comes a more imperfect order. Concerning the perfection of harmonious coestablishment, see n. 602—606. This perfection in things successive coincides with the “transcendental goodness” of the ancients, which, according to Wolff, is predicated of the order which prevails in the variety of those things which are together, and follow one another; or of the order of those which agree with an Entity; whose perfection is greater, in proportion to the greater (or better) variety of consenting things. (*Ontol.*, § 503: *Cosmol.*, § 552). Hence it is evident that the world at large, and also our little world, are themselves most perfect (n. 115, 239, 240), but that we ourselves are the cause of our imperfection.

617. *The prior also can exist without the posterior, but not the posterior without the prior.* I speak not of things undetermined, which are the subjects of the theoretical sciences, but of things determined, which are subjects of the world and of nature, in which there is nothing whatever that is undetermined, because there is nothing which is not either a series, or in a series (n. 586). For the spirituous fluid exists prior to the purer blood, and the purer blood prior to the red blood, in which last the spirituous fluid is the one only substance which lives. The same holds in all other cases, as may be seen throughout Chapter III., on the Formation of the Chick in the Egg. Consequently, what is prior can subsist without what is posterior (n. 67); and thus, after the decease of the body, the soul will survive; for when the body perishes, nothing perishes but mere accidents, and nothing recedes from the soul but mere accessories, or elements borrowed from the kingdoms of the earth.

## VI.

618. Such as are the substances, such likewise are their essences, attributes, accidents, and qualities; or all their adjuncts. Of these also it may be predicated, that they are series, and are in a series; of the adjuncts, that some are more or less simple, prior, superior, interior, universal and perfect, compared with others; just as is the case with the substances in



which they are, and from which they flow. It may be predicated further, that the superior enter by influx into the inferior, and *vice versá*, according to the mode in which the substances are formed, and in which they communicate by connection with each other. But those which occupy a superior place are incomprehensible, and to the sensory of things inferior appear as continuous; whilst those which occupy an inferior place are comprehensible, and appear to the sensory of things superior as contiguous. Yet such is the coestablished harmony of all things in the same series, that they mutually correspond to each other, without any difference but that of perfection according to degrees; wherefore the inferior regard the superior as their analogues and eminences.

619. *Such as are the substances, such likewise are their essences, attributes, accidents, and qualities; or all their adjuncts.* For substances are the subjects of accidents and qualities. If therefore we say, that matter joined to form is the substance; that the nature by which it determines itself according to the form, or the nature joined to the form, is the essence of that substance; that the possibility of admitting modes is its attribute; that the modes themselves are its accidents; and that the variety of modes is their quality; we may in such a case infer the following to be the order of the whole:—that essentials properly belong to the substance itself, attributes to essentials, accidents to attributes, and qualities to accidents. Consequently, whatever is predicated of a substance, is such as the substance itself is.

620. *Of these also it may be predicated, that they are series, and are in a series.* For unless accidents be series, quality cannot be predicated of them. Thus a muscle is a compound substance, and is a series of motive fibres, and is in a series, viz., in the integral or common series of the body: its essence consists in the form or construction of the fibres in and amongst themselves (n. 503); consequently, in the nature, by which it determines itself according to the form: its attributes are the forces or powers of acting that exist in the fibres, or,



if taken collectively, in the muscle: its accidents are modes: its modes, taken either successively or simultaneously, are the action, of which, according to the variety and relation of the modes, quality is predicated. Therefore, since a muscle is viewed as a series, the forces and modes, with the action thence resulting, are also viewed as series, which receive their quality according to the form and the nature of the action thence resulting belonging to the muscle itself (n. 586).

621. *Of the adjuncts, that some are more or less simple, prior, superior, interior, universal and perfect, compared with others; just as is the case with the substances in which they are, and from which they flow.* Thus as the simple motive fibres in a muscle are its first and supreme substances, &c.; as the white motive fibres are its posterior and inferior substances in respect to those which are supreme, but its prior and superior in respect to the fleshy motive fibres made up of the vessels of the red blood, which are its posterior and inferior substances; so likewise are these posterior and inferior substances prior and superior in respect to the entire muscle, or to all the muscles of the same common series, which are the most compound motive fibres, consequently the last or lowest in respect to all those which are prior and superior. The case is the same with the forces, modes and actions resulting from them.

622. *It may be predicated further, that the superior enter by influx into the inferior, and vice versâ, according to the mode in which the substances are formed, and in which they communicate by connection with each other.* For the forces and modes themselves may be compared with fluids, since fluids resemble the forces of active nature (n. 66, 67, 100, 171—172, &c.). Whence also the forces are said to be modified; wherefore forces, viewed abstractedly from substances, may be said *to flow*, and *to be influent*; or *influx* may be predicated of them; just as substances may be said *to be connected*, and, by connection, *to act* mutually on each other. Thus, in a muscle, the power or force of a simple motive fibre flows into that of a compound motive fibre, according to the order in which the substances act on each other.

623. *But those which occupy a superior place are incomprehensible, and to the sensory of things inferior appear as continuous.* For one muscle may consist of a myriad of fleshy motive fibres:

one fleshy motive fibre may consist of a myriad of white or mediate motive fibres ; and one white or mediate motive fibre, of a myriad of simple motive fibres. The sensory, therefore, which discerns only the degrees and moments of the entire muscles amongst each other, cannot distinguish the degrees and moments of the motive fleshy fibres amongst each other, still less of the simple fibres ; wherefore the forces and modes of the latter appear as destitute of degrees and moments, consequently as incomprehensible and continuous.

624. *Whilst those which occupy an inferior place are comprehensible, and appear to the sensory of things superior as contiguous.* For the sensory itself cannot judge distinctly of the sensible impressions of which it is the subject, since it conceives only a general notion of them, that is, of the general action of the forces and modes. Hence, to judge of what belongs to an inferior power, a superior power is required. For the superior distinguishes and discerns, in the inferior, the essences, attributes, accidents, and qualities, as compounded of their more simple principles, but entering into them in a general manner, consequently as distinguished into degrees and moments ; whence comes the perception of what is simultaneous and of what is successive, consequently of space and time,

625. *Yet such is the coestablished harmony of all things in the same series, that they mutually correspond to each other, without any difference but that of perfection according to degrees.* Thus the simple moving fibre acts precisely in the same manner as both the white and the fleshy one (n. 472, 570). For in order that one may be an acting cause productive of the action of another, there must exist a harmony, not only between the coördinates in the same degree, but also between the subordinates in several degrees ; otherwise one cause could not act upon another, and make a compound action, in which it should be the cause and beginning : since if the two did not correspond, collision and error would ensue.

626. *Wherefore the inferior regard the superior as their analogues and eminences ;* because they are incomprehensible (n. 623), and yet mutually corresponding to each other (n. 625). Therefore, the proximately superior may be called the *analogue* of the proximately inferior ; that which is still superior, may

be called the *eminent* of the inferior; and that which is still superior, may be called its *super eminent*; and so on.

627. What has now been said respecting the forces and modes of acting of the museular motive fibres, is to be understood also respecting sensations, regarded as forces and modes. For if the organs themselves be considered as series, and these series as compound substances, which sustain accidents both intrinsic and extrinsic; or if they be considered as subjects of the sensation of the things which befall them; in this case the organs, according to their kind, have sensation of those things, and impart their sensations to the brain, according to the kind of connection intervening between the two. Again, *vice versá*, the brain, which is the common sensory of the organs of the body, has sensation according to its quality or kind, and causes the organs to sensate according to the kind or quality of the connection intervening between them and itself (n. 622). Therefore, from the connection of the substances, we may form a judgment concerning the influx of sensations. What is the harmony coestablished in the brain for this purpose, will be seen in n. 641—648.

## VII.

628. Aggregate entities of the same degree and series have reference to their units, as to their most simple parts, with which they are homogeneous. From the form, nature, and mode of acting of these aggregates, are discoverable the form, nature, and mode of acting of the parts. Consequently, a general and particular experimental knowledge of the things which at any time reach any sensory, will point out the essence of the most minute things of the same degree, as also of the corresponding things of the still more simple or superior degrees. Wherefore we are led into the inmost knowledge of natural things by the doctrine of series and degrees conjoined with experience.

629. *Aggregate entities of the same degree and series have reference to their units, as to their most simple parts, with which*

*they are homogeneous.* By units I do not mean the monads of Morinus ; or the homœomeriæ of Anaxagoras of Clazomene ; or the atoms of Epicurus, Democritus, Leucippus the Elean, or of Mochus the Phœnician ; nor the primitive and simple elements of other philosophers, considered as incapable of being further resolved ; but by units I mean the most minute constituents in each degree of any series. For in a series of three degrees there are three distinct units, or three distinct quantities of units ; or, should any one prefer another mode of expressing it, in a series of three degrees, there are three substances or simple forces to be considered as units ; one of which is more simple than another, yet having a mutual relation to each other ; thus the other things composed of them, are as numbers composed of such units, each of which is homogeneous to its own unit (n. 156). Thus in the animal kingdom there are three successive fluids to be considered as quantities, viz., the red blood, the intermediate blood, and the spirituous fluid, each of which has reference to its own unit as the most simple particle of its own degree (n. 115, 156). The case is the same in other instances : as in that of the blood-vessels and fibrils of the nerves ; in that of the motive fibres of the muscles, and of the simple pores and vesicles of the glands. It is the same also in the vegetable and mineral kingdoms, thus in every species of metal, mineral, earth, stone, salt, water, oil, and spirit, in every degree of composition of which there are particles, which are the units of their quantities. So again in the circumfluent or atmospheric world ; the air, ether, and higher auras are all composed of such parts. Consequently, as this is the case with substances, so is it the case with their essences, attributes, accidents, and qualities (n. 619—627). If these be viewed as the matter of the things belonging to them, their units are the parts or elements of such matter, with which all other things of the same degree maintain a homogeneity. It is here to be observed, that matter, parts, and elements are predicated of things considered as abstracted from their substances, or of the adjuncts of their substances : so that these units are the parts and elements of philosophical matter. The degrees also and moments themselves, when considered differentially in regard to each other, are each equivalent to their unit (n. 155, 156, 158—161.)

630. It is important to have a distinct idea of units or parts, and of the quantities and qualities thence resulting, in order that we may have a distinct idea of degrees in the progression of things; for from these ideas flow a distinct notion of series, its form, nature, composition, change, and divisibility. For every series of things simultaneous, or in other words, every aggregate of things coördinate, admits of being divided till you arrive at its unit; beyond which you cannot proceed further, and yet leave a unit, or a part of that degree; for if this unit be resolved, there no longer remains a unit of its own degree, but of a superior degree. For a unit itself is a series of several other units, because it is itself in the series of the universe; nor can anything be conceived as not being a series, except the first substance of all (n. 586). Consequently, a superior unit, and the proximately inferior unit of the same series, are to each other in a triplicate ratio; that is, the one bears the same ratio to the other as a root to its cube: the case is the same with regard to the rest. Thus they are not homogeneous to each other; neither are the units of different series, unless they are contained under the same genus. For to the production of all the variety that exists in the universe, it is requisite that there be distinct series, viz., one within another, one in juxtaposition with another, and one for the sake of another; yet all wonderfully connected with each other, and all having reference to the first series of the universe. Units thus considered are either of a determined or certain quantity or quality, as in all terrestrial things; or of one that is undetermined or varying, as in the auras of the world, amongst the parts of which therefore there is a harmonious variety (n. 604—606); parts which nevertheless, in respect to their own ratios, are determinate. The Pythagorean philosophy seems to have acknowledged similar units, having their harmonies and concords, which it compares with the units of numbers.

631. *From the form, nature, and mode of acting of these aggregates, are discoverable the form, nature, and mode of acting of the parts.* For aggregates are nothing but a number of their units or parts, which does not carry with it any peculiar nature of its own, but merely that of its units. This may be illustrated by the instance of the air or ether, the greater volumes of which

are circumstanced, in all their modes of acting, exactly like their lesser volumes, and their lesser like their least or their particles: for there is nothing in such a pure volume, which is proper to it, but what it has received from its parts; as elasticity, expansibility, compressibility, modifiability, fluidity; with the distinguishing quality belonging to each, and by reason of which it is such as it is. So likewise in regard to the fluids of the animal kingdom; each of which, in its largest volume, represents its least volume; consequently, any one part is the type of the whole (n. 105, 156, 159, 306). The case is the same with everything else which at any time becomes an object of sensation and perception. But the aggregates of units, or of parts, are no longer of one and their own degree, when, by other intermediate or accessory units, they form a compound unit; for then, of what was before an undetermined aggregate of units, a determined single one is formed, which acquires the name of a substance subsisting by itself (n. 589). From these remarks it follows as a consequence, *That a general and particular experimental knowledge of the things which at any time reach any sensory, will point out the essence of the most minute things of the same degree.*

632. *As also of the corresponding things of the still more simple or superior degrees.* For according to the theorem in n. 625, such is the coestablished harmony of all things in the same series, that they mutually correspond to each other, without any difference but that of perfection; and the inferior regard the superior as their analogues or eminences (n. 626 and 252). There is nothing in any series which does not contain the cause of all that is subsequent to it, and refer itself to all that is antecedent. Thus the nature of the efficient cause is made manifest from a careful examination of the effect. Hence by reflection alone on perceptible phenomena, only adding to them the degree of perfection which our rules direct, and investigating the origin which is proper to their nature, we arrive at the knowledge of things superior; but only of those which are in series of the same species, in which everything that occurs illustrates and declares, in its own way and manner, what is the quality of each particular. Nay, from these we may even arrive at the knowledge of what there is in the others, if the con-

nection and relation between them be given, and their specific and particular differences. *Wherefore we are led into the inmost knowledge of natural things by the doctrine of series and degrees conjoined with experience.*

## VIII.

633. The most simple and the only substance of the animal kingdom is the spirituous fluid; which is most perfectly determined by the first aura of the world; whence it obtains such a nature, as to be a substance capable of forming its own body; and to have in it life and consequently soul, which is the principle of the things existing in the whole of that series.

634. *The most simple and the only substance of the animal kingdom is the spirituous fluid.* This we have often shewn in our preceding remarks. It is the all in every part, and the only substance which lives, all the rest being derived from it, through the interjection of elements borrowed from the earth, which are accessories, by means of which it passes into the inferior fluids, through these into the material body, and thus into the ultimate world.

635. *Which is most perfectly determined by the first aura of the world.* This follows as a consequence, if the parts of this fluid are a series, and in the series of the universe; since nothing is prior, superior, more universal, more perfect, than the aura immediately formed from the first substances, from which it possesses all its potency—a potency which is scarcely more expressible than is that of the parent substance itself, on which, as their first principle, the principles of natural things are impressed by the Deity (n. 591). For the first aura is the veriest form of the forces of the created universe, to which the qualities of the inferior auras can be ascribed only by way of eminence; such as determinability, modificability, fluidity, elasticity, with several others; for this aura is the very and most perfect force of nature in form. But whether the individual particles of the spirituous fluid are formed by the determination of that aura, so as to be the first and most perfect series of the animal kingdom, can only be concluded from the knowledge of



effects, or seen as it were by reflection in a mirror; for the mind [*mens*] cannot be elevated into the knowledge of things which are above itself; hence it must aim at the higher by beginning from the lowest; consequently, it must begin with the phenomena which indicate in what manner the inferior auras flow into the life of an animal;—as first, in what manner the air flows in, next, in what manner the ether, then in what manner the superior aura, and lastly, the supreme: for that there are four in order is shewn in various parts of our Work (n. 53—58, 65—68, 584). With regard to the *air*, it expends all the natural potency and force it possesses in sustaining the animal body. It exercises, for instance, the potency and force of pressure on its surface, that the parts may be held together in connection with the whole: its potency and force of fluency upon the lungs, that they may respire, and enable the parts of the body, in connection one with the other, to live: its potency and force of producing modifications upon the windpipe, larynx, and tongue: its potency and force of receiving modifications upon the ear, the whole structure of which most artificially corresponds to its modes or modulations; nay, it also assists in the composition of the red blood (n. 43—45, 50—52, 91, 92). With regard to the *ether*, or more eminent air, this also employs its potencies and forces in holding together in connection, and in giving animation to, the parts corresponding adequately to its nature; as might be proved by numerous examples which it is not necessary here to adduce. I will mention only, that this ether modifies its own organ, or the eye, whence comes vision as the analogue of hearing: it produces also modifications in those animals that spontaneously excite for themselves light in darkness, as cats, dormice, &c.; beside which it contributes to the existence of the purer or middle blood (n. 53—57). With regard to the *superior ether*, that it supplies to the purer organs similar aids for their activity and life, is sufficiently evinced by the subordination of the organs and sensations of the body to those of the brain,—a subordination, which, on comparing the instincts of the higher with those of the more imperfect or brute animals, whose spirituous fluid is determined by this ether, is seen to be different in different species. With regard to the human spirituous fluid, this is



determined by an aura still more eminent and celestial, all things in which are inexpressible, because incomprehensible, and as it were continuous, to the inferior sensory (n. 623, 624). Thus as by a ladder composed of so many steps, we in a manner ascend from the sphere of visible effects or comprehensible determinations, to the supreme sphere; and this, according to the maxims of the old philosophers, who have asserted, that superior things do not suffer themselves to be known, except by reflection, and in effects, as their mirror. The Chaldean, Egyptian, Greek, and Latin philosophers, were of opinion that that there are several heavens, by which they meant the circumfluent universe. Mercurius Trismegistus, Plato, Jamblicus, and Alcinous, believed those heavens to be alive and animated; and Origen conceived them to have reason, together with virtuous and vicious inclinations. Aristotle says, indeed, that they are animated, but he attributes to them an assistant soul without intellect; exactly according to our meaning in this theorem.

636. *Whence it obtains such a nature, as to be a substance capable of forming its own body; a faculty and virtue which have been treated of in Chapter III.* By the nature of a thing, I mean, according to the definition of the philosopher [Aristotle], its principle of motion and rest,—a nature in which it is of itself, and not by its accidents. According to the same author, there are three principles to everything, viz., matter, form, and privation, from which exists its nature, so as to be the cause of the things in its series. The first aura is therefore the matter from which other things are derived; from the determination of this aura results its form; to this matter and form may be added the third principle, or that of privation, to the end that a substance may exist which subsists by itself, having in it a nature which is its principle of motion and rest, in which nature it is of itself, and not by its accidents. Thus the same philosopher says, that by natural things he means a body resulting from the union and composition of matter and of form.

637. *And to have in it life, and consequently soul, which is the principle of the things existing in the whole of that series.* Of this subject we have treated in Chapter III. Aristotle defines the soul to be the first perfection of the natural organic body, having life and potency; also, as the principle by which

we first live, feel, are moved, and understand; but that its extraction is more noble and exalted. He further affirms, that soul and form are the first perfection of body, and that its second are the functions and operations, which depend upon the first. These things are further treated of in n. 647.

638. Materiality cannot be ascribed to the human spirituous fluid. For when we speak of form, and the matter or *materia ex quâ, in quâ et circa quam* [Wolff, *Ontol.*, n. 949], to which matter are assigned its parts, which are such that quantity cannot be predicated of them, we mean, with the ancients, some things in opposition to no things; in which sense, the philosopher says, that matter is the first subject from which all things subsist, which are born originally of themselves, and not through the medium of another; and that it is the ultimate part into which things are resolved, and in which they terminate: wherefore also amongst principles he reckons matter and form. But the same term, applied to substances, is at this day applicable to compounds, as having *vis inertiae* and extension. Wolff says: "Matter is an extense endowed with *vis inertiae*; it is modified by variation of figure; and is that which is determined in a compound entity." (*Cosmol.*, § 140, 146; *Ontol.*, § 948.) This very fluid itself, in which is life, is determined from the most eminent aura of the world, and has nothing in it of inertness; because that aura is the most perfect force of nature in a form, and knows nothing either of resistance, or of weight, and its correlative lightness; for it is itself the first principle of weight and lightness, consequently of inertness. The heavens, says Aristotle, have neither weight nor lightness: wherefore all materiality, as being inert and a terrestrial phenomenon, must be abstracted from force as the first principle of weight, consequently from the first aura, and from its most noble determinate. Thus active and living force answers to gravity, as its analogue, or fellow by way of eminence. But alas! how difficult it is for the understanding to exercise such a degree of abstraction, as not to retain, in thinking of first principles, notions which it has conceived from the entire effect (n. 650). Owing to this cause it is that the very mind itself, whose activity in its body is in no case pure, is often at variance both with itself and with

others: and thus that one and the same thing, when not similarly conceived as in the succession of things dependent on it, gives rise to great disagreement, especially if derived from things which are said to be included in the principles.

## IX.

639. If we would explore the efficient, rational, and principal causes of the operations and effects existing in the animal body, it will be necessary first to enquire what things, in a superior degree, correspond to those which are in an inferior degree, and by what name they are to be called; which is a work demanding both a knowledge of facts and skill in judging of them. For in proportion as nature ascends by her degrees, so she raises herself from the sphere of particular and common expressions to that of universal and eminent ones; till, at length, in the supreme region of the animal kingdom, where the human soul is, there is no corporeal language which can adequately express its nature, and much less the nature of things still superior. Wherefore a mathematical philosophy of universals must be invented, which, by characteristic marks and letters, in their general form not very unlike the algebraic analysis of infinites, may be capable of expressing those things which are inexpressible by ordinary language. Such a philosophy, if well digested, will be, in a manner, the one science of all the natural sciences, because it is the complex of all.

640. Before proceeding to an explication of this part of our subject, it will be necessary to premise a brief description of the brain and its substances. For to deduce, *à priori*, the mode in which the soul flows into its mind, and the mind into its body, would be to act like an augur who should utter his predictions before he had inspected the entrails of the victim; or, if I may use the simile, would be like describing, from the egg, the body which has yet to be formed, instead of taking the description from the body itself after it has been already formed.

641.\* From the two brains, of which one differs from the other in size and function, and of which one is called the *cerebrum*, the other the *cerebellum*, flow and are derived the two *medullæ*; the superior of which having a common connection with both the brains, and distinctly deriving its origin from each, is called the *medulla oblongata*; and the inferior, which is a continuation of the superior, is called the *medulla spinalis*. From the two medullæ flow and are derived the *nerves*, and from the nerves all the texture of the adjoined *body*. The connection and composition of the body are such, that the body acts and suffers according to the impulse, and at the pleasure, of the brains; and the connection and composition of the brain are such, that the brain knows whatever is passing in the body, so that everything which occurs in the latter may be under its regulation, and that everywhere there may be unanimity and concord in performing the several offices resulting from the several divisions of labor. For this reason the superior medulla, as to a great part of it, appears to be a continuation, appendix, and offspring of the brains; the inferior medulla to be a continuation, appendix, and offspring of the superior; the nerves, to be a continuation, appendix, and offspring of the medullæ; and the body to be a continuation, appendix, and offspring of the nerves.

642. Each brain and each medulla is encompassed with its coats and membranes, which are called *matres* and *meninges*. That which forms the outermost surface, and lines the inside of the skull, is the *dura mater*, or *crassa meninx*; that which occupies the place next to the brains, is the *pia mater*, or *tenuis meninx*. Another covering also intervenes, of a reticular form, called the *arachnoid*, which, like a lymphatic duct projected into a plane, incloses the better lymph, or nervous juice, and dispenses and distributes it into the beginnings of the nerves, wherever there is need of it. These membranes, *matres*, or *meninges*, as common coverings, accompany the nerves, which, on leaving the medullæ, gradually assume and superinduce from them a coat as a sheath: and thus clad, as they proceed into

\* The paragraphs from n. 641 to 646 are marked in the original by inverted commas: which perhaps implies that they are extracted from the author's great Work on the Brain.—(Tr.)

the provinces of the body, and descend into its hollows and valleys, they gradually lay their coats aside again. The nerves themselves, with their membranes, become finer and finer in their progress, till they attain their extremities and the inmost parts of the viscera, where at length they are possessed of such a delicacy, form, face, and expansion, that they are affected by the slightest modes, changes, and differences, answering to similar ones in the brains to which they return. Thus the brain, in its first principle, is made sensible of whatever is transacting in all the extremities of its kingdom.

643. Each brain and each medulla consists principally of three *substances*; the first of which, when occupying the outermost region of the brains, is called the *cortical substance*, and when occupying the inner region, as in the medullæ, is called the *cineritious substance*. The second is called the *medullary* or *white substance*, and is always in continuity with the cortical or cineritious. The third is produced from the minute arteries, which, accompanying the meninx, penetrate into the brain, and unfold themselves everywhere in its minute spaces.

644. The cortical substance, either when lying proximately beneath the pia mater, and watered, nourished, and cherished by the purer blood, or when, under the name of the cineritious substance, it occupies various tracts more remote from the surface, may, by the naked eye, and more plainly still by the help of glasses, be seen to consist entirely of minute spherules nearly approaching to an oval form. The cerebrum and cerebellum themselves, also approach nearly to the spherical and oval form, and thus assume a shape like that of their parts. Hence these minute organic substances, inasmuch as they are like their whole, and have the same potency individually, which, conjointly and aggregately, is exercised in the compound, merit the name of *cerebellula*. The eye also, by artificial aid, is enabled to discover that these forms, spherules, or cerebellula, are clothed with, and inclosed in, a membrane or meninx, much in the same manner as the brain itself, except that their membrane or meninx deserves the title of pia in the superlative degree, and that they are distinguished from their neighboring and associate spherules of the same kind. It may also be discerned, that these most delicate coats are composed of villi and capillary

shoots, of most minute arteries, in multitude innumerable, in determination wonderful, and in order most beautiful; which diffuse in all directions a volatile and spirituous fluid, educed from the blood, and conceived by eminent generation in their most pure wombs. These cerebellula appear to be the internal sensories, which receive impressions and modifications from the external sensories, and which convey them afterwards higher up to the judgment-seat of the mind. These cerebellula being again collected into tori or masses of different forms, and encompassed by a complication of minute vessels, construct and constitute a kind of second dimension of organic parts.

645. When, therefore, animal nature, in this last and first end of its arteries, nerves, and tunics, has first moulded its organic elements into spheres of the most perfect form, so that from these, as from its summits or centres, it can survey whatever is passing within the range of its appendages; it next becomes necessary, in order for it to contemplate the state of its economy in and from these organic elements, to emit radii into the whole circumference of its dominion; it therefore puts forth minute fibrils from each of these conglomerated spherules, by means of which it continues itself to all the ultimates of its kingdom; much in the same manner as the brain, which is the complex of all the spherules, continues itself, on a larger scale, into its medulla oblongata and medulla spinalis, and thence into the nerves. Those cineritious particles clothe the fibrils emitted from themselves, with coats, in an order similar to that in which the brain at large clothes its medullæ and emissary nerves. Hence, whatever of a fibrillary nature is visible in the medullary or white substance, is derived from the cortical and cineritious substance, as its parent. Many of these minute fibrils collected into a fascicle, and clothed in like manner with a membrane, originate a second dimension of fibril, corresponding to a collection of the same number of cortical spherules. In the same manner is originated also a third dimension enveloped with tunics; to which answers the brain itself, which, with these, proceeds through the foramen magnum of the occiput into the cavity formed by the vertebræ, down to the os sacrum and os coccygis; and which from this cavity, through the vertebral holes and notches, proceeds onward, to excite and strengthen

the whole machinery of determinations, which the formative substance aims at forming according to the exact mode and law of its own power and representation.

Inasmuch as the arteries of the brain continually divide themselves, until they become most minute capillary tubes and filaments, and are continued into all the cortical substance; the cortical and circutious substances depend from the shoots of their minute arteries, like mulberries and elderberries from the tender stalks of their boughs, or like clusters from the branches of the vine, or else like other forms according to the different species of the animals, so that they seem to be similar to the ultimate effects in shrubs, and to resemble, as it were, the little seeds, in which the most precious juice, issuing from a rich vein, terminates and concentrates itself; just as in citron and other precious fruit-trees, in which one citron or other fruit perpetually comes to its birth as another drops off, that it may always have something from which to begin anew, and in which to enclose and transmit its alkahest and most highly refined essence; and also that it may represent most purely what is the quality of the whole, and at what quality it aims while tending from its first principle to its last effect.

646. Thus the brain is so determined from, and constructed of, little vessels and fibres, as to contain the principles or beginnings of the things existing in the body in so active and living a state, as from its hemispheres to enlighten as it were every particular part, and compel it to action whenever it pleases: these parts being thus subject to the brain, refer to it every one of their changes, so that, from consciousness and foresight, there may be determination to action. Nay, the human brain is endowed with intelligence, or the power of examining, consulting, and judging, previous to acting; as likewise with the power of refraining from action, until reason persuades and occasion requires.

The brain has, in general, two offices to perform: the first, to will what it knows, and to know what it wills; the second, to transmit into the blood, contained in the sinuses at its base, a certain most noble fluid, elaborated in its cortical spherules. To the first kind of these offices are appointed all the organic parts which encompass and constitute the surface like a cortex



or bark. To the second are appointed its members, which, taken collectively, form a sort of chemical laboratory, of which we have spoken in n. 360, 361, 556. These members of the brain, or, if the reader prefer the term, these chemical organs, ought to be carefully distinguished from its sensitive and intellectual organs: they are moreover so separated by an intervening septum or fence, that one cannot enter into the province of the other, except by a most general mode of acting.

If however we would see how, by a most wonderful contrivance, all things are arranged in their respective order, we must conceive of the whole brain as formed in motion and for motion, or represent it to ourselves as having an animation; that is, an alternate expansion and contraction. For thus we shall see what is the function, cause, and mode of acting, proper to each part: since the individual parts are so arranged in reference to each other, under the more general, and these under the most general, that whilst the whole draws its breath, there is no part but is drawing its breath at the same time, or contributing to the animation of the whole; for which reason, we have been led to say, that all the parts of the brain are situated in the stream of its motion (n. 219, 258, 281, 287, 557).

The brain is constructed with a view to reciprocate the alternations of its animation in so orderly a manner, that whenever it spirates and respirates, it refers itself from its surfaces to its planes, from its planes to its axes, and from its axes to its centres.

For its *surfaces* are several. Its outermost is constituted by the dura mater or crassa meninx; the next by the thin membrane called the pia mater; and the next by the membrane called the arachnoid. Under this threefold surface is deposited the cortical substance; which being the part that encompasses the centrum ovale or medullary nucleus, discharges as a sort of cortex the office of a surface.

The common or general *planes* are those which are called the processes. One of these divides the cerebrum into two hemispheres: it is called the first, the vertical, the longitudinal, and the faciform process, or falx: proceeding from the crista galli, or rather from the spina coronalis, it runs under the longitudinal sinus, and over the corpus callosum, as far as the fourth sinus. The second is the horizontal plane, or the transverse or second



process of the dura mater, which is continued near the fourth sinus from the superior process, descends to the cerebrum between it and the cerebellum, and proceeds sideways, in each direction, to the opposite regions of the cranium. It thus involves the cerebrum, and divides it from the cerebellum, so that both may discharge their offices conjointly and separately.

There are also two *axes*. One of these, which is the transverse, descends from the highest region of the cranium, where the canals of the sinuses meet in the occipital bone above the cerebellum, and passes midway between the cerebrum and the cerebellum, down to the isthmus of the ancients, or the region of the pineal gland, the nates, and testes. This axis is constituted by the fourth sinus itself, or the torcular Herophili, and is supported by the isthmus. The sinus seems to terminate in the third ventricle; for it is there taken up by a vein which is sometimes double, and runs across the ventricle: but when it descends there into the chemical laboratory, it is immediately continued from the infundibulum into the pituitary gland; a gland which thus occupies the other extremity of this axis. The second, or the longitudinal axis, begins in the crista ethmoides, where it is divided; but is continued, through the left of the septum lucidum, under the fornix, across the third ventricle and the aqueduct, and so through the fourth ventricle and the calamus scriptorius, till it reaches beyond into the spina dorsa. It makes its appearance on separating the hemispheres and taking out the corpus callosum; and its continued progression is seen on raising up the isthmus and the cerebellum. It is thus a common or general canal, surrounded and shut in on every side with banks, which have here and there intervening creeks.

The *centres* are formed by the pineal gland and the base of the fornix, placed at the two extremities of the third ventricle. There are two of them, because, as observed above, the brain has two general offices. One of these centres, or the base of the fornix, acts as a peduncle to the chemical laboratory, to collect and transmit its medullary substance; whence, in a certain sense, it may be called the centre of rest, the other being the centre of motion.

There is also a similar order and arrangement in every sub-

divided part of the brain ; as in all that which constitutes its cortex, and is composed of conglomerated cortical substances ; for every conglomeration has respect, from its proper surface, to its planes, from its planes to its axes, and from its axes to its peduncles, as to its centres ; much as is the case with the brain in general. Even the pia mater, which is the common surface, everywhere insinuates and enfolds itself among the serpentine anfractuositities, much as the falx does between the hemispheres ; by which means there are insinuated as many planes as there are congeries formed of such substances. Along these planes there also everywhere descend arterial sinuli, just as the fourth sinus descends between the cerebrum and cerebellum ; and these, by their descent, form a species of axes. These arterial sinuli, soon running out into ramifications, at length determine themselves into the individual cortical spherules, as into so many centres ; from which are educed fibrils compacted into peduncles, which then enter the medullary globe. But it is not so easy to discover what representation of the processes and centres is exhibited in the surface itself of these congeries or tori of the cortical substance, except by comparing them with the cerebellum, which is the greatest cortical congeries or torus, and an effigy of which, in miniature, is afforded by these of the brain ; for when they are dissected and examined as to their inmost structure, we find a shadowing forth of the same arboreal ramification as in the cerebellum.

Now as the above mentioned cortical tori are most regularly formed in motion and for motion ; so also are the individual cortical spherules, which are composed of vessels divaricated into the most delicate fibres : and as they are most perfect forms and organic parts, it may be inferred without doubt, from the regularity of the parts compounded of them, that they also have a most distinct relation, from their piissimæ matres to their planes, from their planes to their axes, and from these to their centres. For they are so mutually discriminated one from the other, and so perpetually conjoined, as to be enabled to act as the beginnings of determinations. For one spherule, by general and particular contact and connection, has respect to another as the companion of its task : so also have the fibres produced from them, which, being bound together to form a

certain particular texture under the general one, cause the brain, from its most particular individual parts, to conspire to one common animation; cause each at its pleasure to flow into its alternations, and by its mutual relations one to the other readily to suffer itself to be excited into its prescribed mode of acting.

647. From an attentive consideration of the organic structure of the brain, it is very manifest that the spirituous fluid, in which is life, has not an immediate communication with the operations of its body, but that its communication is effected through various organic substances; the first of which are those which we have called cerebellula, namely the minute spherules of the cortical and cineritious substance, which prevail in the brains and the medullæ, and are the first determinations of the spirituous fluid by its fibres, or the subdetermining substances of the brain, to which correspond the subdetermining substances of the body (n. 287, 505, 557, 561, 598). These spherules in the brain are so coördinated, as to be enabled to be excited into action either separately or conjointly; for the purest fibrils of all, or the ultimate divarications of the minute arteries, are dedicated to form the contexture of that substance. Thus there is no influx of the soul into the ultimate operations of its body, except mediately, by these most exquisitely organic substances. Nor does that influx take place by and from these immediately; for even these are associated and collected together into congeries, clusters, and cortical tori, which being encompassed and interwoven with minute vessels of the purer blood, as their determining fibres, constitute a further degree of organic substances, which are so arranged as to be capable of being elevated, of exercising an animation, and of being modified, both separately and conjointly (n. 287, 505, 561). Finally, to these succeeds the whole brain as the common sensory and complex of all, in which each particular part keeps itself most distinct from every other. Yet there is a continuous connection of them all by the fluids, and their vessels, filaments, and fibres, or by their determining substances; for a blood-vessel, divided into similar degrees, is continued from the whole brain into its cortical tori, and from these tori into the cortical spherules, and from these spherules into the medullary fibres, consequently

into the nerves. Thus there exists a COESTABLISHED HARMONY. Thus also we see what are the channels which this spirituous fluid prepares for itself, in order that it may descend by degrees into the effects of its body; we see that its capability of acting on the body depends on the state of its organic substances, and on their connection; consequently, that although these substances may suffer changes, lesion, privation of their fluid, or remain without culture, still the soul lives in the state of its own intelligence, as in embryos, infants, and idiots (n. 265—269). Thus we perceive how the soul, according to Aristotle, has no immediate communication with the operations of its body; how, together with form, it is the first perfection of the natural body, having life and potency; and how the second perfection consists in the functions and operations which depend on the first (n. 637).

648. *If we would explore the efficient, rational, and principal causes of the operations and effects existing in the animal body, it will be necessary first to enquire what things, in a superior degree, correspond to those which are in an inferior degree, and by what name they are to be called.* In other words, what things in one and the same series mutually succeed each other, are dependent on and have respect to each other by degrees; for so separate from each other do they appear, that without the most internal and analytic rational intuition, it seems impossible that the things of a superior degree should be recognized and acknowledged as the superior forms of things inferior; for to the sensory of the inferior forms, they are incomprehensible, and appear as in continuity with them (n. 623—626). In other words, unless the things of the inferior degree were distinct from those of the superior, they could not be compared with a substance which subsists by itself (n. 589), but would be the same things with the superior ones, taken in the aggregate, or collectively (n. 629, 630). In order then to ascertain and to know what that is in a superior degree which corresponds to its proper inferior, rules must be discovered to guide us in pointing it out, which we are enabled to do under any of the following circumstances. 1. In case in the several things, which are beneath any given one, and not only in the one proximately beneath, but in all which follow, it be found to be the common

and universal reigning principle. 2. In case it be so distinct from the superior that it subsists by itself; or is able not only to subsist together with the other, but separately by itself without it. 3. In case it be unknown whether it be its superior correspondent, except by way of analogy and eminence; and we are ignorant of its quality except by reflection, or by the knowledge of inferior things, as in a mirror. 4. Hence in case it has to be marked by an entirely different name. 5. In case there be a connection between the two, otherwise the superior and inferior entity of that series would have no dependence on each other, or mutual relation. "By reflection and abstraction alone," says Wolff, "universal notions are not made complete and determinate. For reflection is wholly occupied in the successive direction of the attention to general principles; nor is anything obtained by abstraction, except that those general principles are seen to be different from the objects of perception in which they exist. . . . Thus it does not hence appear, whether those general principles contain more or fewer particulars than are sufficient to . . . distinguish the things of that genus or species from those of another. . . . Therefore it is unknown whether they are complete and determinate." (*Psychologia Rationalis*, § 401.) The making the discovery, therefore, *is a work demanding both a knowledge of facts and skill in judging of them*: for if we rely either on reason without facts, or on facts without reason, our endeavor to find what we seek will be to no purpose.

649. *For in proportion as nature ascends by her degrees, so she raises herself from the sphere of particular and common expressions to that of universal and eminent ones.* For example: I. *The red blood* is a substance of an inferior degree: to this, in a superior degree, corresponds the purer blood; and to this latter, the spirituous fluid, which is the common and universal substance, reigning in the inferior ones. Of this universal substance we may thus predicate what is affirmed in the rules, viz., that those sanguineous fluids are distinct, so that they may subsist together, and separately by themselves; and that it is unknown whether the superior be the correspondent of the inferior, except by way of analogy and eminence; as that the spirituous fluid is blood eminently, or blood by analogy; that its

quality is unknown except by reflection, or by a knowledge of the substances inferior to it; that it ought to be expressed by a quite different name; that there is an intervening connection between them, whence they have a mutual dependence and relation to each other: all which subjects have been frequently treated of above. II. *An artery* is a vessel of an inferior degree: to which, in a superior degree, corresponds a vessel of the purer blood; and, in the supreme degree, a medullary or simple nervous fibre. III. *A muscle* is that to which corresponds in a superior degree the motive fleshy fibre; to the motive fleshy fibre, the motive white fibre; and to the motive white fibre, in the supreme degree, the motive nervous fibre. IV. The *sensations* belong to the organs of the body: to these, in a superior degree, corresponds the imagination; to the imagination, the thought: for if we ask the simple question, what is imagination eminently? the notion spontaneously presents itself, that by it is meant thought, to which therefore images and ideas are attributed by way of eminence: but to thought in a superior degree corresponds a representation of that which is universal, or the intuition of ends. V. *To the body*—as far as regards the looks of its countenance, the arrangements and states of the parts belonging to it, and its powers [*potentiæ*] of acting and forms of action—in the proximately superior degree corresponds the animal or external mind [*animus*]; to this, the intellectual mind [*mens*]; and to this, the soul; wherefore, according to the rules proposed in n. 648, the soul is the common and universal principle which reigns in all things beneath it (n. 270), and all these, singly, so subsist and live one amongst another, that they can act separately, and also conjointly. That they can act *separately*, is evident, since the superior is frequently in combat with the inferior, or the interior with the exterior, and *vice versâ*, as with something alien and diverse from itself; nay, they evidently act each by itself. That they can act *conjointly*, is also evident; for they do so in every determination which comes forth from that which is inmost: for the state of the external mind [*animus*] is usually effigied in the countenance, in the forms of the actions and speech. In the external mind [*animus*], also, the intellectual mind [*mens*], though less manifestly, has its image; consequently the soul,

likewise, is effigied in the intellectual mind [*mens*], although of the soul, as being most remote, it is impossible to form a judgment. The soul, then, is an intellectual mind [*mens*] by way of eminence. Now, since the soul does not flow into the actions of its body, except by intermediates (n. 611, 647); nor by a continuous medium, but as it were by a ladder divided into steps; there can be no such thing as Occasionality of Causes and Physical Influx. For if the state proper to the soul be called a moral state, in which is found the beginning of reason, or the principle from which reason originates; and if the state proper to the intellectual mind [*mens*] be called a rational state, in which is found the beginning of affections and impulsive causes, or the principle from which these originate; and if the state proper to the external mind [*animus*] be called a physical state, in which are found affections as the impulsive causes of the actions of the body; and if the state proper to the body be called a mechanical state; it then follows, that there can be no influx from the moral state into the mechanical state of the body, except by the rational state, and thence by the physical, or by two intermediates (n. 611): and this also, for the most part, not by direct determination, but by a mode of concurrence or consent; by reason that the powers and faculties are distinct, whence results liberty (n. 610): according also to the rule in n. 648, connection is requisite, whence result dependence and mutual relation (n. 587, 601, 608, 618, 622, &c.). Consequently, there can be no such thing as Preëstablished Harmony. Hence the more an inferior principle derives from a superior one, the more the inferior partakes of its state, or of the perfection of its state; for instance, either more of morality, or more of rationality, or more of solicitation from the affections as impulsive causes. Thus there is a Coestablished Harmony.

VI. *To actions* correspond forces [*vires*]; to forces, potencies [*potentiæ*]; to potencies, in the supreme degree, the force of forces, that which is principally the living force, which, in an animal, is life. VII. *To sensual pleasure* [*voluptas*] seems to correspond, in the next superior degree, animal desire [*cupido*]; to animal desire, the desire [*desiderium*] of something future, whence results will; and finally, to this, the representation of ends in self-preservation. VIII. *To sexual intercourse* corresponds



love considered as an enticement and animal desire; to this, a purer love which wants a proper name, conjoined with the representation of another person in onesself, and of onesself in another, or of a certain most intimate connection; and to this, in the supreme degree, the representation of onesself, in the preservation of one's own kind for the sake of more universal ends. IX. *To laughter*, as a gesticulation, corresponds gladness [lætitia]; to gladness, contentment; and lastly, in the supreme degree, a good conscience. According to our rule in n. 648, one of these may subsist both separately without the other, and conjointly with it. That they may subsist *separately*, is evident; for laughter may exist without gladness, as in the case of actors, mimicks, and little children who are compelled to laugh whilst they weep, &c.: moreover to exhibit gladness without a contented mind, is an art most common at the present day in the world of compliment and politics, and one which we continue to learn, and to which we accustom ourselves from childhood; for to wear a serene countenance, and display a cheerful external mind [animus] under circumstances which the intellectual minds [mens] regards as most adverse, is an attainment esteemed above all others as necessary for those who live in civil society. To enjoy a contented intellectual mind without a good conscience, is also not uncommon among those who either know or care nothing about what conscience is. There can be no doubt also that they may exist *conjointly*; and gladness itself, with its free expression in laughter, is the more perfect, in proportion as it proceeds from a contented intellectual mind, and this again from a good conscience: and when a good conscience reigns in the various things which follow beneath it in succession, nothing in the whole world can be more full of a sense of enjoyment and delight. Thus it is that we attain the *summum bonum*—the supreme good. In the meantime, the gladness which naturally flows from the active state of a contented mind, acknowledges as its efficient cause the harmonious series of things, or order perceived with its degrees and connection; this order, however, is not perceived except by relation to its opposites, and by reflection, either direct or indirect, upon others and upon onesself: hence such gladness as gives birth to laughter cannot exist, except in a subject capable of perceiving



such things, that is, in man; and more largely in men of empty minds [*mens*], and in such as are possessed by the love of themselves, &c. X. *To pride*, considered as appertaining to the body, answers haughtiness and swelling of mind [*animus*]; to this, ambition of mind [*mens*]; in the supreme degree, eminent ambition, or the ambition of ambition, which seeks to be above all; spurious, if it thus descends from what is highest into the things of its own body; legitimate, if it ascends into the things of the soul, and connects itself with the soul for the sake of more universal and perfect ends. XI. *To avarice*, considered as the possession of worldly goods, corresponds a lust for the goods to be possessed; to this, the representation by those goods of all possibilities in the world. Avarice does not ascend further, because it is destitute of the representation of universal ends; for it is conjoined with a tacit denial of divine providence and of a life after death; wherefore it is the root and mother of vices. XII. *To heroic action* corresponds intrepidity of mind [*animus*] as its virtue; to this, self-preservation and the preservation of all that belongs to us, and lastly, both of these, with a view to the preservation of society. XIII. There is a gradation of *ends*, as being inferior and superior, consequently more universal and more perfect. The lowest and most entirely natural, common also to the brutes, is self-preservation; a superior end is self-preservation for the sake of society, as for the sake of a man's country, &c.; the end superior to this is self-preservation and the preservation of earthly society for the sake heavenly society, in which the soul exists as a member; and the highest, which is the end of ends, or the most universal of all, is the glory of the Deity. So likewise in all other cases in which ends are assumed as ultimate, though in reality they are intermediate. For there is nothing which does not admit of being elevated to higher degrees; wherefore, if we are incapable of conceiving of their elevation in a suitable manner, and according to the nature of the thing considered, it is in vain to attempt to ascend to the causes of things. As was observed however above, there is need in these cases both of the knowledge of facts, and of skill in judging of them. For it is possible that into any inferior thing several things may enter from divers other series, and sometimes in such numbers, that what forms

in it the generally and universally reigning principle may be altogether obliterated, nay, may even perish; thus an effect flowing down from its genuine principles and purest fountain, is frequently so overcharged with imperfection, and so obscured, that it is impossible to recognize it as an emanation from that fountain: to ascertain, therefore, its immediately superior degree, we must often rise above it to one superior still, that by its aid we may discover that which is intermediate.

650. *Till, at length, in the supreme region of the animal kingdom, where the human soul is, there is no corporeal language which can adequately express its nature, and, much less the nature of things still superior* (n. 256, 297). For when, in proportion to the degrees of elevation, the distinct notions of things perish, the expressions of language significative of these notions must also perish with them; and the more so in proportion as we rise higher, or more remotely from the objects of the sensations to which the words and phrases of language are appropriated; or where occur the universals of apparent universals, and the things above the common ones of those which are usually accounted common. This then is the ease in the human soul, to which the most abstruse kind of terms, such as “the intuition of ends,” “the representation of that which is universal,” “the determining first principle of reason,” and the like, are alone suited; and these are terms, of which, as they are destitute of adjunctive, modal, and other forms of the same universality, it is difficult to define the exact signification; and if we attempt to define it by phrases borrowed from lower things, there still remains implied in them a notion similar to that of matter, as was observed above (n. 638) concerning the first aura and its force, so far as it corresponds to the gravity of lower substances. Thus in vain does the intellectual mind [*mens*] boast of its powers, and as it were seek for terms to express its meaning, in terms which leave many things to be understood which are not capable of being expressed; and is unable to find the proper expressions when it aims at ascending above itself. “We cannot,” says Wolff, “represent to ourselves universals, except so far as we perceive singulars” (*Psychol. Rat.*, § 429); and “if we point out by words . . . the generals of those singulars that enter a universal notion, the words are not understood, except

so far as there is a perception of those generals in individuals.” (*Ibid.*, § 428.)

651. *Wherefore a mathematical philosophy of universals must be invented, which, by characteristic marks and letters, in their general form not very unlike the algebraic analysis of infinites, may be capable of expressing those things which are inexpressible by ordinary language.* On this subject Wolff observes: “Among the desiderata of learning, is a science which should deliver the general principles of the knowledge of finite things; a science from which the geometrician might draw his measures, when desirous usefully to exercise his calculations in the mathematical knowledge of nature. . . . And this science would have a better title to the name of *universal mathematics*, than the science of quantities in general, or of indeterminate numbers, since it would deliver the first principles of the mathematical knowledge of all things. . . . Thus we might at last obtain the true mathematical principles of natural philosophy and psychology, which might be of use to philosophers in guiding their further discoveries, and in general to all for accurate practice. I wish the learned would turn their attention to it.” (*Ontol.*, § 755.) It was for this end that I was here disposed, as a preparatory step, to offer the doctrine of series and degrees, since without a previous knowledge of the general and particular form of nature’s government, in vain should we exert the powers and labors of the mind in composing such a philosophy, since it is no other than that of the soul itself. It is that philosophy alone which can put an end to the contest between truths and assumptions, and pave the way to the palace of reason. For *such a philosophy, if well digested, will be, in a manner, the one science of all the natural sciences, because it is the complex of all.*

652. I have now completed the first Part of my *Economy of the Animal Kingdom*. But I am not sure whether on every point I have pursued the truth, as I place no reliance upon myself, but leave the candid reader to form his own judgment. If I have anywhere been betrayed into mistake, the subsequent Parts, in proportion as they are based upon true science, will correct it. But what is truth? Will it be the work of ages to discover it, or of ages to recognize it when discovered? The sound and well-approved opinions of certain ancients, who lived

in ages when the rational mind exercised its functions more universally, more distinctly, and less overladen with accessory considerations, are at this day, and after the lapse of thousands of years, disputed by many; as was also, in later ages, the case for a long time with the discovery by the illustrious Harvey of the circulation of the blood, &c. Still, however, that fashion of judging of a work cannot be eternal, which regulates the approbation of the reader not so much by the truth of the writer's sentiments, as by the felicity of his language. The latter is an attainment easy and common among persons belonging to polite society: it is the former that presents the difficulty, which is to be surmounted only by intense mental labor. But, as Seneca observes: Falsehood is flimsy; on careful inspection it is easily seen through." (*Epist.* lxxix.)

THE  
ECONOMY  
OF THE  
ANIMAL KINGDOM,

CONSIDERED

ANATOMICALLY, PHYSICALLY, AND PHILOSOPHICALLY.

PART II.

OF THE MOTION OF THE BRAIN, OF THE CORTICAL SUBSTANCE, AND OF  
THE HUMAN SOUL,

“ QUI PRÆCESSERANT, NON PRÆRIPUISSE MIHI VIDENTUR QUÆ DICI  
POTERANT, SED APERUISSE. . . [SCIENTIA] CRESCIT IN DIES, ET INVEN-  
TURIS INVENTA NON OBSTANT.”—SENECA, EPIST. LXXIX.

## PART II.

### CHAPTER I.

ON THE MOTION OF THE BRAIN ; SHEWING THAT ITS ANIMATION  
IS COINCIDENT WITH THE RESPIRATION OF THE LUNGS.

1. BEFORE we approach the subject of the moments or intervals of motion observed by the two brains and medullæ, which motion we call animation, it will be requisite as a foundation to prove the motion of this viscus by experience. We must not treat of these moments before we have ascertained their existence, nor enquire into quality before we are certain of actuality. For the ancients utterly denied the existence of this motion, as also do certain of the moderns, though it has at last been clearly detected by several great anatomists, such as Ridley, Vieussens, Baglivi, Fantoni, Bellini, Pacchioni, and others ; and so clear is the evidence of its existence that whoever doubts it at the present day must doubt the senses of sight and touch. In asserting the existence of this motion, it will be requisite merely to cite the experimental facts recorded by the above illustrious authors ; these facts being worth innumerable arguments. Thus Ridley says, that having opened the head of a living dog, “ he observed a systaltic motion of the dura mater and longitudinal sinus, . . . analogous to the pulsation of the heart, which was quicker than usual, and exactly corresponding with it in point of time. . . . When one blade of a blunt pair of scissors was cautiously introduced into an aperture made in the membrane, and the latter was slit open, the brain covered with the pia mater protruded through the aper-

ture, its motion\* still continuing strong to the touch. . . . On afterwards gently smearing over the dura mater with a few drops of oil of vitriol, no vibration of the membrane, or at least only an insignificant and obscure vibration, was perceived, . . . though on applying the finger, the pulse of the brain itself was very distinct. . . . When a probe was driven deeply into the brain, the animal manifested signs of great pain; and when the blade of a knife was passed right through to the opposite side of the skull, horrible spasms were the result. . . . Lastly, not only the author himself, but others who witnessed the experiment, on thrusting their fingers into the brain, observed that its systole and diastole were carried on in spite of the great resistance thus opposed." (*Philosophical Transactions*, an. 1703, p. 1481—1483.) And Vieussens says: "We assert that the whole mass of the brain, especially where it is at some distance from the bones of the skull, has a natural motion of intumescence and detumescence, and we prove it by the single fact, that when we open the head of a dog, or of any other animal, traces of the several external convolutions of the brain are found accurately and deeply engraved upon the bones of the skull. Such traces of the exterior figure of the convolutions of the brain, could never be imprinted upon the inner surface of the skull, if the brain were entirely destitute of motion; for no one, we presume, will affirm, that the dura mater, as it lies between the skull and the brain, is capable of producing depressions in the skull." (*Neurographia Universalis*, cap. vi., p. 41; fol., Lyons, 1685.) Baglivi says: "Whoever wishes to be assured upon this matter, has only to inspect and consider the anterior part of the cranium in a new-born child; for the bones being exceedingly soft, by placing the palm of the hand upon them we shall feel a strong and regular motion of systole and diastole. . . . But if we wish to perceive still more clearly the systole and diastole of the dura mater in its whole extent, we may do so in wounds of the head which are accompanied by fracture of the skull, and penetrate to the brain, (such as we ourselves have seen in several of the Italian hospitals,) and we shall then find that the entire portion of the dura mater laid bare by the wound, pulsates equably and

\* Ridley says in a passage omitted by Swedenborg, that he observed a motion of the brain also.—(*Tr.*)



foreibly, and not only in those channels and furrows that are hollowed out by the little arteries distributed through it: as would be the case if the motion of the dura mater depended upon these little arteries; supposing which, should convulsive motions supervene from the wound, we should be quite at a loss to account for the strong and evident pulsation discernible throughout the dura mater, and distinguished by its own proper intervals and spaces, so that one would really think it was the heart that was pulsating. [This phenomenon the author has witnessed often and in the presence of others.]” (*De Fibrá Motrice Specimen*, lib. i., cap. iv.) And Fantoni says: “Nothing in the brain is more conspicuous, than its alternate swelling and subsiding, or dilatation and contraction: these motions are visible in cases of wounds of the head, and in the vivisection of brutes. . . . We find it recorded of Zoroaster, the celebrated King of the Baetrians, . . . that on the very day that he was born, his brain palpitated to such a degree as to repel a hand when placed upon it. . . . It is well known by experiments, that in living animals, when the brain is wounded, and the finger thrust well into it, a very strong diastole and systole of its substance are perceptible. To state a general opinion, not a particle of the brain is destitute of this motion: all the glands and all the little tubes enjoy an alternate and regular compression.” (*Epist. ad Pacchionum*, in *Pacch. Operibus*, p. 171, 172; 4to., Rome, 1741.) I say nothing of other observations to the same effect, drawn directly from living subjects, and recorded by a great number of celebrated authors, as Pacchioni, Mayow, and particularly Bellini in his *Opuscula*, [?] where he speaks of the systaltic motion of the brain and the natural contractility of the spinal marrow. For from the citations already given it is sufficiently evident that the brain has an alternate motion of an internal kind; in other words, a motion arising out of its own bosom; also that its entire surface, namely, the surrounding membranes, the blood-vessels, and also the septa and sinuses, depend upon the animatory vibration of the subjacent or interjacent brain, and in part also the dura mater, which is the uniting medium between the motions of the brain and heart, as will be seen in the sequel.

2. We must in the first place bear in mind, that it is a very

difficult task to explore accurately in living subjects the distinct intervals of the elevation of the brain; for in order to perceive them, a considerable portion of the skull must first be raised; the dura mater which adheres to the skull beside the sutures must then be separated from it, and this mater must be divided, in order to open a passage for the finger to the substance of the brain. The following obstacles to a just observation of effects arise from these proceedings:—

*Either* in consequence of the dura mater being detached from the bones, and divided, the force and ability of the brain to reciprocate its motions proportionably fail; for its faculty of restitution depends upon this outermost membrane, as its lever, or rather as its spring.

*Or else* the animal, in consequence of pain, fright, or stupor, is unable to draw its breath; for when life is in danger, all freedom of (animatory) breathing is gone, and consequently all regular and distinct respiration of the brain.

*Or else* the sinus of the dura mater, especially the superior longitudinal sinus, and perhaps also the two lateral sinuses, fill with blood. For as the arterial blood then rushes immediately into the sinuses, and a full egress through the jugular veins is denied it, in consequence of the contraction of the brain, and its cessation from motion, the brain becomes quiescent, or else with great effort labors to make an intimate motion, and as it were to overcome its own substances. This likewise takes place whenever the neck or chest is tightly bound with a ligature in the manner sometimes adopted for destroying dogs.

*Or else* there is some hindrance arising from extravasated blood and serum. It generally happens in vivisections, in consequence of the contractions and efforts they produce, that the channels are clogged and the interstices filled that exist both without and within the substance of the brains and marrow, as a provision for the free exercise of expansion and constriction.

*Or else* if we do not reach the brain itself, we perceive either by sight or touch the motion of the dura mater alone, and conclude from it to that of the brain. But here we are deceived by first appearances; for there is a mixed or compound motion in the dura mater,—one motion owing to its arteries, which communicate immediately with the arteries on the outside

of the head, and another motion received from the brain through the medium of the three great sinuses. This is the reason, as I think, why Baglivi, Paechioni, and all other anatomists, so far as I know, founding their assertions upon what appears to them to be experimental fact and evidence, assert that the moments or pulses of the brain and heart are synchronous. But that this is not the case with the brain itself will appear from a closer investigation of the phenomena.

3. Let us next proceed to arguments; first, to such as are probable, next, to such as are more demonstrative. The subject is so wide, that if what we have stated be true, we shall find clear and ample confirmation not only from the whole of anatomy, but from the whole circle of medical experience and animal physiology. Indeed it is a subject which, as we proceed, cannot remain long in obscurity; for the brain considered in its widest acceptation, that is, as comprising the cerebrum, cerebellum, medulla oblongata, and medulla spinalis, reigns universally and particularly in the fibres of the body; and the heart, in its arteries and vessels. Hence wherever there is a fibre associated with an artery, or an artery with a fibre, that is to say, throughout the whole body, manifest signs must exist to decide the question whether or not the action of one flows concordantly into the action of the other. But let us come to the arguments.

## I.

4. There does not seem to be much probability in the opinion, that every time the heart beats, the blood rushes into the brain, and rouses the entire mass thereof to perform reciprocal motions with it; for the brain is elevated not only surfacewise, but also through the whole of its substance, as ascertained by experiments. And the heart beats, nay, experiences subsultus and palpitation, sometimes from a slight, sometimes from a graver cause, and this, either rapidly, slowly, feebly, strongly, or irregularly. Now that the brain itself experiences a similar fluctuation and inconstancy of motion, is, I say, a circumstance destitute of probability, for in this case, whatever morbid cause prevailed in the body, whether it were some malignant nature

or undue quantity of the blood or serum, some aneurism, poly-pous accretion, or other incidental malady, the brain would assume and imitate the inconstant motion of the heart; which could not but be attended with imminent danger to this most noble organ, and particularly to its cortical substance, which requires the most refined blood, because it requires its purest essence.

5. Were the motions of the two organs synchronous, in this case, either the motion of the brain would flow into the motion of the heart, or the motion of the heart into that of the brain; if the former were the case, then the brain could not be moved by causes originating in the body, as already indicated: if the latter, then the brain would be moved by all the causes that affect the pulse. This likewise appears to be repugnant to the constant and certain laws of nature, and of the animal economy, nay, even to the laws of subordination; for the brain is prior to the heart, hence its motion is prior to the motion of the heart; as is evident from the observations of Malpighi and others on the chick in the incubated egg. What is prior does not in the order of nature suffer itself to be commanded by what is posterior; nor what is superior by what is inferior; nor what is interior by what is exterior; just as in civil order, the master must not be under the control of the servant; that is to say, the brain must not be under the control of the heart, unless the brain purposes to live under the jurisdiction of the crasser blood, or to lead a kind of mere corporeal life governed by instinct.

6. Neither does it appear probable, that the small blood-vessels that pervade the surface of the brain, or its proximate membrane, have such a degree of strength, and swell to so great an extent, as to elevate the entire subjacent mass of the brain; for according to the experience of Ridley, Fantoni, and others (n. 1), the pulse of the brain is perceptible internally, and swells up from beneath the dura mater, so that the traces of its arteries and of the furrows of the brain appear accurately imprinted upon the inner tables of the *sinciput*. Wepfer also doubted whether the arteries possessed this power, and candidly expresses himself on the motion of the brain: "That the brain is moved by the arteries," says he, "although it be furnished with very many, and although considerable ones lie under

its base, is more than I can venture to assert; considering the inadequacy of the arterial pulse to elevate so large a mass as that of the brain in the human subject." (*Exerc. de loc. aff. in Apoplexiâ*, p. 44.) And Fantoni says, "The mass of the brain is large: the force of compression operates upon its whole surface; and not only this, but also upon its inmost substance and very core." (*Epist. cit.*, p. 172.) Hence we may infer that in all probability, the arteries themselves are not the cause of the motion of the brain; but that its origin must be sought elsewhere, that is to say, in the brain itself; and consequently inasmuch as the origin of its motion is different from that of the heart, it follows that the two may either coincide or not coincide. For in order that the two origins of the motion of two bodies may constantly unite with each other in their progress, it is requisite that there be a third uniting and intermediate body, which shall be dependent equally upon both, and which shall continue under the same necessity of reciprocating its motions, as the impulsive causes of both the bodies.

7. That the origin of the motion of the brain is voluntary, or in the will, we may plainly infer from this, that the brain knows what it wills, and wills what it knows, and hence is capable of being the cause of its own motion or animation. That it is the cause and author of its motion in particular, is sufficiently evident from its active power over the muscles of the body. If it has the power of unfolding itself and its substances in every particular (see Part II., n. 132—176), it follows that it has the power of doing the same thing in general. This follows as a matter of course, because every particular taken collectively is identical with the general. Similar is the origin of respiration or pulmonary motion, for every one knows that it is voluntary during the day. If therefore the origin of the motion of the brain be voluntary, and if that of the lungs be also voluntary, it would appear, that the animation or respiration of the brain is coincident with the motion of the lungs rather than with that of the heart, whose systole and diastole are entirely spontaneous or natural. There is indeed an animation of the lungs which is partly spontaneous, as during sleep, but such also appears to be that of the cerebellum, which assumes the government at night, when the cerebrum sleeps in respect to any exercise of will upon

its parts, and the cerebellum draws a deeper and more regular inspiration uninterrupted by any voluntary animations of the cerebrum. Thus this voluntary motion, mixed with the natural motion, appears to be referable to both brains, for the motion of the cerebellum and the two medullæ is coincident with the motion of the cerebrum, as shewn above.

8. As we may argue from the origin of the motion of the brain, so may we argue likewise from the final cause, and from the effect of this motion. The effect is, by the animation of the brain, to propel the purest fluid or animal spirit from the cortical substances through the medullary fibres into the nervous fibres of the body, and thus to animate its whole kingdom, and make it live, at every successive moment, by means of the transmission of this fluid. In order for this effect to extend to the uttermost hamlets and corners of the kingdom, it was necessary for it to summon to coöperation some other motory agent in the body having a motion concurrent with its own; and this agent is no other than the lungs, which appear to play the same part in general as the brain does universally in particular. For the pulmonary action plainly extends to every single point of the body, and even if it does not act upon all, still it is in the effort so to do, as observation and experiment might sufficiently attest, were this the time to adduce them. Now if these two motions are concordant in their intervals, then by means of this general auxiliary, the spirit, which is the life of the body, will be diffused rapidly and in its natural vehicle round the whole inferior region. See Part II., n. 168—176.

9. The case would be otherwise were the motion of the brain not consociated with the motion of the lungs, but with that of the heart, in those creatures which respire; for the heart acts solely upon the red blood, the brain acts more universally, and with each lung, upon the purer or white blood, and at the same time also upon the spirit of the blood, or the exquisitely subtile juice of the nerves. If the circle of the red blood were performed in the arteries at the same intervals as the circle of the nervous fluid in the nerves, I scarcely know whether any muscle in the body, with the exception of that of the heart and arteries (which are stimulated to action solely by the influent blood), would suffer itself to be incited to act; for in proportion

as the nerve acted, the blood would react, when nevertheless in order to produce any alternate motion, action and reaction must be so ordered that one may alternately overcome the other. Hence it is most wisely provided that the motion of the brain shall be coincident with the motion of the heart only when a universal concord prevails throughout the several parts of the body, as in embryos and creatures that have never breathed; in which cases the lungs, and all the muscles, remain inactive. But as soon as the motive forces are to be excited into acts,—as for instance, from the first moment of birth and especially of respiration,—the brain seems to leave the company of the heart, and to associate itself with the lungs; producing, instead of an inactivity of the muscles, a voluntary activity; and instead of an insensibility of the organs, a voluntary sensibility. Hence by these two extreme motions,—for the motion of the brain is the first in order and that of the lungs is the last,—the intermediate motion, namely, that of the heart, is wonderfully kept in a state of perpetual connection with each, or in such a state as to allow of an influx of the one into the other.

10. And the general state of animation cannot be seen better reflected than in the general state of the pulmonic respiration. For as often as the brain is intent, and thinking deeply, or is occupied with anxious cares, the lungs draw their breath tacitly and slowly, and the breast either rises to a fixed level, and fears by any deep breath to disturb the quiet of the brain, or else compresses itself, and admits only a small amount of air. When the brain is exhilarated and joyous, the lungs expand and unfold. When the brain collapses with fear, the lungs do the same. When the brain is disturbed by anger, the lungs are the same. And so it is in the case of all other affections, in which similar states are observed to be superinduced upon both, and this, sometimes without any sensible change in the vibration of the heart and arteries of the body.

11. But we abstain from adducing further arguments of this kind, because, as we have said, they are only probable, albeit they favor not a little our view of the subject, when we have once conceived it. We shall now proceed to anatomical, and afterwards to medical experience, from which we shall find that we obtain a clearer light. For as already observed, if our pro-



position be true, everything will pronounce in its favor; for the brain, heart and lungs move every point in the living animal.

## II.

12. From the very peculiar arteries of the cerebrum and cerebellum, namely, the internal carotid and the vertebral arteries, it is very evident, that the sphere of the heart's activity does not extend into the sphere of the brain's activity; for on the confines of the two, where the arteries pass out of the body and enter the sphere of the brain, by an ingenious provision a boundary line is established to prevent the two currents from becoming confounded with each other, that is to say, to prevent the blood arising from the body from rushing without restraint into the hollow of the cranium, and much more into the brain.

13. For where the internal carotid separates from the trunk, or from the external carotid (which it does near the larynx, in the petrous apophysis of the temporal bones, between the great process of the occiput and the styloform process, a little below the Eustachian tube), it suddenly enters an osseous canal, in which it twists itself about at various angles, backward and forward in such a wonderful manner, that to trace its tortuosities by a drawing and verbal description, would require a true artist, so various are its angularities. On this subject Morgagni says: "I do not see how a figure that exhibits the curvatures of the carotid artery, only in reference to those which follow a perpendicular line, can be the best method of expressing them, because when this artery crosses the substance of the cranium, it is curved transversely; which Lower represents by another figure that presents the artery to view not laterally, like Willis's figure, but from behind; although even this is not the best mode of representation." (*Advers. Anat.* vi., Anim. 5.) A clear proof this, that as soon as the blood of the body arrives at this first point of ingress, or last boundary of the body and first boundary of the brain, it feels that it has passed into another sphere of activity, and aims at disengaging itself from the force and empire of the heart, and at breaking the continuity of its fluxion. For it is evident that if the heart attempts to propel



the blood beyond this limit, the attempt at further progress is effectually checked, "by the constant curvature or barrier of the shores," as Willis expresses it. (*Cerebri Anatome*, cap. viii.) And in every part of the body where the artery goes out in a perpendicular line from the trunk, as the intercostal arteries do from the aorta, and also several others, it is a sign of the continuous fluxion of the blood being in some measure retarded, and the more so in proportion as the artery is more frequently reflected at such a perpendicular, as the internal carotid is in the cuneiform bone, as well as afterwards. I shall say nothing here of the import of the fact that this takes place near the larynx, in the petrous apophysis, a little below the Eustachian tube, where a little sesamoid bone is sometimes found; &c.

14. Not only the internal carotid, but also the other common artery of the interior of the head, namely, the vertebral, is compelled to undergo similar modes of reflection and infraction in its passage to the large foramen of the occiput. For "as this artery ascends and passes through the transverse foramen of the second vertebra, it is generally incurvated, to accommodate itself to the particular obliquity of this foramen; . . . and between this foramen, and that in the first vertebra, it takes another larger turn, in a direction contrary to the former. Having passed the transverse foramen of the first vertebra, it is considerably incurvated a third time, from before backwards, as it goes through the superior and posterior notch in this vertebra." Such is Winslow's accurate description of these curvatures. (*Exp. Anat., Tr. des Arteres*, n. 96.) Ridley gives a figure of the uppermost curve, and describes it as follows: ". . . The vertebral artery . . . entering the brain at the last and largest foramen of the skull, . . . coming thither on each side out of the hole in the transverse process of the first vertebra of the neck, [or between the first vertebra and the bone of the occiput, as Ridley points out in describing Fig. 1, E, to which he refers the reader,]\* after a very remarkable curved manner, . . . and by no means like to the delineation and description given by Lower and Dr. Willis, &c. &c." (*Anatomy of the Brain*, chap. iv., p. 35.) This artery therefore disengages itself from the power and

\* An interpolation by Swedenborg.—(Tr.)

pressure of the heart, lest the brain, or rather the medulla spinalis, medulla oblongata and cerebellum, should be compelled to rise at every beat of the heart, or every momentum of the blood. But to return to the internal carotid artery.

15. This artery, on passing through its foramen, and entering the hollow of the cranium, does not immediately climb to the brain, but rises and curves over a certain osseous mound, at the posterior clinoid processes; it next passes downward into the receptacula cavernosa of Vieussens,<sup>x</sup> and even in these it has a sinuous course. Such a number of inflexions in every direction made by a single artery in its progress as one and the same trunk, sufficiently indicate that its blood, as propelled by the heart, cannot invade the province of the brain, unless the brain allow it to do so; that it consequently rids itself of the stroke of the heart, if not in the osseous foramen, at least afterwards in the cavity of the skull.

16. Nor is this the only precaution taken with a view of separating the sanguineous current of the inferior region from that of the superior, for the very tunic of the artery is itself adapted to coöperate in producing this result, since the artery is said to divest itself of its muscular tunic as soon as it enters the foramen, and to procure another more suitable, and which shall comply with the motion of the brain. For it is the muscular tunic continued from the large muscle of the heart, that alone propagates the pulse through the arterics; so that wherever this tunic is, the heart is virtually present. Hence without this auxiliary fibre disposed into annular forms, or continued by the same method, the pulse ceases to act, for it cannot extend beyond the termination of this tunic.

17. The carotid artery subjects itself to the dura mater upon its first arrival at the entrance of the cranium, and again, in the receptacles, to the duplicatures of the dura mater, to the upper of which on the side of the sella turcica it sometimes seems to wish to unite by means of vessels and intercommunicating septa; finally, before reaching the brain it perforates this membrane. There is also a kind of foramen cœcum, covered solely with this membrane, upon which the artery lies, and of which Heister makes mention. (*Comp. Anat.*, n. 100.) Thus in place of the muscular tunic, this artery borrows as it were an outer

tunic from the mater of the brain, in the place where this mater, proceeding from the circumference and processes of the matres of both brains, is concentrated about the middle of the sphenoidal bone or sella equina with the whole of its general vibration. The pia mater also receives the advancing artery after it has crossed another foramen, according to Ridley, who says: "After this crooked passage into the brain, they [the carotids] are propagated quite through its substance, having first divested themselves of that thick coat borrowed of the dura mater; . . . but not without the mediation or intervention of the pia mater, which membrane all the branches of the aforesaid . . . more or less prop themselves upon, before they enter on and disperse themselves through the substance of the brain itself." (*Anatomy of the Brain*, chap. iv., p. 33.) And again, between the above-mentioned adscititious tunic of the artery and its own proper tunic, it admits frequent offsets from the intercostal nerve, which enfold this virtually new artery, and do not quit it, thus enveloped, until it is under the foot of the brain. It may be shewn by a variety of proofs, that the said intercostal nerve conveys the animus and motion of the brain and spinal marrow from its primary origins,—a subject which I shall briefly touch upon in the sequel (n. 28). The carotid artery therefore, thus stripped of its muscular motive tunic, is invested with other tunics more suitable, and which, as we have said, comply with the pulse of the brain (n. 16), hence at once, in its new cradle and swaddling clothes, it is inaugurated into a motion different from that which it brought with it from the heart and aorta.

18. And it is worthy of remark, that as soon as this, the proper artery of the brain, subsides into the valley of the cavernous receptacles, it swells out into somewhat of a belly, that is to say, from a smaller diameter it widens into one considerably larger, and forms indeed a kind of sinus. Besides what has been observed by Vicussens, Willis and others, Wepfer alludes to this particular as follows: "While the parts of the carotid artery are still near to each other, and as it were conglomerated or doubled up together,\* they present the appear-

\* Wepfer had previously given a plate of the sigmoid curvature of the internal

ance of a kind of bladder placed at the sides of the sella turcica, and are larger in size than a nutmeg, and fill the whole space under the dura mater in this situation." (*Observationes Anatomicæ ex Cadaveribus eorum quos sustulit Apoplexia*, p. 39; 12mo., Schaffhus., 1675.) That the same is the case in the vertebral artery, see Ridley, *Anatomy of the Brain*, fig. 1, E. Now this is contrary to the usage and nature of all the other arteries in the body, which as they recede from the heart, do not increase in width, but always slowly decrease in the form of a cone, tapering to the finest and most delicate point. Wherever they begin again to enlarge, as in the veins, they immediately lose their pulsific force; a clear indication that in this place principally the heart ceases to pulsate, or a new origin of motion takes up the former, and that here also the artery forms a channel, cistern, or receptacle from which the brain can take out its blood according as it wants it.

I know that similar swellings and nodes have been observed in the arteries of the silk-worm and other multicord insects, by Malpighi and Swammerdam; but wherever these exist, there are always new fountain-heads or origins of pulsatory motion, as we are abundantly instructed by the admirable observations of Malpighi, which I will in part cite in illustration of this phenomenon. "The diastole of the upper hearts," says he, "occurred but seldom, that of the lower hearts was quick and frequent, and that of the middle hearts again occurred only at long intervals: in this instance the pulse at last continued about the head alone, the other hearts being at rest, and the motion was wavy, directed from below upwards. In the butterfly likewise the heart began to pulsate at the lower part, and the pulsation extended upwards toward the head; and if while this was the case the cardiac pipe was cut across, then the lower section exhibited a motion from below to above, which motion was exceedingly rapid at the bottom of the pipe, and comparatively slow and infrequent higher up: but on the other hand, the upper section pulsated the contrary way. . . . In the silk-worm again, just be-

carotid artery (*Op. Cit.*, p. 38), in which plate the sides of the artery are somewhat separated from each other, in order the better to display its sinuous and tortuous course: hence in the passage cited by Swedenborg, he speaks of the parts while they are still in their natural situation.—(*Tr.*)

fore it passed into the chrysalis state, the motion of the heart, previous to the opening of the belly, was directed from below upwards, but after the opening, the point of departure was changed, and 70 pulsations ensued, freely traversing the entire line of the hearts: yet gradually the motion regained its first direction from the tail to the head, and at last on slightly drawing apart [the parietes of] the lower heart with the nails, the movement from above downwards was revived. Very often after death a variety of motions are displayed by these numerous intercommunicating hearts" (Part I., n. 244). It is to be noted, that these little hearts are mere vesicles or swellings of the artery, not unlike those of the carotids in the cavernous receptacles.

19. It is therefore the right of the brain, fortified with these safeguards and munitions, to admit from the heart, as the common reservoir, no other and no more blood than it wants, and only at the stated moments in which it makes its demand, as indeed experience testifies. Thus Wepfer says: "More than once I have injected water colored with saffron into the carotid before its division into its external and internal branches, and I have remarked that the arteries of the dura mater were rapidly colored and filled with the injection, while almost none of it appeared in the internal carotid, on account of the curve which that artery makes near the styloform process as it is about to enter the osseous canal." (*Op. Cit.*, p. 102, 103.) I am not ignorant that Vieussens, Willis and Paechioni arrived at a somewhat different result, but none of these writers mentions whether the tincture was injected on the outside of the foramen of the cranium, or on the inside, or in what subject the experiment was made.

20. But in most brutes that hang the head and feed on herbage, animal nature, in prohibiting the incursion of the blood into the head, has recourse to a method different from that which is adopted in man, and yet even in these the contrivance is wonderful to prevent the blood from flowing into the brain according to the pulsatory movements of the heart. For in such animals, as soon as the internal carotid passes into the cranium, it splits into twigs, on which it is almost spent, with the exception of a small residual canal; being accompanied with

little bands which are produced principally from the dura mater, which either constitutes or invests the parietes of the receptacles, according to Morgagni. (*Advers. Anat.* vi., Anim. 18.) But the greater part of these ramifications unite again into one artery before they climb the brain. We find, therefore, that in this manner likewise the pulse of the heart is compelled to stop at the point where the pulse of the brain begins. This is the origin of the *rete mirabile*, which exhibits three generic varieties in three classes of subjects. The *first* is that network called rete mirabile by way of eminence, as also rete Galenum, although Galen appears to use the term in a wider sense. This kind of network is very conspicuous in the receptacles, interwoven with little membranous bands and cords, and with vessels wonderfully twisted like ropes. The *second* kind is formed when the carotid artery does not carry round the offsets however numerous that proceed from it, in the receptacles, but hides them in the duplicatures of the dura mater, especially at the posterior side of the sella equina, near the circular sinus, at the beginnings of the basilar sinuses, and likewise at the sides, where the carotid runs close to the pituitary gland, and perhaps also above, as Vieussens seems to intimate. (*Neurographia Universalis*, lib. i., cap. vii. ?) The *third* kind of rete exists when there are either no traces, or no visible ones, of its appearance, but only some twigs taken from the carotid are insinuated into the gland, the rete thus existing in the gland alone; according to the statement of Ridley.\* But these observations are only by the way.

21. But let us pursue this artery further, for the sake of ascertaining whether the heart can claim any power over it when it becomes an internal or cerebral artery. For as soon as it reaches the brain, it disposes its larger branches between the lobes thereof, or in the fissures of the lobes; its smaller branches and offsets between the convolutions, furrows and ridges; it then carries them on more deeply into the substance of the brain, and indeed to every individual cortical and cineritious spherule in whatever corner and intimate recess it lies concealed. For this reason Ruysch maintains that the whole of the cortical substance is vascular, (*Thes. Anat.* i., ass. iii., n. 19, et in oper. passim.) and thus it is everywhere most obvious that while the brain is animating the system from this its substance, and twist-

ing in and out its winding gyres and labyrinthine mazes, every artery is at the same time undergoing its alternation of expansion and constriction, is deriving its blood by alternations from the carotid, and propelling it into the great and small sinuses of the mater. The anatomy of the brain abounds in proofs that there is not the smallest twig but indicates (and I should not be far from the truth if I said demonstrates) that this artery is situated in the stream of the general and particular motion of the viscus, and indeed so situated, that when the two brains perform their systole, the blood-vessels of both perform their diastole, and *vice versâ*. Hence that the brain is the mover of its own arteries, veins and sinuses, and the dispenser of its own blood. Wherefore Ridley justly contends from experiments made upon a living dog, "that the sinuses themselves have no pulsation other than what is communicated to them from the subjacent brain." (*Anatomy of the Brain*, chap. vi., p. 50.)

22. We must not omit to mention, that as the carotid and vertebral artery in ascending to the brain, twist into tortuous forms (n. 13—15), so also does the lower part of the sinuses into which the venous blood of both brains ultimately passes. For the lateral sinuses, before they precipitate themselves into the round osseous cells in the petrous bones, or into the jugular veins, turn to the right and left along the sides of the occiput; as Vieussens observes (*Neurographia Universalis*, lib. i., cap. ii.); nor do they merely descend to the base of the cranium, but proceed still further towards the middle of the base; as Morgagni observes (*Advers. Anat.* vi., Anim 1). Moreover as the carotid and vertebral artery in their way to the brain first dilate into a ventriose channel (n. 18), so also does the lower part of the sinuses, for it enlarges to form an ampullated cavity or retort. At length, as the internal carotid again contracts from a large belly into a narrow trunk, from which it ramifies (n. 18), so also does the lower part of the sinuses on entering into the osseous caverns and jugular vein. Thus as the former is contrary to the usage and nature of arteries, so the latter is contrary to the usage and nature of veins. Finally, as the carotid admits a fibrillary plexus from the intercostal nerve into its own proper tunic (n. 17), so also does the jugular vein admit a similar plexus from the par vagum, with which it passes out through



the same foramen, and at the same time also from the intercostal nerve; for both these nerves run between the above artery and vein, and send filaments from a ganglion to each, as Lancisi shews (*De Motu Cordis, &c.*, tab. vi., fig. 1). From this parallel we learn that the arterial blood does not enter the brain, and that the venous blood does not leave it, without the consent of the brain, and that it is in the power of the brain, and flows from its mode of acting, either to admit or to emit the blood; for everywhere in the extremes we find receptacles from which and to which the brain, which acts as an intermediate, extends the boundaries of its activity.

23. As it is now quite evident, that the arterial blood can by no means be poured into the hemispheres of the brain by the mere power and force of the heart, so in like manner the venous blood of the brain can by no means rush into the chambers of the heart at the moments in which the heart performs its diastole, or the auricle its systole. For a bolt or muscular sphincter is interposed behind the superior vena cava, (the conflux of all the blood of the brains and of nearly all the blood of the spinal marrow,) and before the right auricle of the heart, but no such barrier exists between the right auricle and inferior cava, which collects the blood from nearly the whole body. Thus abundant precaution is taken to prevent the blood of one organ from disturbing the vibrations of another, and converting them into its own.

24. But all the arguments adduced in this section are not sufficient to prove that the motion of the brain, if it does not coincide with that of the heart, coincides nevertheless with that of the lungs. Let us therefore come nearer to the point.

### III.

25. We may learn from the blood of the spinal marrow more clearly than from the blood of the brains, what are the intervals of its influx and efflux, and more particularly we may learn this from the blood of the dorsal and thoracic portion of the spine, which lies close along the pulmonary region; wherefore if the cerebral and pulmonary motions coincide with each other, we ought to find more evident proofs of it here than above and



below. It is well known that the spinal marrow transmits its blood from its cervical portion to the vertebral vein, from its thoracic portion to the vena azygos, and from its lower portion or cauda equina, to the lumbar vein. Now let us examine the vena azygos which receives the blood of the dorsal region.

26. The azygos or vena sine pari in man, is situated along the vertebræ, between the membranes of the pleura, and derives its blood from the sinuses and veins of the spinal marrow. But outside the vertebral sheath, it receives the blood from the whole spiratory field of the lungs, as from the right and left intercostal muscles, from the vertebral muscles, from the dentati and pectorales, from the diaphragm, through which it ascends at one side, from the mammary veins, from the pleura itself, from the sternum, from the spinal nerves, and from the abdominal muscles; in a word, from all the musculo-motive fibres that grow pale when the lungs breathe; for that the carneo-motive or muscular fibre expels its blood at the time and in the degree in which it is constricted, is a well-known fact, although some persons, to favor a hypothesis, love to leave experience in this matter. The vessels which redden are the large vessels that receive the blood from the smallest vessels constructing the carneo-motive fibre. If then there be a common vein that receives the blood equally from these muscles and from the sinuses of the spine, it seems to follow, as a matter of course, that the times of influx for the two coincide; consequently that the spine, which equally with the brain is the mover and dispenser of its own proper blood, moves systaltically with the lungs.

That the spinal marrow takes in and sends out its blood at the same intervals in which it expands and contracts, is in some measure evident from those numerous arterial and venous offsets that come through the anterior fissures from its cinereous axis, or which insinuate themselves into it: and from the distribution of the same blood over the proximate membrane, and over the beginnings of the nerves which go out through the very notches by which the arterial blood enters and the venous departs; from the passage of its blood-vessels in a kind of gentle spire, conformably to the reciprocal contorsion of the spine; so that of necessity, the vein must be wrung out at the moments of the expansion of the axis or cineritious substance of the spinal marrow,

in which moments every branch without the vertebræ that receives the blood, (in short, the intercostal vein with the recipient vena azygos,) disposes and opens itself to receive this new supply. And because these two motions are coincident when the muscle ministering to the inspiration of the lungs expels the blood, it follows that they cannot differ in their moments or intervals. And this seems to be the reason why the intercostal arteries come off from the aorta at right angles, and why the intercostal veins run into the cava at right angles, as we have above observed.

27. That the trunk of this vein sends out its blood into the superior cava with which it inosculates, exactly at the same intervals in which the bronchia and trachea, or together with these, the lungs, constrict themselves, is indicated clearly by the curvature of the azygos around the bronchia, and by its intimate union with the same parts, or with the trachea, by the fibres and vessels that penetrate it: as also by the semi-sphincter with which it is furnished at the place of inosculation, and which is supplied by a particular nerve derived from the family of spinal nerves; respecting which subject see Morgagni and Lancisi.

28. And that every branch of the azygos admits its own proper blood at the same alternate intervals in which the trunk admits its own blood; that is to say, at the times when the lungs perform their inspiration, or the cineritious axis of the spinal marrow unfolds itself, is evident from the nerve that enters and occupies them all. For the intercostal nerve, which, as above observed, envelopes the carotid and partly the jugular vein, here also goes to perform the same office. Thus the said nerve puts forth a trunk in the neck from both its inferior ganglionic plexuses, which trunk divides on each side into branches, about the fourth or fifth dorsal vertebra; and these branches afterwards again unite into one. They send out cords or fibres on each side, which in divers ways go to, cross over, and embrace, all the branches of the vena azygos, as well as in various places the trunk of that vein; and higher up, the vena cava; and creep over the branches with erratic windings and ivy-like tendrils, as Lancisi describes it,\* *Dissert. de Venâ sine Pari*. Thus this nerve plays the same part here as we above observed

\* See the description of the vena azygos, Part I., n. 567; and in the *Animal Kingdom*, Part II., n. 425, note (b).—(Tr.)

that it performs in the carotid and jugular veins ; that is to say, it disposes these veins to a movement through spaces at a similar rate.

That this nerve itself is moved, and can move the branches that it embraces, only at the intervals in which the spinal marrow moves, we may infer from the mere description of it. For the spinal nerves, excepting the first and the three last, immediately at their exit from the spinal marrow, produce small ganglioform tumors, from which twigs and short cords are sent transversely to the intercostal nerve ; from each, for instance, in the neck there is sent one simple cord ; in the thorax two, one from the superior, the other from the inferior part of the little ganglion ; and again in the lumbar region only one. Of all these cords one large and general nerve is composed, which everywhere thus acquires new origins, and new forces, just as a river enlarges by tributary streams. The medullary stem passes into these ganglions, which are set close to the vertebræ, near the points of exit, like barleycorns, together with the fibres and first beginnings of the nerves, and together also with the two meninges, and with certain twigs containing the blood proper to them, so that they are necessarily in the same motion of vibration with the inmost medulla ; as consequently also is the intercostal nerve which is born of all these, and in the dorsal region with a double origin. Thus whatever state of modification affects the spine, the same also will affect the nerve that occupies these little venous branches, and consequently the same will affect the vein that conducts the blood to the azygos ; and the azygos will be kept in the same by the same nerve being attached underneath to the pulmonary pipes. The interval of its dilatation will thus coincide with the constriction of the veins and sinuses of the spinal marrow within the sheath, and with that of the intercostal muscles out of it, and at the same time with those of the little ganglions that send branches out from the side into this common or great sympathetic nerve.

29. As the vena azygos derives to it the blood of the whole spiratory field, so the internal jugular vein, which is the common vein of the brains, derives to it nearly all the blood from the muscles of the scutiform cartilage, and from the upper part of the trachea, and from the muscles that assist it. For this

vein descends near the side of the cervical vertebræ, and near the windpipe, as may be seen in Eustachius, *Tabul. Anat.*, tab. x., fig. 1. It receives a large branch from the abovementioned cartilage of the larynx and its muscles, and a fresh one again from the lowest root; it receives also a large branch from the right jugular vein, into which several run, as shewn by the same plate, and from the trachea and the muscles that assist respiration and speech. These facts abundantly indicate, in my opinion, that the familiar and natural mode of fluxion of these veins, is the pulmonie, or, what is the same thing, that it is that of the bronchia, windpipe and larynx, which concur every time with the respiration of the lungs.

30. And it cannot, I think, be doubted, that the animatory motion of the cerebrum and cerebellum, is continued also to the spinal marrow, from which in this and the following section we deduce the principal force of our argument; for all these viscera are conjoined as mutual appendages by continuous medullary processes, by the enervitious substance, which is concentrated into an axis in the spinal marrow; they are conjoined also by the blood-vessels and the two membranes, namely, the dura and pia mater, and by the arachnoid tunic; so that it follows as a necessary consequence, that all have one and the same common moving effort, as confirmed by experience in living subjects.

Thus from the carotid, as it enters the hollow of the cranium, until it passes through the brain, and thence through the dorsal spine into the azygos toward the superior cava at the muscular mouth of the right auricle of the heart, there is one continuous connection and circle of causes. But we have now sufficiently argued the point from the fluxion of the arteries and veins.

#### IV.

31. The nerves which run out from this dorsal region of the spinal marrow, no less than the arteries and veins of which we have hitherto spoken, confirm the concordance of motions between the brains and the lungs; for, with the exception of the twigs sent into the trunk of the intercostal nerve, all the nerves that come from this region are spent upon the muscles that open

the cavity of the thorax for the respiration of the lungs, and that fitly inflect the vertebral column. For there are twelve pairs of nerves corresponding with the twelve ribs, along which latter the nerves travel in appropriate furrows. The seven upper pairs accompany the ribs to the sternum, and supply all the intercostal muscles, perforating and intimately entering them. The five lower pairs send down cords from the cartilages of the false ribs to the muscles of the abdomen, and to several other muscles that concur to respiration. These nerves may be seen delineated upon a large scale by Vieussens, and the muscles described to which they are sent. (*Neurographia Universalis*, cap. vii., and tab. xxvii.)

32. That these nerves, which are sent out from the middle and lower part of the spinal marrow for the single purpose of opening the chest, are excited to effect this purpose at the moments when the spinal marrow moves systaltically, has already been shewn. For all those muscles called intercostal, and supplied with these nerves, are destitute of antagonists, which is not the case with any other muscles in the body. Consequently when the brains and medullæ, by their common animation, act and flow into the nerves of the body, and from these into the muscles, the intercostal muscles alone exhibit any conspicuous effect of motion, all the others being quiescent, since in proportion to their action, there is also a reaction; neither are they stimulated to action unless this equilibrium be taken away by some particular force of motion or inspiration—an office belonging solely to the brain. Hence it follows, in my opinion, that every time the brains animate, and with them the spinal marrow, they flow into their nerves, and these into their muscles, consequently into the intercostal muscles, by the contraction of which the ribs are raised and the chest opened, which movement takes place at the very times when the lungs inspire.

33. From whatever source we derive the cause of muscular motion, whether from the immediate influx of the brains into their nerves, or from any kind of touch or friction of a nerve in the body itself, it is evident that the pulmonary cavity is not opened naturally, or of itself and its own accord, (I do not here speak of the voluntary act of opening, which is performed in as many ways as the brain commands, or as the bodily state re-

quires), except at the times when the brains animate and the lungs respire. For whether we deduce muscular motion from the immediate influx of the brains into their nerves, as when the brains exert their active or living force, that is, animate; or whether we deduce it from any friction or touch of a nerve in the body; it is here provided, that neither one nor the other, as a cause, or as a minister to the principal cause, shall be wanting to preserve the continuation of the motion, since in the vertebral foramina through which the above-mentioned nerves pass out, there is a peculiar mechanism of such wonderful construction, that as often as the ribs are raised, a certain species of friction strikes the issuing nerve; the foramina being composed by the meeting of the notches cut out in the inferior part of the superior vertebra, and in the superior part of the inferior vertebra. Thus whatever the time or manner in which the vertebral column bends, or the ribs conjointly rise, the notch of the superior vertebra, by reaction and friction, acts upon one part of the nerve sent out, while the notch of the inferior vertebra is acting in a contrary manner upon the other part. This takes place more especially in the dorsal region, but not to such an extent in the lumbar, the vertebral notches in the dorsal region being carved out more boldly than those of the lumbar. The manner in which this is effected may be even mechanically exhibited to the eye. Moreover the ganglionic bodies exterior to the notches are constricted at the same moment, and by a certain mode of contraction operate conjointly upon the nerves above mentioned. Consequently, whether the intercostal muscles are stimulated to action by the former cause or by the latter, or by both together, there can be no want of an active force and efficient cause in the nerves, and derivatively in their muscles, so that the whole of this region, both without and within the vertebral case, may unanimously conspire to produce the motion of respiration.

We may confirm these views by a remarkable experiment recorded by Swammerdam. "We observe," says he, "in many animals, that as soon as the beginning of the spinal marrow in the cranium is disturbed, all the subjacent muscles suddenly contract. And this also happens in the same manner with respect to all the twigs of the nerves proceeding from the spinal

marrow; at least when they are handled; although in this case only some particular muscles are set in motion, or perhaps only the single muscle through which the irritated twig is distributed." (*Biblia Naturæ*, p. 843.) Swammerdam also states, that he shewed an experiment confirming the latter remark, as applied to the femoral nerves and muscles of the frog, to the Grand Duke of Tuscany, in the year 1658. (*Ibid.*, p. 839.)\*

## V.

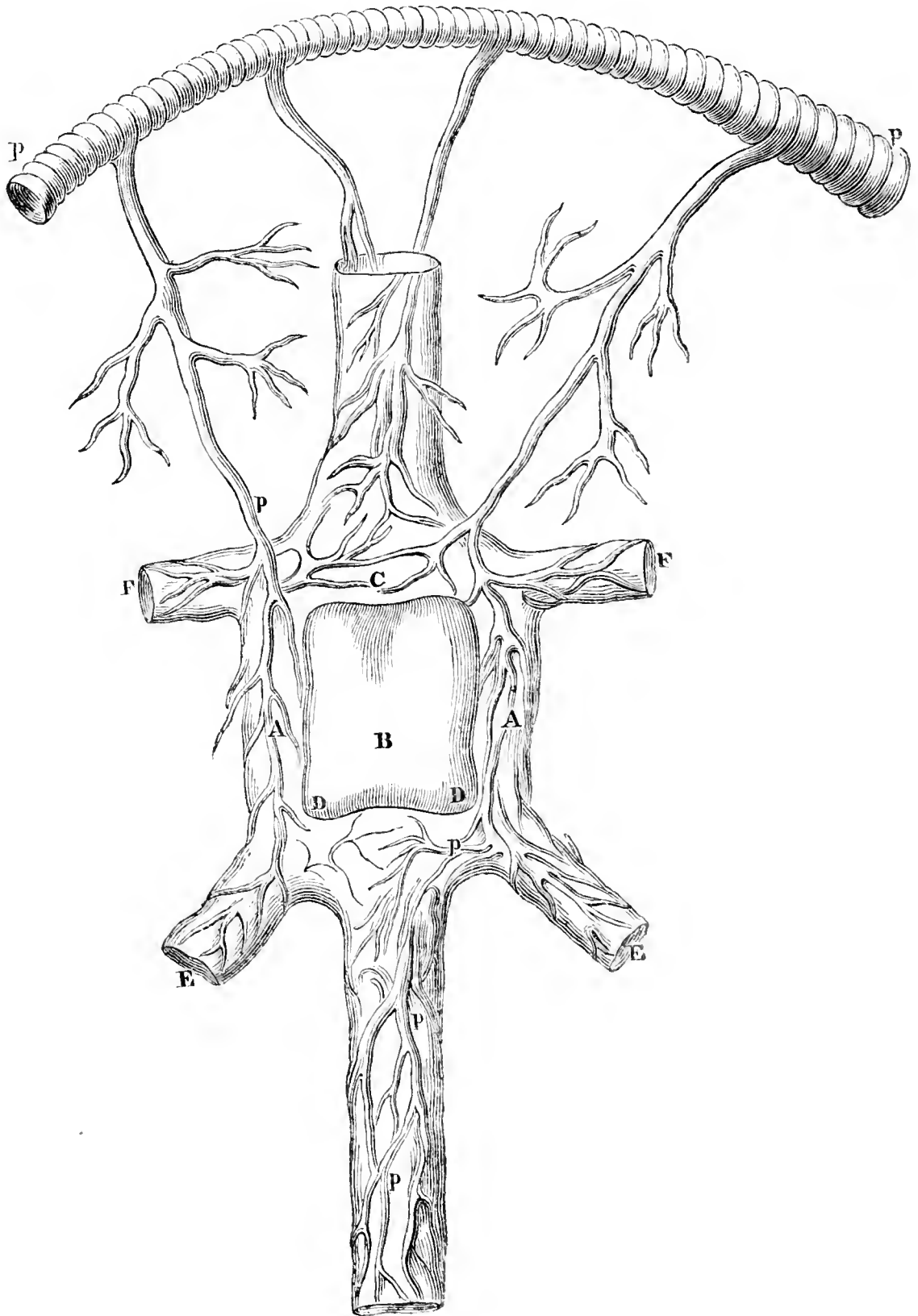
34. But all these things are more clearly and distinctly seen in multicord insects, as nymphs, caterpillars and butterflies, which have indeed several tracheæ and pulmonary pipes, and several little spinal marrows or outgrowths of the brain. The above universal and predominant motions cannot but be more distinctly imprinted and represented by the fluxion and mutual communication of the nerves and vessels in these creatures; for they live principally under the auspices of the above motions, because under natural instinct.

35. From Malpighi's golden treatise on the silk-worm (*Dissert. Epistolic. de Bombyce*), and Swammerdam's work on the anatomy of insects (*Biblia Naturæ*), we actually see by the microscope that the several dilatations of the spinal marrow in insects, which dilatations appear to be so many succenturiate cerebra or cerebella, exert the powers of their activity principally upon the little trachea: for every such molecule or ganglioform tumor of the spinal marrow produces two large pairs of nerves, of which the upper immediately flows into and operates upon the nearest tracheæ and pulmonary pipes; whereas in the larger animals we find them acting first upon the ribs, the osseous and cartilaginous grate of the chest, and so upon the lungs mediately. On the other hand, from the said tracheæ the blood immediately enters the brain and this medulla, divided as it is into several, and pervades and irrigates the whole from the top to the bottom, so that it follows of necessity, that such as is the motion in the medulla, similar is that in the lungs, and *vice versâ*. But we had better give Malpighi's own words. "The lungs," says he, "so abound in the silk-worm, that nearly

\* See the *Animal Kingdom*, n. 449, note (z).—(Tr.)



every ring has two of them, and all parts of even the viscera have pulmonary derivations." (*Dissert. Epistolic. de Bombyce*, p. 13; fol., Londin., 1686.) And again he says: "The spinal marrow is not of a uniform thickness, gradually decreasing from the top to the bottom, . . . but consists of a cord with oval nodules placed upon it at intervals. . . . The cortical substance, which forms the nodules, stands out on the side next the rings: on the other or inner side it is covered by the medullary sub-





stance. . . . On each side two large pairs of nerves are given off, . . . of which the upper pair is sent to the neighboring trunks of the trachea. There are . . . thirteen globules or nodules; for over the first orifice of the trachea, two, but little distant from each other, . . . ascend toward the head. . . . The lower globules beyond the first ring . . . are situated in a line from the orifices of the trachea. . . . The nodules above mentioned are supplied by minute branches of the trachea; for from each of its orifices two branches run toward the intermediate spine, and meeting each other in the middle, generate a mutual anastomosis, which gives out minute twigs, that closely embrace the globules and the prolongation of the spine. (*Ibid.*, p. 20, 21.) The cavity of the eranium is filled with many parts, namely, with a portion of the spinal marrow, with the extreme branches of the trachea, &c." (*Ibid.*, p. 22.) But the author's figure more clearly shews the close relationship and consanguinity between the brain or spinal marrow and the tracheæ or lungs; and the reader will do well to consult it, for he will then see with his own eyes that there can be no motion in the one without the same motion existing at the same time in the other.\*

36. In other insects most acutely examined by Swammerdam, a similar concordance of motions is seen as in a picture. "The ramifications of the trachea," says Swammerdam, "constitute the principal part of the louse; they exist in immense numbers in the head, breast, belly, and legs, and even in the antennæ or horns. . . . The pulmonary pipes may not only be discovered in the head, breast, and abdomen, but they extend also into the intestines, the ovary, the spinal marrow, the brain, and, in fine, into all the internal parts of the body. All these things I have distinctly seen." (*Biblia Naturæ*, p. 71, 72, 73; and tab. i., fig. 4, 7, 8.) "The spinal marrow of the louse consists of three large ganglia or dilatations. . . . The membrane in-

\* This Figure so well illustrates the author's present doctrine, that we have thought it advisable to insert it here. It represents a portion of the spinal marrow with a tracheal pipe and its ramifications. AA is the white exterior part of an oval globule or nodule on the spinal marrow. B, the inner cineritious part, curved above at C, and sometimes forming below two appendages at DD, but which are short, and in the line of the nerves, EE, which run obliquely down to the muscles and joints; while the nerves FF are sent to the neighboring trunks of the trachea. P P P P P are branches of the trachea.—(*Tr.*)

vesting it is interwoven with a vast number of pulmonary pipes. . . . Vast numbers also are suspended at the sides of the nerves. . . . The dura mater of the brain . . . is also furnished with pulmonary pipes." (*Ibid.*, p. 81, 82.) Speaking of the hemerobios or ephemerus, he says that its spinal marrow "consists of eleven nodular tubercles, . . . and has a large number of air-pipes; so that even the brain and the nerves are ventilated as it were with a continual supply of fresh air."\* (*Ibid.*, p. 253, 254.) See also what he says in this respect of the water scorpion (*Ibid.*, p. 231): of the cossus (p. 312—314, 316): of the scarabæus (p. 335, 337—339): of the flea (p. 359, 360): of the bee (p. 405, 406, 431, 432, 452—454, 497, 498): of the worm of the gadfly (p. 662, 663): and of the acarus (p. 704, 706).†

37. As the structure in all these cases is more simple, and nearer to the nature of the thing, than in larger animals, (whose viscera must be more elaborately and artificially woven, and their connections more complex, to suit the concourse of vital motions,) so here we may see as in a picture, that the most universal motions of the whole animal or animating system, are those of the brains and the lungs. For in these most simple living creatures, the brain acts upon the motive fibrils of the whole body by means of the nerves in consort with the numberless air-pipes; but not by means of the hearts, which, disposed under the lobules of the lungs, flow mediately and involuntarily with their blood into the motive fibres. The same is the case in animals that have only one heart, and two lungs, and a continued spinal marrow. For in these cases, every time the brain acts by the nerves upon the muscles, it summons the lungs to assist it, which superadd general force to the most particular forces of the brain; as we may clearly see in all attempts at action, whether in lifting weights, making beds, extruding the fæces, fighting, wrestling, sneezing, yawning, speaking or singing, expelling the child from the womb, or any other effort, when straightway the most general force of the lungs is immediately so exactly applied to every special force of the brain, that the action of all parts necessarily combines into one,—which without

\* The italics are Swedenborg's.—(*Tr.*)

† See also the *Animal Kingdom*, n. 391.—(*Tr.*)

a perpetual conspiring of the said viscera, would never be the case.

## VI.

38. Now since in creatures of this very simple character we observe so close a conjunction between the pulmonary pipes and the brains, that there is reason for believing that the one is necessarily agitated and as it were ventilated by and with the other; hence we may fairly suspect that there is also a similar commerce between the air that we draw into the cavities of the nares and convey to the pulmonary vesicles, and the brain. For nature is the same in the least sphere as in the greater and the greatest, although with a difference of connection and degrees. Now then let us see what influx there is of the air drawn through the nostrils into the brain when it animates. But before we can touch this subject closely, we must well examine the mammillary processes, and the olfactory nerves proceeding from them, as also the cavities of the ethmoid bone, and compare these parts with the phenomena presented by the insect tribe, as discovered by the microscope, and mentioned in the preceding section (V., n. 34—36).

39. In man the mammillary processes are very thin and small, but in other animals, and more especially in those which have an acute sense of smell, they are like two bottles, very large and round, broad at their commencement, and decreasing by degrees, and they occupy a very considerable part of the base of the brain. In some animals, as calves, these processes contain a cavity full of limpid fluid, the inflation of which cavity by means of the blowpipe will cause the whole mass of the brain to rise and swell up; according to the experience of Willis. (*Cerebri Anatome*, cap. i.) They lie upon the dura mater, all the way from the clinoid processes to the ethmoid bone; they are pretty soft; and when they reach the cribriform plate of the crista galli, they transmit a vast number of filaments through its foramina. As these descend, they are invested with and accompanied by an equal number of little prolongations of the meninges of the brain, and proceed until they reach the

pulpy flesh and follicles and granulated substance of the pituitary membrane, in which they terminate. Some authors derive the origin of the fibres extensively from the posterior and anterior lobes, and from the middle portion of the centrum ovale; some, more limitedly, only from the anterior part of the medulla oblongata, and from the corpora striata, from which, running obliquely in concealment, they at last come out between the anterior and posterior lobes.\* Meanwhile the pituitary membrane in which they are inserted, expands far and wide, making a variety of circumflexions, for it insinuates itself into the cavities of the six sinuses, and into the four cells of the spongy and turbinated bones.

40. From this slight description of the mammillary processes, olfactory nerves, and cavities of the ethmoid bone, we may see how it happens, that no air can be drawn through the nostrils into the larynx and trachea, or into the lungs, without in its passage first coming in contact with the papillæ, glands, sensitive membranes and fibrils, which are derived from the brain into the expanded pituitary membrane that invests the above cavities. Thus whether the air be cold or warm, or filled with fragrant or fetid effluvia, this outspreading sensorial organ will necessarily be irritated by the contact; and if the organ, then also its meningeal fibre and prolongation; and if these, then the medullary substance of the brain is excited, with which the above processes from the corpora striata communicate on all sides; for in the calf, when they are inflated with air, the entire mass of the brain is raised thereby (n. 39). And if the medullary and interior substance of the brain, and at the same time both its membranes, or the exterior, be excited, it is impossible but that the cortical substance mediate between both, and continuous with both, must be rendered conscious and participant of the contact and irritation; in other words, it is impossible but that the sense shall instantaneously diffuse itself throughout the whole brain, and, as we may fairly conjecture, excite it to act. We in some measure experience this in our own persons, if we notice how deeply we fetch our breath and how we fill the

\* Nearly the same description of the mammillary processes occurs in the *Animal Kingdom*, n. 345, note (o); but with some remarkable differences of reading.—(Tr.)

brain with pleasure in a fragrant garden, and how straightly and with what constricted lungs we breathe in an atmosphere of fetid smells.

41. But whether the air itself, or rather its warm or cold temperature, and whether the effluvia that it contains in large quantities in the lowest atmospheric strata, as often as they are inspired, excite the brain to act, is a question which cannot be illustrated more clearly than by contemplating the greatest degree of excitation perceptible to our senses. Having done this, we may proceed to draw inferences with respect to the lesser degrees, which scarcely come within the sensible sphere at all. Sneezing\* is the highest degree of animation or respiration, and as it were a species of convulsion. It is excited, as is well known, by the impact of subtile and spicular bodies upon the membrane of the nostrils, also by urinous spirits, fine titillating powder, the solar rays, and other external causes. It is excited also by internal causes, as when anything stops up the little foramina of the cribrous lamina, or the little interstices of the medullary substance, or the winding channels of the cortical or cineritious substance, as may be known from the effect produced; for when the pituitary substances which clogged the parts are expelled by the act of sneezing, the brain is immediately quiet, and composes its cortical tori into their due order; and the lungs with their vesicles do the same; which yet neither of them can do without a great expansion and sudden contraction of the viscera. How this is done may be shewn if we take for granted the animatory motion of the brain. That the dura mater is evidently contracted at the moments of sneezing, is a fact considered unquestionable by all the authors I have ever read; for it is perceptible to the senses of touch and sight in the case of persons struck on the head, and where the brain has been laid open by wounds and removal of the cranial bones. Besides, every one knows that when the brain is somnolent, or when, as in a great variety of maladies, it, together with the lungs, begins to be inert, it is resuscitated to the performance of its proper motion by the application of urinous salts titillating the nostrils. This then, as I have said, is the highest

\* See the *Animal Kingdom*, n. 348, note (s).—(Tr.)

degree of excitation, and consequently of constriction and expansion, belonging to the brain and lungs. All other excitations are lesser degrees of the same genus, arising from similar causes, that is, from the contact of air and effluvia. These lesser degrees we may infer from the superior or highest; so that whenever the air is drawn in, there is some inciting substance that moves the brain to perform its reciprocations. The reason is, that in compounds the same effect cannot be obtained except mediately, which in the more simple substances is obtained immediately. I do not say that the air is the cause of the animation of the brain, because it is at the option of the brain to draw in the air, or to animate. But when it is the will of the brain that the air should be inspired through the nostrils, this air becomes a kind of conjoint motory and impulsive cause of the continuation of its motion, as we had occasion to say of the friction of the nerves issuing from the spinal sheath, which friction is a subservient cause. This excellently meets the questions put by Boerhaave, where he says: "Why is there so extensive a communication between the interior of the nose and the muscles of respiration? . . . Does not sneezing excite and increase the motion of the brain, of the spirits, and of all the humors? Why does it so frequently occur in the morning after sleep." (*Inst. Med.*, n. 507.)

Now then we see clearly why, as I stated at the beginning of this section, in the most simple animalcula, there is so close a conjunction between the pulmonary pipes and the brains; and why in larger animals a similar conjunction prevails, with a difference only as to connection and degrees.

42. The mammillary processes are so thin and small in the human subject, and their roots are not extended so widely into the medullary substance of the brain as in brute animals, because the human brain is not intended to be so excited by external causes, as the brains of irrational animals which live under the guidance of their instincts, and are stimulated to act by all causes; by the internal, or those proper to the body, and by the external, or those proper to the senses. For whenever the human brain is pondering reasons, and directing the rational mind to them, it desires to be at rest, and to draw breath quietly, as is usual with intense thinkers: it also, in order

that it may be left to itself, deprives all the organs of their acumen, and consequently also the olfactory organ; lest anything should disturb its own process of analysis, and provoke a greater influx of blood than such a state of the brain then requires. Power therefore is given it to draw in the air through a shorter passage, without its coming in contact with the sensory fibrils, namely, through the mouth, differently from what we find to be the case with other animals. But brutes, as they have no reasoning power, in order to avail themselves of all the cause of their instincts, and to apply it to themselves and their own nature, are under the necessity of continually expanding the acuteness of their sensations to the ultimate degree, so as to provide for themselves out of present objects. Hence it is that they are endowed with such exquisite organs of smell, and with such very ample mammillary processes, occupying the greater part of the base of the brain, and entering into the medullary substance.

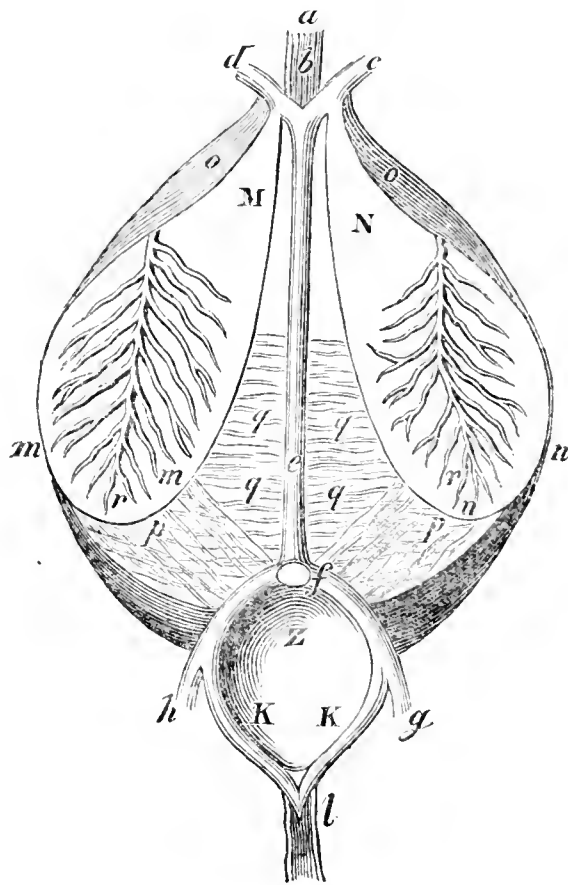
## VII.

43. But as the animation of the brain flows by a natural necessity into the respiration of the lungs; and as there are amphibious animals that live alternately in the water and the air, or that alternately draw and retain the pulmonary breath, hence I felt anxious to examine the brains of such animals, and although I have dissected several, I shall here describe only that of the *drake*. This bird, as we all know, sometimes dives into the water with its whole body, sometimes with its neck and head, (just as is the case with swans, geese, and other birds of the kind,) and so retains for some time the breath of the lungs, if not of the brain. If by removing the cranium we lay bare the brain of any of these birds, either while it is alive or after its neck is twisted, we witness a very remarkable spectacle, and one well worthy of observation. For in either case the arteries of the brain come in view, shining conspicuously through the *dura mater*.

44. The accompanying figure represents the upper surface of the cerebrum and cerebellum. This surface is covered with



a membrane or *dura mater*, which is in close contact with the *pia mater*, and surrounds it, but does not anywhere adhere to the cranium except beside the orbits, and where the nerves and blood-vessels make their exits and entrances. The orbits are placed about *oo*. Under the *dura mater*, in which no arteries are visible, blood-vessels run in most beautiful order, and are better seen when this transparent covering is removed. The longitudinal sinus (*e*) runs between the hemispheres in a slight fissure; and divides above and below into two arms, the upper (*d, c*) at the sides of the olfactory nerves; the lower (*f, h, g*) between the cerebrum and cerebellum. From (*f*) the point of union, the fourth sinus dips down deeply. The inferior arms or lateral sinuses (*fh, fg*) pass out of the cranium by their own foramina, first however giving off two remarkable sinuses (*kk*), which uniting, descend to the spinal marrow. When the *dura mater* is removed, the sinuses are taken away, for the latter are



comprised within a duplicature of the *dura mater*. There is also an extremely fine membrane, which besides the above, invests the sinus within, and is seen when the *dura mater* is pulled away from the brain. The arteries have two origins, one at the base of the skull, under a kind of osseous barrier, which is



identical with the posterior clinoid process, over which they curve, and this, at the sides of the pituitary gland, before they climb the cerebrum; the other, in the orbits, below (*oo*), where the dura mater, as we have said, adheres to the bone. The first-named arteries, which come from the base of the skull or from the internal carotid, ascending at the sides of the brain, which are not represented here, reunite principally into a large branch, which bends circularly from (*m*) to (*M*), or from (*n*) to (*N*), and runs into the two superior arms of the longitudinal sinus. From this semicircle innumerable twigs diverge right into the trunk of the sinus (*q q*), and some into its posterior arms, (*p p*). But the arteries from the other or superior origin, which come up from the orbits to the surface, go forth and ramify in the form of a tree (*or, or*), but whether or not they run to the semicircular subtense (*mm, nn*), I did not happen to see, although they certainly approach very near it. The substance of the brain is so rich in blood-vessels as to be intensely red, and indeed one might imagine that nearly the whole was one mass of blood dotted with cortical substances, for but little medullary substance is to be seen.

45. From the fluxion of the sinuses and arteries through the posterior or superior surface of the brain of the drake, and of which I have here given only a very rough sketch and general description, it is clear at first sight, that the arteries have two sources, and discharge their sinuses by two different ways, and that the semicircular subtense passes as an intermediate between the blood-vessels derived from these two sources, alternately receiving the blood which also alternately flows in; so that when this bird respire the air, there is a large influx of blood through the carotids, and a large efflux through the lateral sinuses (*fgh*), but when its respiration is intercepted by the neck being held under water, there is a large influx through the orbital arteries, and a large efflux through the divaricated rostral sinuses (*dc*), underneath which the olfactory nerves proceed, in the middle of the semicircle (*m, m, n, n*), which lends to each its own little channel, whether the little branches flow in or out.

Thus it is provided by a wonderful expedient, that the brain itself shall be the uniting medium between the motions of the heart and brain, which medium is supplied in land animals by

the dura mater attached to the cranium, and a little distant from the surface of the brain.

### VIII.

46. But hitherto we have derived the series of confirmatory arguments from anatomical investigations alone. But the real truth is, that anatomy dictates nothing more than the probability of our position, and is dumb except in cases of vivisection. For although the connections of the vessels, nerves, and air tubes, coincide with the influx of motions, still they do so only in reference to the judgment of the mind, which should it cherish any other preconceived idea, it is with difficulty persuaded, unless the contrary be demonstrated to sight and touch. It is necessary then that the fact should be exhibited to the senses by opening the skull. But perhaps you will say, why all this circuitous and operose deduction when a single living example would settle the matter. Be it so; yet the subject upon which we enlarge, is well worthy of our pains; for it is only by the course we adopt that we can scrutinize and evolve the causes of the wonderful influx of motions established by the mutual connections of the nerves and vessels. This is the reason why I carry the thread of this Part round the vast field of the animal system. For to speak from a cause, is to speak to innumerable effects; but to speak from an effect, is to speak to only a few causes.

47. The history of diseases is full of phenomena and symptoms that by the light of anatomical experience will explain the present subject almost to the life. Hence it will not be unadvisable to cite some morbid instances by way of authority; but they must be few, for were we to quote all, we should enter upon far too large a field. And in fact one and the same disease originates more seldom from the brain than from the body; for example, difficult respiration, or painful, stertorous, panting, asthmatic, deep and high respiration, or quick, slow, suffocative, cold respiration, &c., which are no signs that there is necessarily any affection of the cerebrum, cerebellum, medullæ, cranium, meninges, vessels or cortex; but generally that there is an affec-

tion of the organs immediately subservient to respiration, as the larynx, trachea, bronchia, lungs, pleura, diaphragm, nerves, muscles, thorax, ribs, sternum, abdomen, or some other part that is between the brains and the viscus affected. Any muscle, for instance, which we know to be put in motion at the will of the brain, becomes unable to act in case either itself or its antagonist be cut, flaccid, inflamed, or tendinous, or in case its tendon, fulcrum, surface, or nerve, be injured in any part of its progress from the medulla, or its artery be injured in its progress from the heart: when nevertheless the supreme fountain of causes is in the brains. Thus I do not see the use of medical knowledge, if anatomy does not teach the seat [of the disease].

48. In those who have received wounds of the head, or either by accident or the trepan have lost a part of the skull covering the brain, when the acuteness of the pain ceases, the contraction and elevation of the brain and dura mater are clearly seen to be synchronous with the same motions of the lungs. Baglivi, who so strenuously vindicates the position, that the pulsations of the dura mater are analogous to those of the heart, and *vice versâ*, still does not hesitate to adduce a memorable example of a woman 70 years of age, which makes against himself. "When the head," says he, "is suffering from a wound, or from pain, or torpor, attend to the changes that take place in the inferior parts. Near the temple of Tellus, now the church of St. Pantalleone, built on the site of the house of Cassius, in the street Suburra within the Carinæ, I knew a woman 70 years old, who suffered under severe asthma with continual cough, but whenever she strongly compressed the top of her head with both her hands, the asthma and catarrhal cough immediately ceased; and this, so long as the pressure was continued; but when she withdrew her hands, both symptoms immediately returned: which might be the case many times in the course of the day. In this instance, was the pericranium affected and supported by the strong compression of the hands, and was the effect propagated to its origin, the dura mater; so that the latter acquiring additional power and tone, the motions of the liquids in the inferior parts were better directed, and thus the asthma and cough immediately ceased? Assuredly a more pro-

bable way of accounting for the facts cannot well be conceived." (*Specimen Quatuor Librorum de Fibrá Motrice*, lib. i., cap. v., *ad fin.*) Unless perhaps the joinings and sutures of the cranium were so loose, (as was found to be the case in the head of Pascal after his death), that by the assistance of the hands, the patient forced the dura mater attached to the sutures to perform its natural office in assisting in the elevation of the brain, the dilatation of the sinuses, and the due influx of blood thereinto.

49. Similar cases occur in those who after the application of the trepan, are desired by all skilful surgeons to hold the breath strongly, by which means the collected sanies is extruded, or is prevented from passing inwards. Thus Nuek says: "If the blood or sanies does not come out spontaneously, the dura mater must be depressed by the decussorium,\* and in order that the matter collected in the cavity of the cranium may the better find an exit, let the patient close his mouth and nostrils, and hold his breath, and then when the brain is compressed, the more deeply-seated matter will rush out." (*Operationes et Experimenta Chirurgica*, exp. v., p. 21; 12mo., Lugd. Bat., 1692.) And Boerhaave says in his aphorisms on wounds of the head, and on the trepan: "Sneezing and holding the breath will help the patient during the operation of elevating depressed portions of the skull." (*Aphorismi de cogn. et cur. Morbis*, n. 271.) And again he says: "Deep and slow respiration indicate an obstructed brain, and the diseases attending or following it, as coma, lethargy, delirium," &c. (*Inst. Med.*, n. 986.) I forbear to make further citations, for all the authors that I have consulted are of one and the same opinion upon this point; a proof that the brains are elevated at the moments when the lungs respire; thus producing effects upon the membranous and osseous coverings and the fluids between them.

50. In all brains obstructed by any sanies, viscid phlegm, or other malignant impurity, the faculty of reciprocation is similarly impeded, either in whole or in part, as in apoplexy, epilepsy, and the like, of which an excellent account has been

\* "An instrument which by gently pressing on the dura mater, causes an evacuation of the pus collected between the cranium and the beforementioned membrane, through the perforation made by the trepan." (*James' Medical Dictionary*).—(*Tr.*)

given by Wepfer, illustrated by many cases, of which I will select but one, all the rest being of the same nature. One Reiter, he relates, who had been troubled for a long time with a violent cough, which was attributed to suppressed gout, was found lying upon the ground, deaf to the loudest exclamations, and deprived of all his senses as well as of animal motion. His pulse was at first strong, full and quick, but soon became comparatively weak and small, and increased in quickness. *His respiration also was laborious, and soon became irregular, often seeming as if it was on the point of ceasing altogether.\** He died the same day. When the cranium was opened and the dura mater divided, a large quantity of dark blood [eruor] flowed out from the considerable space that lies between the dura and pia mater. And the blood stagnated not only round the base of the brain, but it also reached as far as the vertex, and to the anterior and posterior parts, and in fact it insinuated itself between almost all the convolutions of the brain. On opening the ventricles, they also were found filled with blood, not excepting even the fourth ventricle. The lateral ventricles near the base were in a manner torn, as if they had been fissured by over distension. (*Op. Cit.*, p. 1—5.) Let us now keep to cases of apoplexy, because it is well known by *post mortem* examination that in such cases the brain is obstructed, compressed or injured. Boerhaave has classified the causes of this disease; stating that it arises from every cause that alters the blood, lymph, and matter of the spirits, so that they cannot pass freely through the arteries of the brain, but stick and fasten there. Such causes are often polypous concretions in the carotid and vertebral arteries; inflammatory thickening of the blood; a gross, glutinous, pituitary, sluggish quality in the whole mass of the blood: also whatever so compresses the arteries and nervous vessels of the brain, that the blood and spirits can no longer flow through them; all tumors growing within the cranium, whether inflammatory, purulent, serous, pituitary, steatomatous, schirrous, or osseous, &c. The effect, according to the same author, is difficult, deep, stertorous respiration; and the disease is heralded by the respiration becom-

\* The italics are Swedenborg's.—(*Tr.*)

ing hurried on the slightest motion, attended with compression of the *alæ nasi*; and by nightmare, stupor, sleepiness, vacillating memory, and many other concomitants; respecting all which, see Boerhaave, *Aphorismi*, &c., n. 1007—1035.\*

It is needless here to introduce a whole crowd of authorities all tending to evidence the same positions, such as we find in the various Transactions of the learned, and in the works of the most experienced physicians, treating of patients laboring under catalepsy, hydrocephalus, dropsy, paralysis, phrenitis, leucoplegmasia, scorbutic affections, gout, delirium, mania, melancholia, pneumonia, angina, convulsions, hydrophobia, &c.; in all which cases the lungs either cease to respire, as in apnœa; or respire with pain, as in dyspnœa; or respire frequently with trouble and hissing, as in asthma, when this malady reaches its common fountain, the brain, or when it immediately descends from it. According to the observations made in neurology, and particularly by Vieussens (Part I., n. 559), we find that as soon as the brain is cut, it loses the power of raising itself; or even that if it be strongly compressed with the hand, so as to be forced to stop its animations, the respiration of the lungs ceases, though not the pulsation of the heart, unless similar violence has been done to the cerebellum. Exactly the same effects will be produced in a greater or less degree, if instead of the compression produced by the hand, either blood, lymph, hydatids, schirrus, or anything else intrude upon the spaces between the meninges, upon the winding channels between the cortical substances, upon the interstices between the medullary fibres, or into any of the other cavities that are to be dilated and constricted in general or particular with the brain; or if any rigidity or incapability of moving affect the substances themselves.

Now from these considerations it appears, that the diagnostic signs of compression, obstruction, or lesion of the cerebrum, cerebellum, or spinal marrow, will be more evident if derived from the respiration of the lungs than if derived from the pulsation of the heart; although it is better still to derive them from both at once; for the respiration of the lungs indi-

\* See also his *Institutiones Medicæ*, n. 860.—(Tr.)

eates the peculiarities in the transflux of the spirits through the nerves; and the pulse of the heart, the peculiarities in the transflux of the blood through the arteries; consequently the two together indicate the effect with its own real cause.

## IX.

51. That there is such a close relationship between the animations of the brain and body, that their moments are contemporaneous, is a fact which has not escaped the observation either of modern or of ancient anatomists. But although they have tacitly admitted it, yet none of them have chosen to avow it openly, and as I apprehend for this reason, that in each extremity of the animal body, the heart manifests its presence by its pulsation; whence they have been led to think that no artery had anywhere any other motion than that of the heart itself, which consequently they did not venture to deprive of universal rule, even over the brain, so far as regards the blood; and still less when they observed the dura mater pulsating with similar alternations. But I cannot help thinking, that had the learned once fallen into the opinion, that the brain took the control over its own proper vessels, as soon as it received them within its cranium or osseous fortress, they would likewise have been led into the opinion, that the brains animate when the lungs respire. Indeed, upon this opinion they had already began to touch, but could scarcely reconcile it with the preconceived opinion respecting the pulsation of the heart extending to the brains, and hence every one had recourse to his own particular method of reconciling the two motions.

52. That they tacitly admitted the fact, is evident from their writings. "Beyond all doubt," says Willis, "the dura mater is contracted . . . in the act of sneezing." (*Cerebri Anatome*, cap. vi.)\* And Valsalva says: ". . . As the external air with which we are surrounded, and of which the mouth and nostrils are constantly full, is immediately continuous with the air that fills the tubes and the tympanum, so it comes also into immediate contact with the dura mater; and therefore according as the same external air is various, it is enabled also to exercise various

\* See Part I., n. 283, Vol. I., p. 262.—(*Tr.*)



forces upon the dura mater and upon the brain." (*Tractatus de Aure Humanâ*, cap. v., n. 8.) And Pacchioni, enquiring into the cause of the phenomenon, seems inclined to ascribe the expansion of the brain to the fermentation of the blood. "Wherefore," says he, "when the arterial blood, the air of the blood, and the pure air, reach the brain and its cavities, the air . . . will not only actuate the fluid blood and lymph within the ventricles of the brain and spinal marrow, by [further] dissolving, and fermenting them, but will also distend and inflate the parietes of the ventricles and other cavities to an immense extent; so as necessarily to cause the body of the cerebrum and cerebellum to fill a greater space, and in a manner to be thrust outwards." (*Opera*, p. 91; 4to., Rome, 1741.) And Fantoni says: "This we clearly see, and detect by actual touch, in those who have lost any considerable portion of the skull by wounds; and these degrees of motion are various according as the arteries beat gently or strongly, and as their diameter is greater or less; and also according as the respiration is vehement or the reverse." (*Epist. ad Pacchionum*, in *Pacch. Oper.*, p. 171, 172.)

53. The reader will be surprised to find, that even Baglivi at last candidly moots the same question among his Postulates, in apparent contrariety to what he had said of the motive fibre in the dura mater; as though he were doubtful which side to take. "Since the dura mater," says he, "is almost the sole mistress of the motion of the liquids and solids in the living body, and in a manner has the government of the heart itself, as we manifestly perceive from the passions of the mind, *the question arises, whether the said motion of the dura mater be not partly natural and partly voluntary, that is to say, mixed, like the motion of the respiratory organs\** [see Part II., n. 7]: so that we can, at the command of the will, or as our temporary affections require, render the motion more or less intense or gentle, fitted to express and propel a greater or less quantity of the nervous liquid. [See *Ibid.*, n. 8.] . . . And thus according to the various degrees of contraction and relaxation in the membranes, various motions and various appearances may arise in the liquids and solids of the living body." (*De Fibrâ Motrice*, lib. i., cap. v., coroll. et post. xiii.) From this and other ar-

\* The italics are Swedenborg's.—(*Tr.*)



guments which he adduces, he grants that the motion of the dura mater is partly voluntary; and hence is not like that of the heart, which is purely natural, but like that of the lungs, which is mixed. He goes on to say: "The great degree of power and force exercised by the air in quickening the motion of liquids during respiration, . . . may be very clearly inferred from the following experiment. . . . Take a mastiff, and fasten it to a table in the usual way: then carefully make an opening in the throat, and in this opening place a canula so constructed that by the motion of the lips air may be freely blown into the lungs. . . . Blow from time to time through the canula, and you will then find that as long as you continue to blow, the dog will be easy, and will make no complaint, and manifest no violent motions; but the moment it is deprived of this artificial air, its whole body will be seized with convulsive motions, and with most difficult and almost suffocating respiration, together with a thousand other serious symptoms, all of which again disappear the moment air is again blown through the canula into the lungs. Now if the force of the air is of such great efficacy in quickening the motion of liquids through the lungs, why may we not suspect that the same force contributes in some way to the motion of the dura mater, either by elasticity, or some other occult mechanical means? &c. (*Op. Cit., Epist. in cap. v.*)

54. "That the air inspired in respiration contributes to the motion of the dura mater, was long ago obscurely indicated by Galen, *Lib. de Respirationis Utilitate*, cap. v., ad fin.; and *Lib. de Dogmatibus Hippocratis et Platonis.*"\* It appears then that our view was not without its weight among the ancients, only that a leader was wanting, at whose declaration a conclusion might be formed from the preceding facts and concessions.

## X.

55. But perhaps you will oppose to me the experience of the greatest anatomists, who by touch and sight have observed the motion of the dura mater to be synchronous with that of the heart or arteries of the body; for there is not one of them, so far as I know, but has fallen in with this general opinion. For

\* Baglivi, *De Fibrâ Motrice*, lib. i., cap. v., in *Epist.*—(*Tr.*)

if you apply the finger to the fontanelle in the infant, you will notice a plain agreement between its pulses and those of the heart; and what amounts to the same in adults also. Thus Baglivi says: "In cases of wounds of the head, where the dura mater has been laid bare, I have observed, on placing my right hand over the patient's heart, that the dura mater pulsated at the very same time as the heart, nor could I detect any interval between the pulsation of the two." (*Op. Cit.*, lib. i., cap. v.) But although this excellent author calls the dura mater "the heart of the brain," (*Ibid.*,) and maintains that "its motion is impressed upon it in the primordial stages of generation, by reason of the peculiar structure of its fibres, which is not very unlike that of the fibres of the heart," (*Ibid.*, cap. v. in *Epist.*,) and although he is supported by all this experience, nevertheless he seems to be divided between two opinions, and to fluctuate toward the other side of the question, as appears from the passages above cited, and as will appear further in the sequel. Ridley tells us that, "he observed a systaltic motion of the dura mater and longitudinal sinus, . . . analogous to the pulsation of the heart, which was quicker than usual, and exactly corresponding with it in point of time." (Part II., n. 1.) But it is well to be noted, that the vibration of the heart was found by this author to be more rapid than the vibration of the dura mater [?], or longitudinal sinus; consequently a discrepancy in time was observed, such as there is between the motions of the heart and of the lungs when compressed. Realdus Columbus says: "When the head of a living dog is stripped of its skin, you may very readily fracture its skull; and by dividing the membranes, see the motion of the brain. For the brain moves in the same manner as all confess that the heart itself moves, namely, with a motion of dilatation and constriction." (*De Re Anatomicâ lib. xv.*; lib. xiv., *de vivâ Sectione.*) But this writer passes over the main point to be noticed, namely, whether or no the brain dilates and constricts synchronously with the heart. We need make no further citations. Those already given are quite sufficient to perplex the mind, and render it unable easily to take either one side of the question or the other: but the thing will become clear if we duly examine the mixed or compound motion of the dura mater.

56. Here we may repeat a former observation (Part II., n. 2), that it is extremely difficult accurately to detect in living subjects the distinct intervals of the elevation of the brain; for unless the brain itself be presented to view, we only perceive the motion of the dura mater; and this motion is mixed, consisting of one motion from the arteries, and of another from the brain received through the medium of the three sinuses; and hence we are deceived by first appearances. This is the reason why Baglivi, Pacchioni, Vicussens, and all the other authors that I have hitherto consulted, deriving their information apparently from experience and autopsy, assert that the rhythms or pulses of the brain and heart are concordant.

57. *In the first place*, there is no question that under the finger the dura mater receives a motion from its arteries; for it has innumerable arteries, and only a few veins, and these are rejected towards the sides of the sinuses, or their processes. These arteries of the dura mater immediately communicate with the arteries on the outside of the head, and are sent into the anterior and posterior part of the membrane, through their own proper foramina, as also through the spinous foramen of the sphenoid bone, through the foramen by which the eighth pair of nerves and the jugular vein escape, according to the observations of Ridley, (*Anatomy of the Brain*, chap. iii., p. 22, and fig. 2, *kk*,) and through the carotic foramen, whether the meningeal artery comes off from the carotid as a twig, or enters as an accompanying branch from the external carotid, as the same author seems to intimate: still no artery of this membrane ever arises from the internal carotid, after it once ascends the brain, lest the motions of the two should be confounded. Thus even after birth this internal periosteum maintains the same compact that it formerly entered into with the external periosteum or pericranium, and corresponds with it in a marked manner in the brains of infants, and during inflammation, particularly near the fontanelle, where, joined to the pericranium in the remarkable space between the coronal and sagittal sutures, and anteriorly by the frontal suture, and constructed of an immense number of arteries confluent from both hemispheres of the dura mater, and communicating with the arteries on the outside of the head, but not with those of the brain, (as we may see in one

of Ruysch's plates, *Thes. Anat.* v., tab. ii., fig. 4,) it remains open for a considerable time.

58. *In the second place*, that the dura mater is expanded and contracted by the subjacent brain, appears from its connection with the longitudinal and lateral sinuses, and with the fourth sinus, and from the connection of these with the brain by vessels and membranous prolongations and cords: and from the position of the sinuses themselves in the duplicature of the dura mater, and between the hemispheres and brains: also from the oblique course and inflexion of the fibres of the dura mater in exact agreement with the direction of the motion from the circumference towards its centres: and from the similar progression of the cords: and from the insertion of the little veins running into it from the brain into the sinuses in a manner corresponding with the peculiar expansion and contraction of the brain: also from the common course of its arteries from their origins over the cerebrum and cerebellum toward the fourth sinus, to which the motions of the cerebrum and cerebellum themselves tend: and from innumerable other indications in the fabric of the dura mater and sinuses. But it is even yet more evident from autopsy; for Ridley, having made an experiment upon a living dog, shews that "the sinuses themselves have no pulsation other than what is communicated to them from the subjacent brain." (*Anatomy of the Brain*, chap. vi., p. 50.) And again he says, "We saw a systaltic motion of the brain propelling outwards the small quantity of blood which was left in the orifice." (*Philosophical Transactions*, n. 287, an. 1703, p. 1482.) Thus if the sinus itself be dependent on the motion of the brain, so of course must be the inner lamina of the dura mater, which invests and surrounds the sinus, and is continued into the processes. And Pacchioni says: "The dura mater appears to me to have a mixed motion, namely, one motion of constriction and restitution; and another, of elevation and depression. . . . So that the natural motion of its circumference consists in a gentle and bland alternation of contraction and relaxation." (*Opera*, p. 153, 154; 4to., Rome, 1741.) Baglivi says: "The true systaltic and compressive motion of the dura mater, is not found on its external surface, but in its centre and middle, about the falx and all its septa, where the mem-

brane is furnished with strong lacertous cords." (*Dissertatio varii Argumenti*, cap. ii.) And Fantoni says: "Although the contractile motion is with more difficulty seen in the head, yet it may be observed in the upper part of the dura mater, as indeed it has been by various anatomists, who have clearly witnessed the motions of this membrane, and have observed that they are dependent upon the motions of the arteries and brain." (*Epist. cit.* in Pacch. Oper., p. 169.)

59. Thus I think it is evident, that the dura mater has a mixed or compound motion; that is to say, two motions; one, pulsatile and sensible to the touch, corresponding with the vibration of its arteries; and another, expansile, coming from the whole of the circumference where the sinuses are situated, and which latter motion is not so perceptible to the sense of touch. Nevertheless that it does exist, is evident not only from the proofs above adduced, but also from the extreme elasticity of the fibres of the dura mater, and their capacity of expansion and contraction; from the duplication or triplication of its strata or laminae, between which the arteries run; and from the two-fold discharge of its venous blood, namely, either into the sinuses through particular small orifices, according to the observation of Winslow, (*Exp. Anat., Tr. de la Teste*, n. 36,) or through the sutures into the substance of the cranium, or all the way to the pericranium, and sometimes through a particular foramen near the junction of the sagittal suture with the lambdoidal. And a similar discharge of venous blood obtains in the body, where two motions, as of the heart and lungs, alternate their play; for example, in all the intercostal veins, whose blood is derived into the vena azygos at the times of the respirations, as above observed (Part II., n. 25—30); but at the other times, when the respiration is not determined thither, the blood is derived into the inferior cava, for the intercostals tend directly thither also; &c. Thus Pacchioni says: "The motion of the dura mater is not simply pulsatile, as Mayow and others have thought: . . . for it is quite evident that this pulsatile motion is not the genuine motion of the dura mater, but is rather owing to the brain and to the arteries of the pia and dura mater," &c. (*Opera*, p. 152, 153; 4to., Rome, 1741.)\* And in another place he says:

\* See Part I., n. 281, Vol. I., p. 256.—(*Tr.*)

“The motion of the dura mater . . . is composed, first, of the constrictive motion of the whole membrane and its segments over the cortex of the cerebrum and cerebellum ; and secondly, of the resilient motion of the membrane to the internal parietes of the cranium,” &c. &c. (*Ibid.*, p. 92.) And Baglivi says : “The motion of restitution consists in the relaxation of the fibres previously on the stretch.” (*Dissert. varii Argumenti*, cap. ii.) And again : “Two motions may be granted in parts of this kind ; one, proceeding from the membranes to the parts ; the other, proceeding from the parts to the membranes.” (*De Fibrá Motrice*, cap. v.) So that all our authors wonderfully agree in the fact, that there are two motions in the dura mater : although each of them has his own problem to defend ; Baglivi maintaining that the systole and diastole of the heart depend upon the systole and diastole of the dura mater, (*Ibid.*, cap. v.) : and Pacchioni, that the dura mater is a membranous muscle of a peculiar kind. (*Opera*, p. 136 ; Ed. cit.) Still, as I have said, they all agree to the above opinion : for as the dura mater vibrates at once with the heart and with the brain, it is in a manner the uniting medium of both their motions. And for this reason, before the brain sends off its veins into the sinuses, it transmits them into the borders of the dura mater, (as also does the spinal marrow,) which borders depend immediately upon the motion of the brain.

Now from these considerations we may conclude, that the internal lamina of the dura mater belongs to the brain, the external to the heart, and the middle, where the arteries run, to both ; but with this qualification, that in infancy the latter belongs rather to the heart ; in old age, rather to the brain ; and in middle age, to both equally. For in infancy the numerous arteries of the dura mater climb over the sinuses beside the external or cardiac lamina, and the fontanelle ; in old age they turn aside to the processes that are composed of the internal or cerebral lamina ; and this, to such an extent at last, when the effete or senile brain gasps for breath and begins to die, that the motion of the dura mater ceases to be mixed and compound ; all which positions will be proved in the Part on the Dura Mater.

60. Nothing is more common or better known in nature or

art, nothing is more in agreement with the laws of both, than that two or more motions may subsist simultaneously in one body or extense: and this is particularly the case in the animal body, where nature reigns in all her science and art.\* As in the lungs, for instance, whose arteries and veins then especially concur with the systole and diastole of the heart, when the lungs themselves alternate their own motions in a different manner. Likewise in the diaphragm, which coöperates with both: also in every part of the thorax and abdomen, where the motions of both the heart and lungs are constant and persistent. Still more evidently in the pericardium, which may aptly be compared with the dura mater; for it surrounds the heart much in the same manner as the dura mater surrounds the brain. That the pericardium is acted on in a general manner corresponding to the traction of the lungs, is evident from its connection with the diaphragm, the mediastinum, the sternum, and the bronchial vesicles; from its insinuation between the lobes of the lungs; and from its continuation from the pleura: and still its arteries keep time with the vibrations of the heart. Thus the motions of the lungs and heart in one and the same space, are perfectly harmonious, so that the members freely live by their concurrence, because the fibres of the nerves are filled by the motion of the one, and the arteries of the body by the motion of the other. And indeed for this reason the cardiac nerves are always transmitted through the pericardium before they go to the parenchyma of the heart.

61. Before we close this section on the dura mater, I will propose to the most experienced anatomists of our age, a matter possibly worthy of their further observation: namely, that the dura mater, which in itself is passive, and belongs equally to the inferior and superior regions of the body, seems to undergo pretty nearly the same changes in regard to the direction of the blood-vessels, as we observe throughout the body, and particularly in the heart. For it is well known that after birth the blood changes its course considerably, and no longer runs through the *canalis venosus*, *duetus arteriosus*, and *foramen ovale*, &c., but closes the old ways, and opens new ones. So

\* See the *Animal Kingdom*, n. 165 (*p*); n. 425 (*x*).—(*Tr.*)



also in the dura mater. The distribution of the arterics through this membrane during infaney, is well shewn in a beautiful figure by Ruysch. (*Thes. Anat.* v., tab. ii., fig. 4.) The distribution long after birth is represented in the figures of Ridley, Vieussens, Willis and others; in which the fluxion of the vessels is seen to be of a widely different character. Thus in the infantile membrane the vessels are applied more closely to their sinuses, and run in abundance over the longitudinal sinus; but in the dura mater of adults, a large portion of the vessels is obliterated, and changed into quasi-tendinous fibres, like the ductus arteriosus and umbilical vessels; that portion only remaining which agrees exactly with the direction of both the motion of expansion and contraction. And this, to the end, that in the embryo the motion of the brain may coincide with the motion of the heart, but in the child and the adult, with the motion of the lungs, and the motion of the dura mater with that of both. And it would be worthy of observation, whether the coccal diverticula or foramina of the longitudinal sinus, which are closed in adults, were open, and more numerous, in the foetal state.

## XI.

62. In the present and last section, we propose to make a few observations on the point of use, for of right we measure everything by its utility. The knowledge of what motions in the animal system are concordant, and of what are not concordant, is immensely conducive to the entire interests of anatomy, medicine, and physiology: as we may infer more particularly from the fact, that the motions of the brain and lungs are the most universal and the predominant motions, by the coöperation of which we enjoy the privilege of living distinctly. Whatever therefore constitutes life in the animal, in the same degree constitutes life in the sciences relating to the animal. But this subject will be better seen if we say a few words respecting it.

63. When we obtain a knowledge and distinct perception of the universal and natural motions in the animal body, we are necessarily led to infer that it is only by such a knowledge that we can comprehend the stupendous connections of the blood-



vessels in the body itself, in the brain, and in the confines between the two, of which we have hitherto been treating. That we can comprehend, for instance, why the carotid artery in the human subject, arises as a branch and not as a trunk from the arch of the aorta: why the internal carotid twists through the cranium in angular flexures and repeated diametral gyres: why again, after entering the cranium, it winds about into similar gyres; why it expands into a ventricose bed (Part II., n. 18), as do also the lateral sinuses; why it puts off the motive tunic of the arteries of the body, and puts on a plexiform tunic instead; why it subjects itself to the dura mater, and afterwards entirely to the pia mater: with many other peculiarities, of which in our preceding remarks we have, I think, spoken as fully as the occasion would admit.

64. By the same knowledge we may also comprehend why the most general nerves of the body, as the intercostal and par vagum, sent into the provinces of the body to govern the natural motions, take possession of and envelope the vessels, as the carotid arteries, and the jugular, vertebral, and azygos veins, and their branches; for these nerves so order it, that when they come into the kingdom of the heart, they still pass under the control of the brain; and cause all the special and particular motions of the body to terminate in the universal motion of the brain, and the common motion of the lungs, just as they begin from them. For it is indeed highly interesting to observe that the motions of the living body constitute an entire series, there being primary, intermediate, and ultimate motions; and that the intermediate motions, which are also kept in a certain series by their proper motions which are more universal than themselves, subsist and flourish under the auspices of the most universal motions. These, and several other things, will never be traced to their causes, I mean, they will never be laid open to the rational sight, or to the mind, unless we first know the times, modes and nature of the motions.

65. From a distinct perception of the above motions, we may also perceive why the blood-vessels of the brain and dura mater, and the blood-vessels of the body, undergo such remarkable changes as soon as the infant or chick is excluded into the atmosphere, and begins to draw the new breath; why it salutes

the new air with deep sighs, yawns, and sneezes ; these being natural helps for turning the hinge of the motions. The causes of all these effects would never come to light as the infant does, unless we explored the nature of the motions which are the efficient here.

66. Much less without a previous knowledge and distinct perception of these motions, can we understand how the brain, and the human brain particularly, is enabled to be the mover and dispenser of its blood : how it has the power of not admitting more than its state requires ; and this, with so notable a difference in man and in brutes. For by these means alone can the brain be left to itself, and to the analysis of its reasons : by these alone can it so govern all things, that unanimity may still reign over the discords of the body, as it does when the brain fears no invasion from the blood of the body, which cannot burst in without invitation, because the animations of the brains and lungs are coincident. And as the brain has the power of acting upon its fibres and vessels, it also has the power of acting upon the muscles, which depend upon the fibres : wherefore without a concord existed between the motions of the brain and lungs, the brain could exercise no jurisdiction, because it could possess none, over any motive fibre of the body.

67. Finally, from the same knowledge we may understand how the affections of the brain flow into the body ; and how the discases of the body flow into the brain. It follows as a consequence from this doctrine, that in proportion as disorders spring from a deeper and higher source, they fall with greater certainty upon the lower spheres, and spread more widely. Thus if they proceed from the brain itself, which holds the highest place ; or from the spinal marrow, which holds the place next under the brain ; or from the nerves, by which the brain is continued, according as they are more or less distant from their origins or ends ; instantly the subjacent region (which is wider in proportion to its distance from the supreme fountain) is affected with the disorder which influences its superior ; although it is to be observed that the region of the superior is not affected by the disorder of the inferior until after a certain interval of time has elapsed. This would not be so, did the motion of the heart and arteries of the body coincide with the

motion of the brain and nervous fibres ; for then the contagion would diffuse itself upwards and downwards equally.

68. These utilities then we promise to anatomical, physiological, and pathological science, from a knowledge and distinct perception of the coincidence of the motions of the brain and lungs ; from which, after we have expounded them in their universal relations, it is easy to descend to particulars.

## CHAPTER II.

### THE CORTICAL SUBSTANCE OF THE BRAIN SPECIFICALLY.

69. WHEN designing to treat of the brain, I was for a long time in doubt from what point to commence ; whether from the dura mater, which is the first part that comes in view on opening the head, or whether from the arteries of the brain, considering that in the former Part I had treated of the arteries of the body. But wherever I turned, I could not help recognising in the brain a more than Gordian knot, and all things so concatenated, that one was to be sought in the other, the last and the middle in the first, and *vice versú* ; so that unless I would make up my mind to unravel the entire brain, it would be in vain to attempt to unravel a part : proving that a special treatise dedicated to one part of it alone, would serve only to defer the reader's hopes, and to refer him onwards to the next links in the chain. Still, to evolve the entire brain in the method already begun, I found to be a work of greater extent than could be comprised within the limits of a single Part. What then was to be done ? I must begin somewhere ; and therefore I resolved to begin from that which is specifically called the cortical and cineritious substance. The reason is, that this substance, proximately, is the principal efficient cause of the operations not only of the brain, but also of the body ; for it is this substance that animates and spirates, and excites the whole of the animal machine to motions and modes : that elicits the purest spirit of the blood from the arteries, and transfuses it into the fibres of the medullary substance, and from thence into the fibres of the nerves : or, finally, this it is that is situated in the middle, between the principal fluids of the animated system, namely, the

blood and the fluent spirit; and consequently in the centre of all the fluids, or in the first and last term of all. Wherefore, in order that I might contemplate the posterior sphere from its first principle, and the sphere of consequents from its highest antecedent, I was under the necessity of beginning, or taking my principles, from this substance. This substance once explored, it becomes easy to turn to whatever point I please, either to the surfaces of the brain, namely, its arteries, sinuses and membranes; or to its inner substance and members; or to the inferior sphere, namely, the body itself.

70. It is to be noted, that in the present Part I have proposed to observe the same method as heretofore; namely, before entering upon the subject matter of the Part, to premise the observations and experience of the most learned enquirers, by way of foundation; then from these to form a general induction, the clauses of which I shall afterwards consider in minute detail. I could not devise any other method that appeared to me more akin to the peculiar operations of the mind itself, and better adapted for unfolding phenomena, and unlocking the arcana of nature by the aid of experience, and the force of rational philosophy. Here then follow our facts.

71. LEEUWENHOEK. "First of all I undertook to examine those parts of the brain of an Indian hen, which are commonly termed the cortical substances. These parts . . . are composed of a very pellucid, crystalline, and . . . oily matter, of so limpid and pellucid a character, that it ought rather to be called the vitreous, than the cortical substance of the brain. When I attempted to separate this matter into its least particles, I immediately observed a small quantity of a thin fluid or ichor oozing from it; which ichor was crowded with globules, by far the smallest of any I had met with; and of which I calculated that thirty-six would not equal in size one of those globules that give our blood its red color. . . . Besides the small globules we have mentioned, there were certain larger ones, six of which I reckoned would be equal in size to one globule of our blood. . . . Moreover, there were certain clear and irregular globules dispersed about through this substance, some of which were equal in size to a globule of our blood, while others were larger. Through this pellucid matter and these globules again most minute blood-vessels were scattered in great numbers, . . . many of them being indeed so minute, that to judge from the eye, if one of the constituent particles of the plano-oval globules that redden the blood of fowls and other birds—if one of the particles existing in the round corpuscle were divided into fifty parts, even such parts would still not be small enough to traverse the cavities of these blood-vessels. . . . These exquisitely fine vessels also displayed a red color where they were laid one upon an-

other in layers three or four deep, without any other matter interposed between them. . . . Besides the above-mentioned minute vessels in the brain, there were others also of such tenuity that, in my opinion, no round body such as I have previously spoken of, though it were divided into more than a thousand parts, could permeate them. . . .

72. "Coming to the medullary parts of the brain, I there met with certain irregular globules of different sizes, some of them equal to one globule of our blood, some of them larger, and which, to judge from the eye, consisted for the most part of a thin, pellucid and oily substance. These globules are found in the medullary part of the brain (particularly in the place where the spinal marrow commences), and in such abundance that they seem to constitute the greater part of the brain. This vast multitude of pellucid globules is what causes the white color [of the medullary substance]. . . . These irregular globules were so closely united together, that when I saw any which were small or single, and attempted to separate them, some of them underwent an extension twice as great as their length seemed to admit, and appeared to me to be connected by threads in the form of a net. . . . The opinion I had formed, that many of these irregular globules were surrounded by vessels, was confirmed when I saw that many of the vessels beforementioned were transparent in the middle, and somewhat opaque at the sides; and still more when I found that on the globules bursting, a number of fine fibrous parts came into view, which to all appearance were vessels. . . .

73. "In the course of my inquiries I took the head of a sheep, and on examining its brain, I found in like manner in the cortical parts a vast number of extremely minute blood-vessels; and I recognized that the substance that gives the blood its red color was contained in them, which vessels therefore also communicate a brownish color to the cortical parts. This incomprehensible multitude of exquisitely fine blood-vessels I frequently beheld with my own eyes, . . . and I saw almost every vessel again splitting into lesser branches. . . . And I imagined to myself that the globules . . . which constitute a sixth part of one perfect [blood] globule, meeting with vessels so narrow that they cannot pass through them, are under the necessity of being divided into lesser parts, and that the above narrow vessels are destitute of color. . . . Nevertheless I am of opinion that these small particles of blood are always flexible, just as those blood globules that have come to perfect maturity. . . . In the cortical parts there were certain small white streaks. . . . I also observed brown lines or streaks running through the medullary parts of the brain. . . . In the medullary parts running towards the beginning of the spinal marrow, I thought sometimes that I saw very clearly . . . that the large translucent . . . and oily globules were in a

manner surrounded with, or lying in, an ineffable number of most minute retiform vessels or lines, mingled with some that were larger, which last took a straight course, and were remarkable for their transparency.

74. "During my investigation of the cortical parts of the brain of the ox, I have often thought that I could see and observe that the vitreous and highly pellucid matter that constitutes the principal part of the cortical substance, consists of nothing but very fine lines or vessels, all joined together in the closest manner. . . . I also investigated the cortical parts, or cortex, of the brain in sparrows, immediately after I had killed them, and here I observed small blood-vessels of all kinds . . . as clearly and distinctly as I had observed them in the brains of the ox and sheep; and all the other [microscopic] parts of the sparrow's brain were of no less size than they are in the ox. . . . And when I accurately examine the vitreous or cortical substance of the brain, it seems to me to consist of nothing else than an inconceivable multitude of the least vessels, lying so close together as, by reason of their pellucidity, to represent a vitreous substance under the microscope; and this, even more clearly in the small brain of the sparrow than in the large brain of the ox. . . . The minute vessels that in part constitute the vitreous substance, I find are so small, that a largish grain of sand would have to be divided into many millions of parts before it could pass through them. . . . The remaining parts of the white brain of the sparrow did not differ from the white parts of the brain of the ox, sheep, and Indian fowl, . . . except that the pellucid oily globules that were in a manner beset with vessels, were by no means so large in the ox. (*Arcana Naturæ Detecta*, in *Oper.*, tom. i., p. 30—39; *Epist. de Structurâ Cerebri*, &c.)

75. "When I examined . . . the structure of the pig's brain, I had no difficulty in determining that there must be a connection between the blood-vessels and the particles of the brain; in order that these particles may be supported, and their vitality kept up, by a never-failing supply of blood. . . . [The author has a figure (1) representing a minute portion of a pig's brain; where we see that several arteries run down from the pia mater, and are united to each other by threads, which Leeuwenhoek calls the fibrils of the brain, and which, till this time, had escaped his notice; these arteries run perpendicularly, and contain but little red blood.] . . . I reckon that these fibrils of the brain are full four times as large as the fleshy fibrils of the ox. I placed under the microscope a very small portion of brain, in which there appeared an incredible multitude of blood-vessels, cut off both transversely and directly [as shewn in the plate]. . . . Through all these blood-vessels, which are exhibited in tab. ix., except those which are invisible, and do not occupy more space than the surface of a largish grain of sand, there is no doubt

that the blood glides and circulates with a perpetual ebb and flow. Nor does any one of them pour out the blood through its extremity, as some would feign." (*Epistolæ Physiologicae*, epist. xxxiv; in *Oper.*, tom. iv, p. 330—336; see also to p. 339.)

76. MALPIGHI. "It is quite obvious to the senses, that the cortical substance of the brain is not the product of coagulated blood, but is a kind of peculiar parenchyma, full of minute pores and passages, that serve as a sieve by which a portion of coagulable serum is sifted from the blood. . . . In the brains of red blooded and perfect animals, I have found that the overspread cortex is an assemblage and congeries of most minute glands, which in the gyres and long-drawn intestinula of the brain, (where the white roots of the nerves terminate, or rather, if you please, originate,) are fitted together in such a manner, as by their grouping to produce the exterior surface of the brain. They are of an oval figure, but compressed all round by the adjacent glands, which creates certain obtuse angles, and a great number of pretty equal intermediate spaces. The outer portion of these glands is covered by the pia mater and its blood-vessels, which penetrate deeply into their substance; the inner portion puts forth a white nervous fibre, as it were a peculiar vessel, as the lucidity and whiteness of the glands permit us to observe; the white medullary substance of the brain being in fact produced by the connection and fasciulation of many of these vessels or fibres. And if the nature of the cortex may be explained by a familiar example, no better one can occur than the structure of the pomegranate, in the symmetrical grouping of the granules of which, we are presented with an image of the glands of the brain, which by their grouping produce the cortex; while the fibres, issuing from each granule, and conveyed through the membranes, exhibit a rude image of the medulla of the brain. And I recollect having seen some young dates, which, as they hung on both sides of the stem, resembled the glands of the brain, while the vessels or fibrous structures by which they hung, ultimately formed a fascicle, and so were analogous to the corpus callosum and corpus medullare.

"But these cerebral glands are seen with difficulty in the raw brain, even though it be the large brain of perfect animals; because they are lacerated by tearing away the pia mater, and their conterminous limits are not easily distinguished by reason of their lucidity, nor the spaces between them on account of their softness. But they are more easily seen when the brain is boiled, during which process they become thickened, and the intermediate spaces are better defined, particularly in the sides of the convolutions; and they become still more evident by peeling off the pia mater, particularly if they are examined while yet warm. A



good way to see the divisions between these glands is by pouring ink upon them, and then softly wiping it off with a piece of fine muslin; when the intermediate spaces are left black, and the outlines of the glands brought prominently into view. The same glands may be readily seen in the boiled brains of fishes and birds, their structure in all animals being the same. Joan. Pseil, according to Joan. Kentman, seems to have anticipated this discovery in his observation of a stone found in the brain, which stone was a conglobate of minute roundish acini, of a cineritious color, and very like a mulberry. It is probable that it was produced by petrification of the cortex, the natural figure of the glands thereof being preserved. These cortical glands, tortuously placed, make up the exterior gyres of the cerebrum, and are appended to the medullary fibres or vessels arising therefrom; so that wherever the gyres are cut across, a determinate and firm mass of glands is always found overlying the medulla: and this is still more evidently the case in the cerebellum. And the substance of the cortex is of the same character in the ventricles of the brain, and at the beginning of the spinal marrow; for after boiling, it has the form and exhibits the characteristic substance of the glands, being exactly similar in these respects to those in the exterior region of the brain; but still there is this difference, that the former glands are set among the excurrent nervous bodies or fibres, the protuberances of the ventricles being made up of nervous vessels with cortical glands among them; and in the inside of almost the whole spinal marrow, the cortex (described elsewhere) has the same glandular character, and is everywhere supplied by blood-vessels; and in that part of the spine that issues from the cerebellum and cerebrum, under the pons Varolii, at the supposed ventricle of the cerebellum, cortical glands of the kind are scattered about in different places; for under the external surface, which is fibrous and nervous, a large portion of them lies concealed, and particularly under the pons Varolii itself; and soon after we find little portions of the same glands hidden within, commixed with the medullary substance.

77. "It may be doubted whether the brain be framed on the same model as the liver, which, as we have stated,\* is in some cases divided into numerous lobes, and is made up of other lesser lobes, as it were glandular portions, which are themselves further subdivided into minute acini, in which at last the vessels terminate. This I say may be doubted, for if you take from the cerebrum and cerebellum the nervous fibrils of which the medullary substance consists, you have nothing left but glands, each separate from the other, and which form the mass of the cortex,

\* See Malpighi, *De Hepate*; and in the *Animal Kingdom*, n. 197.—(Tr.)

and perhaps correspond in structure to the lobules of the liver: although on the other hand it is still a question whether the glandular substances of the brain are not conglobated of other minute parts, in the manner so evident in the liver. But the lucidity and whiteness of the brain, the mucous character of its substance, and the minuteness of its glands, elude the powers of the microscope, and therefore we cannot decide the subject by an appeal to the senses: at any rate we leave it to others more sagacious than ourselves, to be cleared up by accident rather than study; in the meantime thinking it probable that these glands of the brain may be conglobated of the same acini. (*De Cerebri Cortice*, cap. i.)

“Wharton . . . is of opinion that the substance of the brain is different from the substance of glands, because the brain is more soft, tender, pure, and friable than the glands, and is moreover lubricous and white. . . . But some of the glands are also soft, as the thymus in young children, and the pancreas; and furthermore among the glands themselves there is a difference of more or less in this respect; the conglomerate being softer than the conglobate. . . . In the nerves too, we find the same diversity in color, softness, and friability; for at their origin from the [cortical] glands, and during their course through the body of the brain, they are extremely soft, and of an agreeable flavor; but when they issue from the brain, they form solid cords, and are tasteless, and yet their nervous character is unaltered. (*Ibid.*, cap. ii.)

78. “In the mass of the cerebrum and cerebellum, we find large and numerous ramifications of arteries and veins, such, in fact, as are not to be met with in any other part of the body; but the trunks of the arteries are not always accompanied by the veins; especially in fishes, in which a single vessel runs its course inside the ventricles. Yet it is a universal rule, that every single gland of the cortex is supplied by the extreme ends of both arteries and veins. In the more perfect animals then we find, that the blood-vessels, by means of the meningeal membranes, irrigate the extreme glands of the cortex of which the gyres of the brain are composed, so that a network of vessels is seen in the pia mater, the twigs from which penetrate the intimate substance of these cortical glands; and hence, when the pia mater is torn away, the soft structure of the glands is injured to no slight degree; and when the glands themselves are cut, red points are still seen which communicate with the vessels. . . .

79. “The intermixture and combination of the nervous fibres in the cerebellum produces the arborescent appearance described by Cortesius and others, and which also I find is exactly repeated by nature in the cerebrum. For if the gyres of the cerebrum with their cortex be cut or torn across, the same appearance of a tree with its branches and bark,

will be presented. This may be easily verified by making a transverse section of the entire cerebrum, or of any one of its parts. . . .

80. "Since a large quantity of cortical substance is observed in the ventricles, and at the beginning of the spinal marrow, where the interior prominences are situated; and since, when these prominences are laid open, fibres continuous with the nerves are brought into view, we are necessarily led to infer that the nerves are in fact produced from these interior glands; and therefore, although the fibres of the optic nerves seem to run a still farther course, in the cerebrum and cerebellum, yet as they adhere strongly to the cortical prominences of the ventricles, perhaps they have their root to some extent in these also. (*Ibid.*, cap. iii.)

81. "So exquisite is the structure of the cortical glands, that when the atmosphere is ever so slightly vitiated or altered (as Hippocrates intimates in his book, *De Morbis Sacris*,) the brain is the first part to sympathize, and to undergo a change of state. And the same thing happens if the humors contained in the arteries admit any incongruous medley of external things, or if the proffered blood is not of the right composition, in which case those disorders of the head follow that are described by Hippocrates in his book *De Glandulis*. . . . Sometimes these cortical glands are injured by external wounds, as noticed by surgeons, and considerable excrecences arise, which from their analogy are called fungi; but which are produced, perhaps, by the extravasation of the nervous juice, which in consequence of some disruption of the passages of the cortical glands, is not excreted into the nerves by a continuous passage, or at least is not conveyed back by the veins; but escaping from its vehicle, and all other bonds, it readily coagulates and occasions a tumor, as we constantly find in other parts where tumors arise, from the pouring in of determinate particles in too large quantities." (*Ibid.*, cap. iv.)

82. The same author, rich alike in talent and experience, has the following remarks in another part of his Works. "Piceolomineus . . . was the first, if I am not mistaken, who observed the difference and division in the paretic or mass of the brain: in fact he called the cineritious or bluish white substance that first meets the eye externally, the brain proper; and the enclosed white and more solid substance, he called the medulla: and these substances, which he found to be discriminated from each other by their respective color and solidity, and by special interstices or lines, he separated with great dexterity in animals newly killed. . . . In the more perfect red-blooded animals, and in all the larger fishes that have hitherto come under my notice, I have invariably observed this cineritious substance, termed the cortex. It is

not only spread round the brain externally, like the bark or cortex of a tree, which serves merely as an outer envelope, . . . but in red-blooded animals a portion of it is placed around the outermost appendages of the corpus callosum ; the remaining portion being dispersed about in the ventricles, particularly at the origin of the spinal marrow, where you will find little fringe-like pieces of the medullary and white substance of the brain disseminated and enclosed ; and the eminences that make the ventricles falcated are formed by the cortex. And, furthermore, in the oblong tract of the spinal marrow, outside the brain, you will see this same cineritious substance, not indeed placed at the outside, but in the inside, where a sinus has been noticed by several anatomists. . . . In fishes also, in the larger ventricles, the inner envelope and covering is partly composed of medullary substance, and partly of cineritious substance or cortex ; for that part which is connected to the varicose appendages from which the spinal marrow is generally supposed to begin, and which is prolonged towards the anterior part of the brain, is at first cineritious, and afterwards is succeeded by the white substance that before lay under the cortex, and occupies nearly the half of the ventricle, but finally is again covered by the cortical substance coming up from below, and in which there are singular plexuses of blood-vessels. In the brain of these same fishes, at the beginning of the spinal marrow, where there are two appendages, one on each side, analogous to intestines in form, the cortical substance is generally mingled with the medullary.

“ In the more perfect animals this cineritious substance fills the exterior region of the brain with varicose ducts resembling intestines ; for when the medullary substance after forming the ventricles within it, produces the corpus callosum, it gives out appendages which come beyond the external surface, and are not unlike the mesentery stripped of the intestines ; around which appendages the cineritious cortex is spread ; so that as it covers these varicose appendages on both sides equally, it resembles a long gyre of intestines. But in the cerebellum, as its productions are propagated in the way of laminae placed one upon another, and the outgoing branches are sent on both sides equally towards the external surface, so the circumjacent cortex assumes a semicircular form.

“ It is extremely difficult to determine the nature of this cineritious substance, for we see in it nothing solid derived from the coagulation of the red blood ; nor do the senses inform us even of its organization. Yet it is probable, . . . that it contains at least minute channels through which the blood particles run, and as it appears comparatively soft and mucous, it is also probable that it differs greatly from the medulla of the brain

round which it is spread. And if we are to attribute any parenchymatous structure at all to the brain, for propping the vessels and other organic parts sent through the viscus, the substance of the cortex would readily suggest itself to us as of that kind, since it seems to resemble moss mingled with clay." (*Dissertatio Epistolica de Cerebro.*)

83. VIEUSSENS. "The brain consists of two different substances, namely, the cineritious and the white. The cineritious, whether in its natural state, or after it has been boiled in water or oil, is much softer than the white; and when closely examined through the microscope, is seen to be composed of innumerable globules, all combined together, and to a certain extent of an oval figure; so that it nearly resembles a body made up of conglobate glands. These glands mutually compress each other, occasioning obtuse angles, as observed by the learned Malpighi; which angles are separated from each other by almost equal intermediate spaces. This is proved by the following experiment: Take spirits of wine colored black, and pour it upon the cortical substance of the brain after it has been boiled, and stripped of pia mater. You will then find the fluid enter so far into the little spaces interposed between the external glands of the cortical substance, that after it has been gently wiped away by a piece of fine muslin, innumerable little portions of it will be easily seen even without the microscope, occupying the said spaces, and circumscribing and so displaying the glands. This would not be the case if the cortical substance consisted of particles that were not oval or oblongo-rotund; for then, being soft, they would be in such immediate juxtaposition as not to have even the smallest space between them to receive any portion of the dark spirits of wine.—Moreover the brain hardens when it is slowly boiled in oil, . . . and if at this time any of the particles of which the cineritious substance is made up, are separated from each other, they are never seen extended or placed longitudinally. In whatever manner they are drawn apart, or pulled away from each other, even if they are broken before being inspected, they in no case appear tapering, but rather shortened and as it were contracted into themselves. Yet this would not be so if the particles were of any other figure than oval or oblongo-rotund. We therefore assert with Hippocrates, that the brain, in part at least, is glandular. . . . "The head," says he, "also has its glands, namely, the brain, which is similar to a gland." . . . And he adds, "For the brain, like a gland, is white and friable." The cineritious substance . . . either occupies the exterior parts of the cerebrum and cerebellum, . . . and penetrates deeply into their medulla, . . . or is found in the very middle of the cerebrum, . . . or in the medulla oblongata; . . . and where it occupies the exterior parts, it is called either the cortex, or the cortical substance, or the external cineritious or

glandular substance: but where it is found in the inside of the viscus, it has no other names than the eimeritious or glandular substance.” (*Neurographia Universalis*, lib. i., cap. x.)

84. RIDLEY. “The brain . . . is that large and almost spherical body . . . consisting of two substances (first taken notice of by Arehan-gelus Piccolominius) different both in color, consistence, and office; the one being more compact, white, medullary, or fibrous; the other, softer, greyish, and glandular. . . . The curious Leeuwenhoek made a far deeper scrutiny into these two parts [than Malpighi], being very probably assisted by better glasses, and from what occurred to his view, called the cortical part a ‘pellucid vitreous oily substance,’ . . . from such a close and regular position of the globules swimming therein, as allows the rays of light to pass them without refraction; contrary to what they do in the other or medullary part of the brain, in which they are so disposed that the light cannot pass them in right lines, and consequently being a little distorted, makes them appear white. . . . (*Anatomy of the Brain*, chap. xi., p. 87—90.) The aforementioned ingenious author hath computed, that even the 64th part of a myriad, (*i. e.*) of a ten hundred thousandth part of any substance but as big as a small grain of sand, cannot, especially if of a rigid or inflexible nature, enter those little vessels, which are seen in a retiform manner distributed amongst, and fixed to the aforesaid pellucid globules, which swimming in those little vessels, are discovered to make up both the cortical and medullary part of the brain. As also further, that even the tender coats of the smallest of those vessels which contain the aforesaid most minute globular fluid bodies, are also full of yet far more minute vessels, than they themselves are.” (*Ibid.*, p. 96.)

85. RUYSCH observed in the cortical substance when placed under water, particles of different forms, which he considers to be nothing more than the juicy extremities of minute arteries, and which extremities, although they are continuations of arteries, yet by reason of their softness are so united as to present the appearance of a distinct and peculiar substance. (*Epist. Anat.* xii., Expl. tab. xiv., fig. 1.) While these vessels are floating in clear water, their extremities represent an infinite number of pencils and fascicles, and their last threads which are filled with injection, appear to assume a different figure.\*

86. “Of all the discoveries,” says Ruysch, “that I have made within the last forty years, the following is the greatest, namely, that the cortical substance of the brain is not glandular, as anatomists have wrongly

\* I cannot find any passage precisely like this in Ruysch’s works, but respecting the change of figure at the extremities of the vessels, see his *Thes. Anat.* vi., n. 73.—(*Tr.*)

described and depicted it, and as they have asserted it to be, but altogether vascular." (*Prodromus Thes. Anat.* vi.)

"Ruysch makes use," says Verheyen, "of the following method for discovering the structure of this part of the body. By means of a syringe he completely fills the arteries with a red wax injection; having done which, he takes a little piece of the cortical substance, and suspends it from a hair in a convenient quantity of water; then taking the hair between his fingers he moves the piece up and down until it opens out into an infinity of minute but soft twigs, like flock or tow. 'This method,' says Ruysch, 'I adopted not only with the cortex, but also with many other parts of the body: without it, I think it is impossible to find out their true nature.' And a little after he says: 'I maintain that it may be demonstrated, that the extremities of the little arteries degenerate in various places without any intermediate substance into vessels of a different character.'" (Verheyen, *Corp. Hum. Anat.*, lib. i., tr. i., cap. viii.: see also Ruysch, *Thes. Anat.* vi., n. 73.)

87. "It is worthy of consideration," says Ruysch, "that the arteries of each convolution of the brain, anastomose and unite with the arteries next them. . . . And it is to be noted of the circumgyrations [convolutions] of the brain while still covered with pia mater, that they are by no means seen to be so extensive, or their furrows and windings so deep, as when the pia mater is removed. . . . I shall not now say anything of Bidloo's imaginary and chimerical delineation of the glands of the cortical substance of the brain, . . . through which he represents that no blood-vessels can be seen to pass either with the naked eye or the microscope." (*Epist. Anat.* ix.) The reader should by all means consult the plates of this author, (as *Epist.* xii., tab. xiv. xv.), where he shews the little threads that, after his particular process of maceration, are drawn out in continuity with the arteries; the membranous connexions being entirely destroyed, and the order disturbed, so as to produce the appearance of an immense quantity of vessels. See also (his *Epist. Anat.* vii., tab. viii., fig. 2, 3), where he shews that the processes of pia mater investing the cerebrum are of a serpentine shape, while those investing the cerebellum are falciform;\* also (fig. 1.) that the inner surface of the pia mater exhibits a mossy covering of vessels which insinuate themselves into the cerebellum. See particularly (*Epist. Anat.* ix. and xii., tab. x. xiv. xv.), the appearance of the loculi or thalami of the cortical substance within the serpentine processes of the pia mater next to the surface of the brain.

88. PACCHIONI. "If you touch the cortex of the brain with your

\* See Part I., n. 505.—(*Tr.*)



finger, you will not fail to notice that it is extremely smooth, and covered with as it were a most subtle oil; a fact which I have learnt, not without surprise, from very frequent dissections. The truth of this is brought to ocular demonstration in cases of concretions and hydatids of the lymphatics of the pia mater, in which we sometimes see the oil floating at the top, that is to say, we see that the lymph is full of oily particles of the kind. (*Opera*, p. 118, 119; 4to. Romæ, 1741.) On this subject Vallisneri not long ago reminded me of an observation made by the diligent Ruysch, to the effect that ‘the pia mater . . . is in various places enriched with fat.’\* (*Ibid.*, p. 118.) Bellini first instituted an examination of human lymph, of which he enumerates three degrees or species, namely, the lymph of the blood, the lymph of the lymphatics and thoracic duct, and finally the lymph of the brain. He particularly noticed that if the two first species of lymph were submitted to the action of heat, one coagulated more or less than the other, or else evaporated in smoke; but that the third species of lymph in the brain, when similarly treated, produced no bubbles, and left no coagulated portion, but altogether evaporated and vanished. Zambeccari also assures us, from his own observations, that there is a certain liquid in the ventricles of the brain and spinal marrow, which does not coagulate by heat, but entirely evaporates. (*Ibid.*, p. 89.) After you have carefully opened the cranium, and laid back a considerable portion of the dura mater from the front to the occiput, or to either side, but so as to preserve the more important attachments of the two membranes and of the lymphatics, if you then wipe away the moisture from the underlying membrane, you will see fresh drops and moisture forming upon it, even without pressing the parts with your fingers; a most plain proof not only that the pia mater is in some way pervious and perforated externally, but also that a portion of lymph flows from its little orifices or stigmata, &c., &c. (*Ibid.*, p. 116, 117.)

“A young lad who had fallen from a height, and received a concussion of the head, and a wound on one side of it, died twenty days after the accident. We could not discover any fracture of the skull, but a kind of not very soft mucilage covered the cortex of the brain, and like a sticky glue could not be removed either by the fingers or the probe, but required a knife to scrape it off: this was common to both sides. (*Ibid.*, 110, 111.) A poor youth who had lain for some days in the highway, was carried to the hospital. I found him, lying on his back, his eyelids sunk, and his lips drawn a little to the left side. In answer to questions he spoke but little and seldom, and incoherently. He threw his

\* See Part I., n. 150.—(*Tr.*)



arms and legs about in all directions, unconscious of what he was doing. . . . As while he was alive there were no signs of percussion in the integuments of the head, so after he was dead we could find none in the skull, or the parts underneath it. On proceeding to examine the brain for the seat of the disease, we at once discovered it in the dura mater. On the left side we found a considerable bladder, which at first deceived us, for opposite its convexity we saw a kind of sinuous recess in the dura mater. But cutting the membrane through, a quantity of yellowish serum ran out, and we found an analogous membranous concameration extending from the vertex of the head to the temporal region. We carefully removed the whole membrane that formed the sac, and which was of the same thickness throughout. In this place the cortex of the brain, which was depressed and hardened, displayed a cavity answering to the bladder. The latter we afterwards dried and stuffed with cotton, and had a drawing of it made of the natural size." (*Ibid.*, p. 112.)

89. SWAMMERDAM. "Tab. xxii., fig. vii. *r*, represents another portion of marrow lying in the proper medullary substance of the bee, by the addition or accession of which the marrow is dilated and forms a nodule. This portion is by no means so white as the proper medullary substance, but is somewhat grey, or of a fleshy color. Perhaps therefore the marrow, by the intervention of this heterogeneous substance, is dilated and rendered thicker, that it may have more strength to put forth its nerves. . . . Yet perhaps the dilatation has another use also, for the dilating matter seems to me to be of the same character as the substance of the brain, and answers to the cortical substance and the transverse fibres. (*Biblia Naturæ*, p. 519, 520, tab. xxii., fig. 6, 7.) Tab. xx., fig. 6, *b*, shews the brain of the bee, or rather the second pair of cerebral particles, and how the cortical substance of the brain is brought into view when the fibres covering it are removed. Letters *e, e*, denote the third and fourth pair of particles, or the cerebellum, separated from the rest, and how these particles communicate with each other; but the cortical fibres that arise from them are represented *in situ* in fig. 4, *n n n*. . . . In fig. 5, *s s*, this cortical substance is seen to be divided in the middle, although the division is covered on the other side by a small thin membrane. . . . The marrow then . . . in fig. 5, *r*, appears placed in the most beautiful way between the cortical substances, and at the same time we may see how it communicates, and is united in part with the cortical substance." (*Ibid.*, p. 497, 498, &c., &c.) See also Malpighi's observations on this substance in the silk worm in his *Dissert. Epistolic. de Bombyce*.\*

\* See the figure from Malpighi, inserted above, Part ii., n. 35.—(*Tr.*)

90. BOERHAAVE. "These arteries of the brain are interwoven in firm order in the pia mater, as in an incredibly thin basis, or arachnoid web, and from every point thereof send down twigs almost perpendicularly, which twigs interweaving and anastomosing with each other like their arteries, generate as it were a membrane, which, by its insinuation, forms sulcated and deep gyres, by which the exterior of the cerebrum and cerebellum is divided almost down to the medulla; but the cerebellum less deeply than the cerebrum. These ridges, convoluted in the form of intestines, are again resolvable into other similar lesser ridges; and are all framed by the insinuation of the pia mater, but have red vessels on their outer surface only, such vessels being merely applied to their inner substance. This inner substance for the most part is not tinged with red at all, as it never admits any sanguiferous artery or vein; and as for that portion of it which remains in the cerebrum and cerebellum, after they have been injected with wax, macerated in water, and freed by abrasion or shaking\* from all the parts that the injection has not penetrated, it appears to be a congeries of minute vessels, like flock or down, so soft, juicy and tender as to break with the least force imaginable, and dissolve into a pulsatous humor barely by suspending them in plain water.

91. "This exterior, efferitious, soft, humid substance, is termed the cortex of the cerebrum and cerebellum. It on all sides exactly invests the whole origin of the other and internal substance, which is very white, solid and less juicy, and is termed the medulla of the cerebrum and cerebellum; wherefore the medulla clearly appears to arise primarily from the cortex, both in the appendices, the ventricles, the crura, and the medulla oblongata. But in the inside of the spinal marrow there is a substance similar to the cortex; which likewise is altogether arterial, but is surrounded by the medullary substance inversely to the former case. In the cerebellum these two substances are so conspicuous, that you may there plainly perceive the way in which the medulla proceeds from the cortex, with its proportion, fabric and divisions; and you will also constantly observe, that the cortex of the cerebellum is harder and yellower than that of the cerebrum.

92. "Since, therefore, at every stroke of the heart, a very large portion of the blood (estimated by Malpighi at one third of the whole) is impelled by a powerful and direct force into the cortex, the latter must be actuated by a certain slight systole and diastole, so long as these vessels are full of blood. But there must also be venous vessels everywhere present at the ends of the arteries, although their membranes are too thin, and they themselves are too small, for them to be visible; and there

\* See Verheyen's account of Ruysch's method of exploring the cortical substance, Part ii., n. 86.—(*Tr.*)

must be secretory vessels arising from these minute terminal arteries, as in all other parts; and lastly there must be certain emissary vessels, although they cannot be seen. In consequence of the invisibility of these parts, reason, not in itself well grounded, in endeavoring to supply the defects of sight, has originated discordant views. Malpighi's opinion, however, which declared the structure of the brain to be glandular, was most generally received, until a contrary doctrine was promulgated by Ruysch; a man excelling all other anatomists in the art of discovering, exhibiting and preserving the minutest arterial vessels all over the body. (*Inst. Med.*, n. 236—240.)

93. “When Hippocrates, Wepfer and Malpighi made a careful examination of the cortex of the brain, and compared its structure with that of the glands, they found so evident a similarity between the two, that they made no doubt that the cortex was truly glandular. And Malpighi declared, that the cortical glands were oval, that they were rendered angular by their pressure upon each other, that they were disposed in curves, and that the smallest of them were attached to those next them to form others a little larger, that these again were combined to form others larger still, and that these latter were aggregated into a mass as it were of convoluted intestines, which immediately constituted the exterior cortex; so that the smallest branches of the carotid and vertebral arteries, here convoluted into the structure of a gland, might exhale a most subtle humor from the blood by an infinity of small mouths, and instil it into their proper follicle to be conveyed therefrom into the emissary, the rest being returned by the small veins into the sinuses. This opinion of Malpighi is favored by the eye, and the microscope; by the fact that boiling divides the brain into molecules similar to glands; by the experiment of pouring ink upon the cortex, and then wiping it away, when the outlines of the projecting molecules are defined, and the fissures dividing them become visible; by the case in which the cerebrum was changed into a stony concretion similar in appearance to a mulberry;\* by the degeneration of the contused brain into a kind of glandular fungus, sprouting up through the hole or fracture of the cranium; and by the change of the parts constituting the exterior of the brain, into manifest spherules or hydatids, in consequence of dropsical disorder. For these circumstances prove that there is the same mechanism here as in the other glands, although of a more subtle and delicate character.

94. “But whether the minute ultimate twigs [of the cortical vessels] become by direct continuation the origin of the fibrous substance of the brain, . . . as would appear from what Ruysch has stated, is a question

\* See Malpighi above, Part II., n. 76.—(*Tr.*)

not decided by any valid argument ; for these vessels are totally invisible to us by reason of their fineness, and however successful Ruysch's art may be in injecting this part, the medulla is never reddened thereby, but remains perfectly white. (*Ibid.*, n. 263—265.)

95. “. . . Throughout the encephalon, wherever the minute and invisible arteries, and corresponding invisible veins are continued, (the existence of which, notwithstanding that we cannot see them, we are necessarily bound to admit) ; there also we find this cortical substance, as well in the recesses, convolutions, divisions, interstices, and appendages, as on the external surface next to the cranium. (*Ibid.*, n. 268.)

“Whoever considers, 1. The nature of the cortex as stated above, and fact that the medullary fibrils most distinctly arise from it. 2. The similarity of this apparatus with that of every other part of the body. 3. The vast quantity of the finest, purest, and most mobile arterial blood, undespoiled of its subtlest part, that is driven hither with great force by the neighboring heart. 4. The exquisitely fine fluid that is everywhere discoverable by the unassisted senses of touch and sight, and more particularly by the aid of the microscope, within the medullary substance itself when dissected, and which fluid is oftentimes much increased in serious affections of the brain. 5. The veins returning the blood from the pia mater, and from the cortex of the cerebrum and cerebellum, into the venous sinuses, and so through the [jugular] veins to the heart. 6. The constant, regular, and proportional growth, nutrition, generation and reparation of the stamina of this part from the beginning to the end of life.—Whoever, I say, considers these various circumstances, must judge that the medullary fibres are delicate pervious canals, which receive the subtlest of all the fluids of the human body ; a fluid which is prepared, secreted, and driven into these pipes by the wonderful mechanism of the cortex, and so collected from every point into the medulla oblongata.

96. “And again, whoever will consider, 1. The character of the blood that is driven hither by the carotid and vertebral arteries, and how much it differs from all the rest of the blood. 2. The exquisitely subtle structure of the little arteries arising from the carotids and vertebrals, vanishing in a manner into a downy halitus, and as it were melting away spontaneously by reason of their softness, and by an inscrutable implication and contexture forming the substance of the cortex. 3. The singular nature of this humor, which, contained in these canals, exhales with the greatest rapidity of its own accord, and is not coagulable by heat, but evaporates utterly, while all the other humors of the body either harden by heat, or leave behind them a considerable residuum. 4. The force and celerity which a careful observation of the effects displayed in

the nerves and muscles shews to exist in this fluid.—Whoever, I say, will consider these points, will have no difficulty in believing, that the component parts of this fluid are the most solid, fine, moveable, simple and fluid of all the humors of the human body.

97. “But when it is considered that the red particles of the blood appear by the microscope to be the grossest of all that are contained in our healthy humors ; and in the meantime, that the serum, the particles of which are much smaller, is again divisible into corpuscles incredibly less, as may appear from the growth of the chick in the incubated egg, where the humor of the albumen is successively attenuated until it is adapted to flow through the inconceivably minute vessels of the little embryo ; and that in the smallest insects an infinity of vessels of various kinds are penetrated by their own peculiar humors ; and that far smaller creatures than even these insects, are discernible in human semen—when this is considered, it will become clearly evident that the parts of this most subtle humor, must be conceived to be immensely minute, beyond what is commonly thought. (*Ibid.*, n. 274—276.)

“Again, we are convinced that the quantity of this humor is large, and that it is made afresh every moment so long as we are alive and well. For this is taught us in the plainest manner by the large size of the carotids and vertebrales ; by their direct and totally unincumbered course ; by the great quantity of blood impelled through them ; by the great velocity with which it is driven ; and lastly by the vast quantity or extent of the cortical substance itself.” (*Ibid.*, n. 278.)

98. WINSLOW. “Near the surface of the cerebrum, the convolutions are at some distance from each other, representing serpentine ridges ; and in the interstices between them, the superficial veins of the cerebrum are lodged between the two laminæ of the pia mater, from whence they pass into the duplicature of the dura mater, and so open into the sinuses. These convolutions are fixed through their whole depth to the septa or duplicatures of the pia mater, by an infinity of very fine and delicate vascular filaments, as may be seen by pulling the convolutions a little asunder with the fingers. When they are cut transversely, we observe that the white substance lies in the middle of each convolution, so that there is the same number of internal medullary convolutions as of external cortical ones ; the medullary representing white laminæ invested and surrounded with cineritious substance ; but the cortical substance is in many places thicker than the medullary.” (*Exp. Anat., Tr. de la Teste*, n. 58—60.)

99. I might go on accumulating observations upon the cortex of the brain, more particularly if I were to resort to the history of the

diseases of the brain; but what has been cited will suffice for the present to establish the details of our general induction. Meanwhile, the larger the experience supplied, the more clearly are the points of the induction brought out in a practical light, and the truth shines more and more nearly to its mid-day brightness.

#### INDUCTION.

100. FROM the foregoing experience we infer, that the cortex is the principal substance of the brain; situated in the very first term of the fibres and the last of the arteries: consequently in the middle, in order that it may be able to extract from the blood the purer essences and animal spirits, and transmit them immediately into the finest medullary filaments, and so into the nervous filaments of the body.

101. The cortical and enervitious substance is that which is expanded and constricted, or that from which the brain animates. For each of its spherules appears to be like a little heart prefixed to its fibre, just as the great heart of the body is prefixed to its arteries. Since then there are as many origins of motion as there are spherules of cortical substance, it follows that when the latter are expanded, the entire mass of this conglomerate viscus, (namely, the surface, the blood-vessels, and the interior medulla throughout,) is constricted; and *vice versâ*.

102. In the cerebrum these spherules are so placed and arranged, that they can perform their systole and diastole either singly, or several together, or all in common; but not so in the cerebellum, or medulla oblongata and medulla spinalis. Hence the cerebrum, according to the ordinate disposition of its substance, has the power and choice of inspiring any fibres it pleases, or fascicles of fibres, and consequently any nerves and muscles, and exciting them to act: which particular and special action exists under its general voluntary action.

103. Thus if we gain a distinct perception of the coördination of these substances, we may understand how the will is determined into act by the cerebrum; how by the cerebellum; and how by the two medullæ; also how in the different kinds of brute animals.

104. The brain, by this its faculty and force of animation, extracts, as we said, a most pure essence from the invited blood, and transmits it into the fibres, as its delicate appendages; and pours upon it a new essence, conceived and excluded by a high process of generation in the finest wombs of its substance.

105. We may thus understand the course of the circulation of the animal spirits; namely, that it is from the cortex into the universal fibres, from the fibres into the blood, from the blood into the brain, and so back into the cortex; whereby no portion of these spirits perishes without use. We may also understand the moments of this circulation; namely, that they are synchronous with those of the respiration of the lungs, which wonderfully concur in promoting and transfusing this truly animal juice through the nerves.

106. Since this cortical substance resides in the principle of the actions of its body, and from above contemplates the rest of the system as below it, it is necessary that all things in the system should correspond to it, exactly as effects correspond to their causes. Wherefore it is right to attribute to it, by eminence,\* everything that performs any kind of function in this whole kingdom. Thus each part of this substance may be called by eminence a muscle; also by eminence a gland; and in fact by eminence a microcosm, when the entire body is regarded as a macrocosm.

107. The parts of this substance deserve for the same reason to be regarded as the organs of the interior senses, and as cerebellula; for by means of the medullary substance and the

\* Or *par excellence*.—(Tr.)



blood, they receive the modes and touches coming from the external organs, and refer them to the soul as judge.

108. These truly organic parts may undergo various changes of state, according to contingencies existing either in externals and in the blood, or else in internals; thus they may become warm, hot, expanded, indurated, disturbed, chilled, constricted, flaccid, darkened, or softened, or assume other changes; just in the same manner as the auras of the world, with the changes of state in which, these mutations of the cortical substances may most fitly be compared. And whatever state or animus is assumed by them, the like is at once diffused into the continuous fibres, consequently into the whole system, woven as it is of fibres and blood-vessels.

109. But still, although this cortical substance be the principal agent in its animal kingdom, yet it is not the prime determinant; for it is itself determined by, and built and woven of, the purest fibres; being thus the first determination of the spirituous fluid, by means of which determination the soul, as the universal force and substance, is able to flow into the actions of its body.

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110. *From the foregoing experience we infer, that the cortex is the principal substance of the brain.* We dare not venture to assert that this substance is in the place of a principle over all the other fluid, soft and solid materials both of the brain and the body, before the several details [of the preceding induction] have been explained, for it follows at last as a conclusion from all the particulars that remain to be confirmed and that have been confirmed. In the meantime, if it be the cortical substance, as we shall shew presently, that animates, that begins the circulation of the spirits through the nerves, that excites all parts of the animal system to living motion, or that is the nursing mother of the spirits; that is the eminent gland; the eminent muscle; the eminent sensitive organ; and other things,

as it will be explained that it is, it follows that this substance is the chief of all. But still that it has another substance above it, and which in a higher sense is the principal substance, will be shewn at the end of this chapter.

111. *Situated in the very first term of the fibres and the last of the arteries.* That this substance holds a middle place between the blood-vessels and the fibres of the medulla of the brain, is a fact that we must not infer *a priori*, or by rational intuition alone; for if we do, the mind will still remain in doubt, until experience gives ocular demonstration and real evidence. Hence I would rather seek authority first and foremost from experience, than from rational intuition. In what follows, it will be my endeavor to call upon experience to state the case, to produce the witnesses, and to explain the subject, and lastly to submit it to the judgment of the mind.

112. Leeuwenhoek shews that this cortical substance is placed in the last term of the blood-vessels of the brain, or that the vessels split at last into the finest filaments, so as to be fit to weave the several parts of the above substance. His words are as follow: "During my investigation of the cortical parts of the brain of the ox, I have often thought that I could see and observe that the vitreous and highly pellucid matter that constitutes the principal part of the cortical substance, consists of nothing but very fine lines or vessels, all joined together in the closest manner. . . . I also investigated the cortical parts, or cortex, of the brain in sparrows," &c. (Part II., n. 74.) See also the whole of his description of the brain of the pig (*Ibid.*, n. 75), and the confirmation of it by Ridley (*Ibid.*, n. 84). Malpighi declares the same thing still more positively: "It is a universal rule," says he, "that every single gland of the cortex is supplied by the extreme ends of both arteries and veins. In the more perfect animals then we find, that the blood-vessels, by means of the meningeal membranes, irrigate the extreme glands of the cortex of which the gyres of the brain are composed, so that a network of vessels is seen in the pia mater, the twigs from which penetrate the intimate substance of these cortical glands," &c. (*Ibid.*, n. 78.) Ruysch again discovered the same with even additional clearness, by a new process of maceration or solution, and without the assistance of

the microscope ; for after having recourse to his peculiar method of dividing the arteries of the brain into the minutest branches, until in fact they can no longer hold together, he expressed the result in his Figures, and described it in these words : “ While these vessels are floating in clear water, their extremities represent an infinite number of pencils and fascicles, and their last threads which are filled with injection, appear to assume a different figure.” (*Ibid.*, n. 85.) Again he says : “ Of all the discoveries that I have made within the last forty years, the following is the greatest, namely, that the cortical substance of the brain is . . . vascular.” (*Ibid.*, n. 86.) Proceeding upon these experimental proofs, Boerhaave confirms the very same opinion, where he speaks of “ the exquisitely subtle structure of the little arteries arising from the carotids and vertebrales, vanishing in a manner into a downy halitus, and as it were melting away spontaneously by reason of their softness, and by an inscrutable implication and contexture forming the substance of the cortex.” (*Ibid.*, n. 96.)

113. The fact that the blood-vessels split and ramify into such minute threads, that they are ultimately conglomerated round every spherule of this substance, and penetrate it, is difficult to discern by the eye without it be assisted with very perfect microscopes ; for whatever does not fall within its sphere, appears as continuous and indistinct. For example, those persons who labor under defective vision, see even the most varied object as one unvaried or uniform plane, while others who are sharper sighted perceive its distinctions with perfect clearness. And the same was the case comparatively with the eye itself before the use of the microscope. So also it is at the present day with those objects that still lie hid to the most armed sight, or to the most powerful glasses. And yet it is an eternal truth, that the point of no vision is that at which infinitely more numerous and distinct things begin than ever the eye can detect, though assisted by all the powers of art : wherefore when we have arrived by visible experience at this limit, the rational sight, or the mind, must thenceforward take the matter up in its then state of clearness, and supply the defect, and unwind the remainder of the clue. For unless the mind begins where artificial sight terminates, we shall never get any further than the

point where proximate causes mingle with effects, in which therefore we shall never see anything distinct. And this is the reason why Leeuwenhoek, before he used the most powerful glasses and became skilled in microscopical observations, saw in the cortical substance only streaks and lines discriminated by light and shade, and hence called the substance vitreous. "In the cortical parts," says he, "there were certain small white streaks" (*Ibid.*, n. 73): and previously he says, "I saw that many of the vessels before mentioned were transparent in the middle, and somewhat opaque at the sides; and . . . I found that on the globules bursting, a number of fine fibrous parts came into view, which to all appearance were vessels." (*Ibid.*, n. 72.) But afterwards he found that they [the lines?] were blood-vessels. "In the course of my enquiries," says he, "I took the head of a sheep, and on examining its brain, I found in like manner in the cortical parts a vast number of extremely minute blood-vessels. . . . This incomprehensible multitude of exquisitely fine blood-vessels I frequently beheld with my own eyes, . . . and I saw almost every vessel again splitting into lesser branches," &c. (*Ibid.*, n. 73.)

114. Let us now advance a step farther, and with experience for our guide, see whether these vessels, after having woven and overspread the spherules of the cortical substance, are not continued into the medullary fibres, or as we intimated at the commencement of our induction, whether this substance is not situated at the first term or boundary of the fibres. The eye is sufficient to settle this question. "The outer portion of these glands," says the sagacious Malpighi, "is covered by the pia mater and its blood-vessels, which penetrate deeply into their substance; the inner portion puts forth a white nervous fibre, as it were a peculiar vessel, as the lucidity and whiteness of the glands permit us to observe; the white medullary substance of the brain being in fact produced by the connection and fasciculation of many of these vessels or fibres. And if the nature of the cortex may be explained by a familiar example, no better one can occur than the structure of the pomegranate," &c. (*Ibid.*, n. 76.) And a little after he says: "Since a large quantity of cortical substance is observed in the ventricles, and at the beginning of the spinal marrow, where the interior promi-

nences are situated; and since, when these prominences are laid open, fibres continuous with the nerves are brought into view, we are necessarily led to infer that the nerves are in fact produced from these interior glands." (*Ibid.*, n. 80.) Swammerdam has a figure in which "the marrow [of the bee] . . . appears . . . between the cortical substances, and at the same time we may see how it communicates, and is united in part with the cortical substance." (*Ibid.*, n. 89.) Add to this the remarks of Winslow (*Ibid.*, n. 98); and see the cortex as figured by our authors, with the medullary fibres of the brain issuing from it in the form of minute appendages. Building upon these evidences, as well as upon his own experience, Boerhaave decides upon the matter as clear and unquestionable. "This exterior, cineritious, soft, humid substance," says he, "is termed the cortex of the cerebrum and cerebellum. It on all sides exactly invests the whole origin of the other and internal substance, which is very white, solid and less juicy, and is termed the medulla of the cerebrum and cerebellum; wherefore the medulla clearly appears to arise primarily from the cortex, both in the appendices, the ventricles, the crura, and the medulla oblongata. . . . In the cerebellum these two substances are so conspicuous, that you may there plainly perceive the way in which the medulla proceeds from the cortex, with its proportion, fabric and divisions." (*Ibid.*, n. 91.)

115. I do not know how any person who admits these facts, and acknowledges the influx of the blood-vessels into the substance of the cortex, can deny the continuation of the same into the fibres of the medullary substance, unless he chooses to suppose an interruption of continuity, and a dead stop; but as this is repugnant to nature, whose life consists in the continuity of her parts, and thereby in the perpetual circulation of her fluids, there seems to be no reason to descend to any such view. And yet Ruysch seems to intimate as much, if not openly to state it, in order that he may alter the glandular character of the cortex into one that is purely vascular. Boerhaave replies: "But whether the minute ultimate twigs [of the cortical vessels] become by direct continuation the origin of the fibrous substance of the brain, . . . as would appear from what Ruysch has stated, is a question not decided by any valid argument,"

&c. &c. (*Ibid.*, n. 94.) There are indeed numerous vessels that penetrate beside and beyond the cortical substance into the medullary, but they go partly to the cineritious substance that is hidden and scattered about in the brain ; partly to the diverticula and receptacles formed for the purpose of giving the brain its general power of extension ; and partly to the little sheaths of the fibres and fascicles ; as will be seen in Part IV., on the Arteries and Veins of the Brain. Meanwhile the reader will see an abundance of ocular testimony amassed in Part III., on the Medullary Substance of the Brain, all tending to shew that the medullary substance of the brain proceeds from the cortex.

116. Therefore the cortical substance is placed in the middle, or in the last term of the arteries of the brain, and in the first term of the fibres of the brain, so that this substance, like the two-headed Janus, looks backwards and forwards ; backward on the side of the arteries to the crasser blood, but forwards on the side of the fibres to the spirituous fluid, both of which unite in a manner in the cortex as their common and principal substance ; and this, in order that effects may return to their causes in a wonderful circle every time that causes tend to their effects ; and *vice versâ*. But to proceed.

117. *Consequently in the middle, in order that it may be able to extract from the blood the purer essences and animal spirits, and transmit them immediately into the finest medullary filaments, and so into the nervous filaments of the body.* There can be no worthier subject of enquiry than that presented by the following question : What do the medullary fibres of the brain, and in their turn, the nerves of the body, extract from the blood ? As this is a matter requiring the deepest investigation, we must dwell upon it somewhat at length. The examination of the cortex alone will afford but little light ; the examination of the brain will give us more ; and of the nerves of the body, still more : hence we must follow the subject all the way into the nerves. We shall then easily ascertain whether or not we have found the truth ; for if we have, all our succeeding Parts on the Brain and the Body, with their infinite particulars, will range themselves by its side ; and it is from a careful examination of these particulars, (for I have gone through the whole animal system in the same manner as I have here gone through

the cortical substance, and in the next Part through the medullary substance,\*) that I have at last gained this universal notion of the circulation of the animal spirits.

118. I say that the substance of the cortex attracts the purer essences or animal spirits from the arterial blood of the brain, but not from its concomitant serum, and transmits them into the subtlest passages of the fibres. In order to follow the truth of this assertion, it is necessary to enquire into the character of the blood that is drawn up by the brain. 1. It is softer, lighter, more refined and fluid than the rest of the blood. 2. It suffers itself to be readily divided, through degrees corresponding to the divisions which the little arteries undergo on their way to compose the veriest substances of the cortex. 3. This blood, when divided a first time, or into the purer blood, passes through the little bosom or fine middle bed of each cortical substance, and so flies on into the corresponding little canal of each fibre. 4. But when divided a second time, or into the purest spirituous fluid, it penetrates into the subtlest threads of this cortical spherule, which constitute the surface, and so is poured into the surface of the fibres of the above canals. 5. The medullary substance of the brain and the nervous substance of the body are so framed and woven, that the whole of the truly sanguineous globules, when resolved into their parts and elements, enter them distinctly, and run through their substance; so that nothing of the genuine blood is lost before it has performed a use in the innermost penetralia of the animal system.

119. *Firstly*, the blood drawn up by the brain is softer, lighter, more refined and fluid than the rest of the blood.—This fact is perfectly plain from the character of this blood, as investigated by the best anatomists. Respecting the nature of the blood that is supplied to the brain by the carotid and vertebral arteries, and respecting the difference between it and all the rest of the blood, see Boerhaave, *Inst. Med.*, n. 223—235, 275. And respecting the lymph of the brain,—that it forms no bubbles when exposed to heat, and leaves no coagulated por-

\* This assertion of the author is abundantly attested by his unpublished Manuscripts: see Dr. P. E. Svedbom's excellent Memoir in the Appendix to the *Animal Kingdom*.—(Tr.)



tion, but entirely vanishes and evaporates, see above, Pacchioni, Part II., n. 88; and also Bellini, Zambeccari, and others. In the brains of birds some days after death, I have seen the arterial blood still fluid, and of a beautiful light crimson color; while the blood in the sinuses of the dura mater had coagulated, and was of a foul blackened hue, contrary to what we generally find in the arteries and veins of the body: a plain proof that the blood of the brain is more impregnated with spirit, which gives it its genuine fluidity. And this follows as a matter of course when we consider that the brain has the power of attracting the peculiar blood that it is to expend upon the fibres; as we have demonstrated in the preceding Chapter on the Motion of the Brain; and in Part I., on the Blood, the Arteries, the Veins, and the Heart, n. 227, 346—350.

120. In Part I. we also shewed that the genuine blood is intrinsically and naturally soft, yields to the compressing vessels, and suffers itself to be divided (n. 92—94, 100—102, 149, 150, 158—160, 371, &c.) “In the place,” says Leeuwenhoek, [speaking of the tail of the tadpole,] “where I viewed the circulation of the blood, the arteries were not wider than to allow single particles of blood to pass through them without impediment. . . . I saw that many of the particles were rendered twice as long as broad, and that each of their extremities appeared acute.” (*Arcana Naturæ Detecta*, in Oper. tom. ii., p. 161; see also to p. 175.) In another place he says: “[In the membrane of the wing of a bat] I saw an oblong particle of blood protruded through an artery, and which was so large as to fill the vessel entirely, and twice as long as broad.” (*Ibid.*, p. 205.) Again he says, that “having mixed a portion of decoction of pareira brava with a minute drop of blood, the following remarkable phenomenon was observed, namely, that most of the globules exhibited a certain curvature, or as it were concavity, just as if a small bladder were filled with water, and depressed in the middle by the finger so as to form a pit or furrow. And when these globules, which exhibit a flattened shape when separated, . . . lie closer together, sometimes they assume an oval figure, and sometimes the curvatures or cavities already mentioned are of an elongated form.” (*Epist. Physiol.* xliv.; in Oper. tom. iv., p. 421, 422; see also p. 417—431.) He says further:



“I am of opinion that these small partieles of blood are always flexible, just as those globules that have come to perfect maturity.” (Part II., n. 73.) A comparison of the blood with the little canals which it permeates, also confirms our proposition ; for these canals always become so fine, as not only not to equal the diameter of one globule of blood, but not even the thousandth part of that diameter, and scarcely even the millionth part, so that unless the blood-globule suffered itself to be bent, and to be divided into minuter partieles, transpiration would cease, and nothing would remain but a solid, entirely destitute of fluid ; hence there would be an annihilation of life, since life consists principally in conspirability and perspirability, according to the declaration of Hippocrates. From these observations the next preliminary proposition follows.

121. *Secondly*, This blood suffers itself to be readily divided, through degrees corresponding to the divisions which the little arteries undergo on their way to compose the veriest substances of the cortex.—Although this is a consequence of the former statement, yet I dare not go any length away from the data, without experience be still at hand with new confirmations, to serve as a clue in the living labyrinth. With respect to the divisibility of the blood, we have already treated of it in sufficient detail in the passages cited above from Part I., but to these we may fairly add the further evidences derived from the experience of Leeuwenhoek, who, so far as I know, is the only person that has applied himself with complete success to the investigation of the blood-partieles. “I took some blood,” says he, “as it issued from my finger through a puncture made with a needle, . . . and I saw a large number of blood-globules adjacent to each other, break away and separate, but these small globules, six of which constitute one perfect globule, were much softer than those which constitute a globule of beer or wine.” (*Arcana Naturæ Detecta*, in Oper. tom. ii., p. 8.) And again he says, that he has seen a large number of globules of blood easily dissolved during their protrusion through the narrow channels of the arteries, and that which was previously a single globule, separated into six distinct globules.\* (*Ibid.*, p. 36.) In another

\* This is not an exact quotation from Leeuwenhoek : his words are : “I have seen a large number of blood-globules vanish, and then they all seemed to me divided into six distinct globules.”—(*Tr.*)

place he relates, that on adding the yellow oil obtained by destructive distillation from the bark of china china, to a portion of blood taken from his thumb, he “could most distinctly observe in each of the blood-globules, that they consisted of other distinct globules. . . . These blood-globules,” he continues, “presented a beautiful sight, and particularly when I set them in motion under the microscope. For I not only saw the globules very distinctly, but I could often observe most exactly where the globules constituting the blood-globule were united to each other.” (*Contin. Epist.*, in *Oper.* tom. i., p. 121, 2nd paging.) It is worth while to peruse the author’s beautiful account of the manner in which the globules were divided into lesser globules, *Opera*, tom. ii., p. 36; tom. iv., p. 417—431; tom. i., p. 121, 2nd paging. Artificial chemistry proves the same thing by menstrua, and especially by the furnace and the still; for pure blood in retorts and phials, changes into species of quite a different character, as into oil and spirits, and leaves a few saline residua; shewing that when decomposed, it passes into elements of a different nature. Why not then in its own natural laboratory, where nature lives in her veriest art, and the blood flows in its native softness, warmth, and divisibility, whithersoever the public and private welfare attracts it; and particularly in the brain, which in providing for its fibres requires from the blood so often its finest essences?

122. That the red blood is divisible not only into six such spherules, or into the purer blood discoverable by the microscope, but also into blood still purer, and which we may call the spirituous fluid, is a fact which is not ascertainable by the sense of sight, though raised by the microscope far beyond the range of its natural powers. But we ought not therefore to attempt to deny the fact; for our senses lead us only to the threshold where nature begins to act most perfectly and to live most distinctly. It has pleased the Divine Being that we should arrive at this point by the assistance of art, and that there human reason should be at hand to take up the thread, and to carry it onward. Were we therefore to terminate our researches by the limits of sight, we should deprive the mind of all its privileges, and hence be but little wiser than irrational creatures. That there is a further division of the blood beyond the six pellucid spherules, or purer blood, we are induced to believe from the vessels them-

selves, which divide to the millionth degree of fineness. “ Besides the abovementioned minute vessels in the brain,” says Leeuwenhoek, “ there were others also of such tenuity, that, in my opinion, no round body such as I have previously spoken of, though it were divided into more than a thousand parts, could permeate them.” (Part II., n. 71.) Again he says: “ Through all these blood-vessels [of the pig’s brain], which are exhibited in tab. ix., except those which are invisible, and do not occupy more space than the surface of a largish grain of sand, there is no doubt that the blood glides and circulates with a perpetual ebb and flow. Nor does any one of them pour out the blood through its extremity.” (*Ibid.*, n. 75.) And in another place he says, that in the tadpole, “ the particles or globules which give the blood its red color, are so minute, that a hundred thousand myriad of them cannot equal in bulk a large grain of sand.” (*Arcan. Nat. Det.*, in *Oper.* tom. ii., p. 162.) If we examine with a powerful microscope the transverse section of a little nerve, as our author tells us he has often done, we shall see that it consists of fascicles distinctly surrounded with tunics; and that each individual fascicle is made up of most minute, tapering canals, and which are compressed because contiguous, and that a clear humor flows through them, as observable by the same magnifying powers. Through the little tunics fine lines have been seen winding in a spiral direction. These phenomena occur then in the little nerve, to each fibre of which in the fascicle corresponds a particular cortical spherule; to the little canal in the nerve corresponds a similar cavity; to its little lines or spires, a similar circumference of most minute vessels; for the fibre is an elongated appendix of its cortex or little head, just as the artery is of the heart. In this little cavity the humor which presents itself to the eye is not red blood, yet no one will I presume deny that it is a fluid extracted from the blood. In the little lines surrounding not only the tunic of the fascicle, but the finer tunic of the little canal or fibre, there must of course be a purer, finer, and more perfect fluid, distinct from that which flows through the middle of the canal, that is, of a higher degree, educed from the sanguineous mass, nay, from its globule, or from the white spherule of the globule. Thus the very construction of the fibre, of which we shall treat in Part III.,

indicates that the globule of red blood is a series of three vital fluids, for which three distinct canals appear to be constructed, which are successively elevated into such vessels as we see at last in the nerves. Besides this, the same discoverer has often seen the red globule itself divided into six glistening or pellucid spherules, and has described from his experience the very act of division; also how he saw the six spherules combined in a globule, and discriminated by light and shade, and suffering themselves to be extended one by one into an oval and comparatively oblong form, together with many other most interesting particulars, calculated not only to persuade but convince us, if we are disposed to trust our sight, that this part of the red blood is by no means a simple substance, but only appears so to the naked eye; being in reality composed of six lesser spherules, and at the same time of a quantity of angular or saline particles, which were frequently seen by him through the same microscope. Now if the mind ascends a little beyond the disclosures and acumen of the eye, it must at once admit, that it is not contrary to the truth, because not contrary to a belief correctly based upon the senses, that this division is not nature's last division in the blood-globule, but that there is still another, namely, into what must be called the spirituous fluid, which arises from the pellucid spherules, after the rejection of the most subtile corpuscles or saline copulates borrowed from the bosom of the ether, in the same manner as the pellucid spherules arise from the red globule. From these and many other wonderful glimpses of nature's purer field, Leeuwenhoek at last passes from the sphere of sight to the sphere of the mind, which is the human ground, and offers the following suggestions on the divisibility of the blood. "Observing this," says he, "I thought with myself, whether perhaps each of those globules that make up one sixth part of a blood-globule, be not themselves ultimately composed of 6 of the above-mentioned minimal globules, and that if this be the case, a globule of blood must consist of 36 globules. But who shall say whether this does not go farther, and whether a blood-globule does not consist of 216 globules. (*Arc. Nat. Det.*, in *Oper.* tom. ii., p. 12.) For let us in thought divide a globule of blood into parts ever so minute, and there may still be particles infinitely

smaller, of which such globule consists." (*Cont. Arc. Nat. Det.*, in *Oper.* tom. iii., p. 222.)

123. It will perhaps be said that we ought rather to put faith in those whose range is not limited to lenses and optical instruments, and who are not only gifted with natural genius, but whose minds have been cultivated also by the pursuit of numerous sciences. The accomplished Boerhaave then shall plead our cause. "When it is considered," says he, "that the red particles of the blood appear by the microscope to be the grossest of all that are contained in our healthy humors; and in the meantime, that the serum, the particles of which are much smaller, is again divisible into corpuscles incredibly less, as may appear from the growth of the chick in the incubated egg, where the humor of the albumen is successively attenuated until it is adapted to flow through the inconceivably minute vessels of the little embryo; and that in the smallest insects an infinity of vessels of various kinds are penetrated by their own peculiar humors; and that far smaller creatures than even these insects, are discernible in human semen—when this is considered, it will become clearly evident that the parts of this most subtle humor, must be conceived to be immensely minute, beyond what is commonly thought." (Part II., n. 97.) These observations are sufficient for the present to convince us, that the red blood-globule suffers itself to be resolved not only into six spherules, but also into the principles of these spherules, in fact to be divided until it can flow through the minutest passages, or the canals of canals, in which, although there is no red, heavy, sluggish blood, beset with saline dust, yet the better essence of the blood still remains, hence the blood is there *par excellence*, or the eminent blood, and the vessel also which it permeates is similarly eminent. "I maintain that it may be demonstrated," says Ruysch, "that the extremities of the little arteries degenerate in various places without any intermediate substance into vessels of a different character." (Part II., n. 86.) This fluid, raised to the third degree above the red blood, I would denominate with the most of learned anatomists the animal spirit.

124. *Thirdly.* This blood, when divided a first time, or into the purer blood, passes through the little bosom or fine middle

bed of each cortical substance, and so flies on into the corresponding little canal of each fibre.—To use a comparison, the purer blood passes through the cortical substances into the fibres, much in the same manner as the red blood passes through the chambers of the heart. The eye indeed has not shewn that there is any cavity in any individual part of the cortical substance, for all the observations upon it have been made after the brain has been boiled, consequently when the cortical substances are collapsed, compressed, and juiceless; and if the entire surface and bulk of these is not presented to the eye, how much less can be the minute ventricle that it contains. Still that they are furnished with a corresponding cavity may doubtless be conjectured from the fact, that these substances are nearly oval spherules, and as it were nodules and acini. “They are of an oval figure,” says Malpighi, “but compressed all round by the adjacent glands. . . . But these cerebral glands are seen with difficulty in the raw brain, even though it be the large brain of perfect animals; because they are lacerated by tearing away the pia mater, and their conterminous limits are not easily distinguished by reason of their lucidity,” &c. (Part II., n. 76.) Vieussens observes: “The cineritious [substance] . . . when closely examined through the microscope, is seen to be composed of innumerable globules, all combined together, and to a certain extent of an oval figure. . . . Even if they are broken before being inspected, they in no case appear tapering, but rather shortened, and as it were contracted into themselves.” (*Ibid.*, n. 83.) And Leeuwenhoek, whom we quote so often, has advanced still farther in his investigation of these spherules; as where he describes the irregular globules seen not far from the beginning of the spinal marrow, which that they were spherules of cineritious substance, we may conjecture from the quantity of them placed on the confines of both medullæ. “I saw,” says he, “that many of the vessels\* before-mentioned were transparent in the middle, and somewhat opaque at the sides.” (*Ibid.*, n. 72.) And furthermore he implies, that he there discovered the purer blood, which according to our statement flows through the cavity of these [vessels], where he says:

\* Swedenborg makes Leeuwenhoek say “globules” instead of “vessels,” but that this is not the correct reading, see *loc. cit.* in n. 72.—(*Tr.*)

“ In the course of my inquiries I took the head of a sheep, and on examining its brain, I found in like manner in the cortical parts a vast number of extremely minute blood-vessels ; and I recognized that the substance that gives the blood its red color was contained in them.” (*Ibid.*, n. 73.) In another place he says: “ When I attempted to separate this [cortical] matter into its least particles, I immediately observed a small quantity of a thin fluid or ichor oozing from it ; which ichor was crowded with globules, by far the smallest of any I had met with ; and of which I calculated that thirty-six would not equal in size one of those globules that give our blood its red color.” (*Ibid.*, n. 71.) Nor do I think that in regard to these particles, deeply concealed as they are within our sphere of sight, I am imagining anything new, beyond what the experience and genius of my great predecessors in science have led them to suspect. Thus Malpighi (who calls this substance glandular, and [inclines to] compare it with the glands of the liver, *Ibid.*, n. 77) says, that this substance “ is a . . . peculiar parenchyma, full of minute pores and passages, that serve as a sieve by which a portion of coagulable serum is sifted from the blood.” (*Ibid.*, n. 76.) And Boerhaave observes, that “ the smallest branches of the carotid and vertebral arteries, here convoluted into the structure of a gland, . . . exhale a most subtle humor from the blood by an infinity of small mouths, and instil it into their proper *follicle*,\* to be conveyed therefrom into the emissary.” (*Ibid.*, n. 93.)

125. Since then there are congeries of vessels ; and the arterial blood, divided into the purer blood, penetrates them, and the fibres are continued from them ; and since there are oval globules, not unlike glands, according to Hippocrates, Malpighi, Boerhaave, Wepfer, Ridley, Vieussens, Paccioni, Winslow, &c. ; I do not see how we can deny them a cavity, through which they pour the ichor they receive, into the continuous fibres. But it is by no means possible to see this cavity in recent subjects, unless first the dura mater, and second the pia mater, together with the little arteries, be torn away, which cannot be done without loss of life to the part, and obliteration of the contracted cavity or little sinus.

126. Granting then that these globules have a cavity, it

\* The italic is Swedenborg's.—(*Tr.*)



follows, that no other humor can flow through it but blood resolved into purer blood, unaecompanied however by the serum attendant upon the blood, unless this serum be subtle enough to suit this fluid, or to agree with it in character. The reason is, that none but the purer blood penetrates into the purest arterial branches, the serum being first rejected from all sides, as appears from abundant experience. See Part I., n. 203, 204, &c. Moreover, these vessels are softish to the touch, and readily dissolve away, and being nearly as soft as pituita or phlegm, they in no ease admit anything so hard as watery particles, much less anything prickly or rough, like saline corpuscles; but they admit only what is soft, yielding, elastic, compliant, divisible, applicable to similar pores; as is the purer blood or spherule that constitutes the larger globe of the red blood, to the character of which the vessels are conformed. This is more especially the case with the vessels of the brain, which go to and constitute the cortical substances; for no particle in the body can be more sensitive than the cortical substance, situated, as it is, between the artery and the fibre, and to which, as to their first and last term, the sensations come from the organs by means of the fluids. Wherefore if anything inapplicable, hard and pointed in the adjacent passages, should impinge upon it, the little arteries would contract at the slightest touch, and by a general effort of this substance, conglomerated of so many ramifications, would expel it as altogether repugnant and heterogeneous. It is therefore the pure blood that traverses these cavities, but not the serum, unless it be in exact harmony with this purer blood.

127. *Fourthly.* But when divided a second time, or into the purest spirituous fluid, it penetrates into the subtlest threads of this cortical spherule, which constitute the surface, and so is poured into the surface of the fibres of the above canals.—The cavity of the cortical spherule is itself beset and completely surrounded with vascular tracery and lines, in such quantity, that collectively they form a continuous structure, as our authors' observations testify. "These exquisitely fine vessels," says Leeuwenhoek, ". . . were laid one upon another in layers three or four deep, without any other matter interposed between them." (*Ibid.*, n. 71.) See Ridley especially, where he says:



“The aforementioned ingenious author [Leeuwenhoek] hath computed, that even the 64th part of a myriad, (*i. e.*) of a ten hundred thousandth part of any substance but as big as a small grain of sand, cannot, especially if of a rigid or inflexible nature, enter those little vessels, which are seen in a retiform manner distributed amongst, and fixed to the aforesaid pellucid globules, which swimming in those little vessels, are discovered to make up both the cortical and medullary part of the brain. As also further, that even the tender coats of the smallest of those vessels which contain the aforesaid most minute globular fluid bodies, are also full of yet far more minute vessels, than they themselves are.” (*Ibid.*, n. 84.) To adduce more upon this subject would savor of tedious prolixity. Meanwhile, these vessels, which conjointly weave and fashion the cortical particle, may perhaps to some extent admit of being compared with the superficial vessels and with the carneo-motive fibres of the heart, which collectively form the chambers of the ventricles, and through which vessels the purer blood runs, as shewn in Part I., n. 454, 455. For if there be a cavity, then a fluid comparatively grosser must of course run through it, than through the fibres that form the surface or walls of the cavity. Wherefore it is necessary that the blood, a second time exalted, or raised into spirituous fluid, that is, to the highest degree, should transpire through these minutest of nature’s passages, and then at once be carried on continuously to the surface of the little canals of the fibres. So that this pure fluid, or if you please, animal spirit, does not pursue its way through the middle of the cortical substance, nor through the middle of the little canal of the fibre, but through the surface of each, which it disposes to contract and dilate according to the will of the brain. That these are not imaginations, but matters proved by ocular demonstration, will be seen in Part III. For here, as we remarked above (Part II., n. 117), the cortical substance alone throws but little light, but more is obtained from the medullary substance of the brain, and still more from the nerves of the body : wherefore we are bound to extend our enquiry to the nerves also, in which it will be perfectly clear, that there are little canals that pour out a fluid, and around which others exquisitely minute

are wound in a spiral form ; just in the same manner as in the spherule of the cortex prefixed to its fibre.

128. *Fifthly.* The medullary substance of the brain and the nervous substance of the body are so framed and woven, that the whole of the truly sanguineous globules, when resolved into their parts and elements, enter them distinctly, and run through their substance ; so that nothing of the genuine blood is lost before it has performed a use in the innermost penetralia of the animal system.—Now this is the conclusion or corollary of the foregoing remarks, to which all the preliminaries of this argument are directed : a problem of such great utility, as unquestionably to deserve a principal place in the animal economy. For it shews us what the blood does ; the finer in preference to the viler, the legitimate in preference to the spurious ; whither it penetrates with its elements ; where the purer essence goes, where the grosser ; where the blood's saline coporature ; what circle each of them performs ; with innumerable other particulars, which to recount would be to travel over every part of the anatomical, medical and physiological sciences of the animal body. For ultimately it will shew, that the destinies and condition of animal life depend on the nature, constitution, determination, continuity and quantity of the blood ; and that the blood is the complex, cabinet and seminary of all things in its body.

129. But as I have collected the truth of this problem from an examination of an infinity of particulars and effects together with their causes, so I cannot shew it convincingly from the cortex alone : the complete course of my labors must declare it : although I wish, so far as it be lawful, to give the reader some foretaste of it now. But we ought thoroughly to understand what the blood-globule bears in its bosom ; and how the nerves are constructed, and what they convey.

130. What does the blood bear in its bosom ?\* I think I have explained this satisfactorily in Part I., where I have shewn, that it encloses the purer blood, and this, the purest blood or the spirituous fluid ; all of which are kept in form and combination by means of saline corpuscles of different kinds. But

\* See the *Animal Kingdom*, n. 179, 256—(Tr.)

how are the nerves constructed? This question will be solved in Part III., where we shall shew, that their fibres are exquisitely fine, round canals, connected together by delicate membranaceous processes, and combined in fascicles within a common tunic; and that the fascicles are similarly combined together by membranes, and enclosed in a common sheath; and lastly, that through the little tunic of each fibre exquisitely minute vessels run in a spiral direction.

What then do the nerves convey? It follows that through the little tunic of the simple fibre runs the spirituous fluid, which is the purest essence of the blood; through its cavity or little canal the purer blood, or the spherules into which the red blood is resolved: between the fibres, among loculi constructed of membranous septa, the most volatile salts, with their serum, which have entered into the composition of the purer blood; between the fascicles of the fibres, which fascicles are similarly constricted by membranous ligatures, and whose interspaces are also divided into loculi, the other saline corpuscles with their serum, which have resided in the blood-globule.

That all these species are poured into the fibres and nerves, and between the fibres and fascicles, beginning from their sources, or from the cortex of the brain, is evidenced by an examination of the latter substance, for we have already shewn (Part II., n. 127), that the spirituous fluid enters the superficial fibres of the cortex, and so is carried on into the medullary and nervous fibres. We have also shewn that the purer blood traverses the cavity of the same cortex (*Ibid.*, n. 124—126). But that the most volatile saline corpuscles of this blood run in between the fibres, or into the little interstices between the little canals, is clear from experience, which shews that the substance of the cortex is always covered with a fine moisture, and exhales an ammoniaical effluvium. Whence Læwenhock calls this substance not only vitreous but oleaginous. (*Ibid.*, n. 71.) “If you touch the cortex of the brain with your finger,” says Pacchioni, “you will not fail to notice that it is extremely smooth, and covered with as it were a most subtle oil; a fact which I have learnt, not without surprise, from very frequent dissections” (n. 88). This subtle oil, poured upon the sub-

stances of the cortex, (and which oil consists of the most volatile salino-suphurous halitus of the purer blood, as may be shewn by many considerations,) cannot be carried from thence anywhere else than between the medullary and nervous fibres. This is plain from the fact, that it tinges and smoothes the outer surface of the cortex, and consequently flows down to the outer surface of each fibre, that is, to the interstices between the fibres. Further, that a similar grosser matter, namely, the volatile salino-urinous substances that enter into and support the framework of the red blood, (of which we spoke in Part I., n. 43—45, 50—57, 91, 92, 95, 96, 108, 371; and of which Leeuwenhoek often treats,) is derived between the fascicles of the fibres, will be shewn in the Part on the Pia Mater and Arachnoid Membrane. For that the pia mater is irrigated with an oily lymph of the kind, and that this lymph is enclosed between it and the arachnoid membrane, and so passes down between the windings of the brain, and from these between the fascicles of all the nerves that want it, will be confirmed by actual experience. For if it be derived into the windings and crannies of this substance, no other passage can be open for it than into the spaces or loculi between the fascicles of the fibres in the nerves. But I shall again take up this argument in Part III.

131. Here then you have this exceedingly important subject reduced to a short compass, and stated in the way of a mere outline; for we may not expound it in greater detail, without first having brought forward the experience which is to justify it. But the reader will see the whole matter satisfactorily cleared up in the sequel. And it will there be demonstrated, that the red blood, or its globules, resolved into all their essences and parts, make way for themselves, each discriminately, through the whole compages of the nerves; and then when they emerge from it, each species of humor performs its distinct and peculiar circuit: thus the spirituous fluid again expires into the blood, so that not the least drop of it is lost without performing use, or returns to its fountain in the cortex of the brain. The purer blood the same, of which a large portion also is carried up through the lymphatics and thoracic duct into the venous blood of the subclavian vein. The most vola-

tile saline substance, with its serum, after passing through the spaces between the fascicles of the fibres, is carried back through the periosteum and the tunica vaginalis of the vertebral theca into the dura mater and pericranium. But the saline substance between the fascicles is rejected in the form of effluvia toward the surfaces of the body, to exhale through the epidermis and cutis.

132. *The cortical and cineritious substance is that which is expanded and constricted, or that from which the brain animates. For each of its spherules appears to be like a little heart prefixed to its fibre, just as the great heart of the body is prefixed to its arteries.* It follows that it is this substance that causes the systaltic motion of the cerebrum, cerebellum, medulla oblongata and medulla spinalis, if we grant that each part of this substance has a cavity, into which, and through which, the pellucid, middle or purer blood flows; or that each part is like a gland provided with its follicle, from which there is a way out into the fibre. Thus these substances are born and made for performing a nearly similar systole and diastole to that which the grand heart is continually carrying on. For in order that there may be a transflux of the blood of the arteries of the brain mediately into the fibre, there must be a little head and pulsating point of the kind prefixed to the latter, first to allure the blood from the arteries, then to work and knead it, and then to drive it out through the various lattices of the fibres and nerves, to the very remotest parts of the body; which the brain of itself, without auxiliary organs, possessing active force, could by no means accomplish; for we shewed satisfactorily in the last chapter, that the blood is drawn up and invited by the brain, but is not intruded by the heart. Thus then it is clear what the acting cause is that enables the globules of the red blood to proceed onwards, to be comminuted on the way, to be refined into purer globules, and lastly into the purest, to be propelled into the fibres, and even into the motive fibres of the body; operations which we cannot attribute either to the blood itself, or to the pia mater, and still less to the dura mater, or even to the fibres; but to the principles of all these, or to the cortical substance, to which all the other substances are appendages, anterior and posterior. In ascending to this substance the arteries

decrease to their minimum, in descending from it the fibres increase to their maximum ; thus the intermediate cortical substance must be the centre of the two ; and whatever the diameters and surfaces possess, they must of course derive from their centres. To these centres then we ascribe systaltic mications, not systole or diastole, which properly belong to the heart ; and so to the medullary and nervous fibres we do not ascribe pulsation, which properly belongs to the arteries, but to the medullary fibres *animation*, to the nervous fibres *modification* ; for to draw animations, and every time by means of the fibres to vivify the whole animated system, is the peculiar function of the brain in its comprehensive sense.

133. It is, as I believe, useless to attempt to verify this position by ocular demonstration, or the direct evidence of the senses ; art will never be raised to this pitch by human faculties ; for in order to see the parts expanding and contracting in the living brain, we must open the way thither, I do not say by the removal of the plates of the skull, and the division of the dura mater, but by the division of the pia mater also, from which the arterial twigs for the most part come ; which membrane thus injured and broken through, the vessels themselves are torn, and their communication with the animating substance destroyed. It is as though we should wish to obtain a sight of the systole and diastole of the heart, having first torn away both the venæ cavæ as well as the aorta. Besides which, in the recent brain, when the spherules are concealed by an endless tissue of vessels, and furthermore are to the highest degree pellucid, they can never be seen in this their natural state, nor would they be visible through the microscope, even supposing we could use it, which of course we cannot do, except perhaps where they protrude as a fungus, and even then it is not a single globule that we see, but a complex of multitudes, in which indeed we clearly observe the motion. Wherefore in these points, far removed as they are from both the microscope and the eye, we must make use of the rational sight of the mind. "When I examined . . . the structure of the pig's brain," says Leeuwenhoek, "I had no difficulty in determining that there must be a connection between the blood-vessels and the particles of the brain ; in order that these particles may be sup-

ported, and their vitality kept up, by a never-failing supply of blood." (Part II., n. 75.) As for the fact that these spherules suffer themselves to be expanded and contracted, the same author appears to have discovered in those globules which perhaps were parts of the cineritious substance situated not far from the beginning of the spinal marrow, a faculty of expansion, when he found that they could be stretched to twice their width. "These irregular globules," says he, "were so closely united together, that when I saw any which were small or single, and attempted to separate them, some of them underwent an extension twice as great as their length seemed to admit, and appeared to me to be connected by threads in the form of a net." (*Ibid.*, n. 72.) And Vieussens says: "In whatever manner they are drawn apart, or pulled away from each other, even if they are broken before being inspected, they in no case appear tapering, but rather shortened and as if were contracted into themselves." (*Ibid.*, n. 83.) Malpighi observes: "It is extremely difficult to determine the nature of this cineritious substance, for we see in it nothing solid derived from the coagulation of the red blood; nor do the senses inform us even of its organization. Yet it is probable, . . . that it contains at least minute channels through which the blood particles run," &c. (*Ibid.*, n. 82, *ad fin.*)

134. That this vivacious and most noble substance breathes in this manner, and takes its animations alternately, Boerhaave in fact conjectured, with that persistent force of intuition for which he is so peculiar; and afterwards he thus deduces his own spontaneous idea from a connected series of arguments: "Since, therefore, at every stroke of the heart," says he, "a very large portion of the blood . . . is impelled by a powerful and direct force into the cortex, the latter must be actuated by a certain slight systole and diastole, so long as these vessels are full of blood." (*Ibid.*, n. 92.) And again, after laying down certain premises, he says: "Whoever . . . considers these various circumstances, must judge that the medullary fibres are delicate pervious canals, which receive the subtlest of all the fluids of the human body; a fluid which is prepared, secreted, and *forcibly driven into these pipes\** by the wonderful mechanism of the cortex." (*Ibid.*,

\* The italics are Swedenborg's.—(*Tr.*)



n. 95.) And still more clearly Fantoni says: "The mass of the brain is large: the force of compression operates upon its whole surface; and not only upon this, but also upon its inmost substance and very core." (*Ibid.*, n. 6.) "To state a general opinion, not a particle of the brain is destitute of this motion: *all the glands* and all the little tubes *enjoy an alternate and regular compression.*"\* (*Ibid.*, n. 1.) "As the upper part of the brain, which is more distant from the medulla oblongata, and from the emissaries of the nerves, seems to require a greater compressive force, so there is greater energy of motion in this part," &c. (*Epist. cit.*, in *op. cit.*, p. 172.)

135. This opinion is favored not only by the figure of the cortical parts, as approximating to the oval shape of the primeval heart or corculum, but also by the fact that every cortical spherule is surrounded with a little space, which allows it to move out freely, or expand and contract, in all directions. For according to Malpighi: "They [the cortical glands] are of an oval figure, but compressed all round by the adjacent glands, which creates certain obtuse angles, and a great number of pretty equal intermediate spaces. . . . A good way to see the divisions between these glands is by pouring ink upon them, and then softly wiping it off with a piece of fine muslin; when the intermediate spaces are left black, and the outlines of the glands brought prominently into view." (Part II., n. 76.) This is explained still more in detail by Vicussens (*Ibid.*, n. 83). And to such an extent is it the case, that not only are the glands singly discriminated from each other, and surrounded with spaces, but so also are their groups, small and large: so that each part can be expanded distinctly, each number of parts distinctly, and each sum, product and conglomerate of that number distinctly. Hence between the cortical masses there are winding furrows, from these proceed chinks, from these again little open lines: each form of composition being left to its proper liberty. "These ridges," says Boerhaave, "convoluted in the form of intestines, are again resolvable into other similar lesser ridges." (*Ibid.*, n. 90.) The same thing is very conspicuous in the cerebellum also, for if we make a perpendicular section of it from the vermicular process, or between its hemispheres as far as the fourth

\* The italics are Swedenborg's.



ventricle, we see a complete arborescent appearance, with spaces and as it were meningeal folds intervening, and which represent the shadows between the branches of the trees.

136. Since then the cortical spherules are so many salient points, and as it were little hearts, formed for diffusing the purer blood, and even the purest or the spirituous fluid through the nerves, in the same manner as the grand and single heart of the body is formed for diffusing the red blood, so the type and idea of these spherules is nowhere better expressed than in the primeval coreula of the chick, and of embryos generally, which also are mere vesicles, or oviform spherules like the cortical glands, and are primarily woven of the finest vascular fibres. For the sake of comparison and illustration, we will therefore subjoin a brief account of the latter drawn from Malpighi. "After 40 *hours* [of incubation]," says he, ". . . the heart [of the chick] pulsated, receiving from the veins a rust-colored humor. . . . For the external border of the umbilical vessels was surrounded by a thick venous circle, which at its extremities . . . opened into the heart. . . . Toward the middle region . . . [the aorta] gave off the umbilical branches, which spent themselves by ramifying twigs in the circumference, forming a reticular plexus. . . . I think . . . that these vesicles . . . constitute a true heart, surrounded as they are (for I have more than once indistinctly seen it) with muscular fleshy portions that have not yet taken on opacity or redness. . . . It seems clear that the ichor, or matter above alluded to, which afterwards becomes red, exists antecedently to the motion of the heart; but that the heart, as well as its motion, are antecedent to the rubefaction of the blood. (Part I., n. 242, p. 205, 206.) A long interval . . . elapses, during which the heart and vessels are pervaded by an ichor, which at one time is yellow, then rust-colored, and at last blood-red." (*Ibid.*, n. 243, p. 210.) See also Lancisi, *Ibid.*, n. 245. The comparison teaches, that before the existence of the red blood, the little heart of the body is itself an almost similar oval spherule or vesicle to that of the cortex of the brain. For nature, proceeding by the simplest way, is everywhere similar to herself. Thus each of these two have a similar form, each a similar environment of pellucid fibres, and a similar contexture of surface; for the heart was once a pellucid

and vitreous particle; it was once pervaded by the purer blood and ichor; the little veins and the little arteries were also pervaded by a similar fluid, so as to be analogous to fibres; a most minute and a simple cavity received this lymph, and propelled it, and alternately expanded and constricted; so that the little heart was both one and the other; with this difference, however, that the little hearts of the brain are innumerable, more simple, and formed only for the purer or pellucid blood; while the heart of the body is single and compound, and formed for the red blood and its serum. But the greatest difference is, that the primitive corculum was embraced by minute venous vessels, just as the large heart is embraced afterwards by superficial vessels which are mere veins; whereas the cineritious corculum of the brain is surrounded by arteries alone, for in these animal life and strength consist (Part I., n. 231—233, 421, 422, 459). We conclude then that the cortical spherules are little hearts for the purer and purest blood, while the heart of the body is for the grosser and red blood.

137. But the way in which these animating hearts of the brain pass on their blood, is still better illustrated by the hearts of insects, which are also of comparatively simple structure and of an oval form, particularly in the earliest stages of formation. In the silk-worm, according to Malpighi, the "heart consists of thin membranes, which are of the same color as the fluid they enclose, being at first transparent, but afterwards becoming yellow, and losing some portion of their clearness." (Part I., n. 244, p. 213.) The reader will find Malpighi's elegant description of the manner in which the corcula of the silk-worm are forced into systole, well worthy of a second perusal. (Part II., n. 18.)

138. Such being the state of the case, what is there to prevent us from affording the mind some scope and liberty for expatiating further; and from the grand heart of the body, representing to ourselves some idea of what is carried on with still greater perfection in these lesser hearts; as for instance that there are most subtle lacunæ, subdivided chambers, minute entrances, valves, sinews, analogical motive fibres, and other means, in order that this blood may circulate from the minute cavity to the surfaces, from the surfaces to the cavities, precisely

according to the requirements of the animal economy. But in these most hidden things of nature, it is dangerous to proceed to the particulars and specifics of the universals; for if we give reins to the imagination, without placing by its side the experience of the external senses, it will be impossible to fix the goal, or to prevent ourselves from running out to infinity, until we are precipitated into the shadows and fallacies of mere conjecture. Hence it is better to restrain this faculty, and direct ourselves to points where there are defined or marked ends in view. The time however will come, when, having traced all the effects in the animal economy distinctly to their causes, we shall be able to ascertain what is done in these minute cortical spheres, and what kind of tissue and degree of permeability they necessarily possess. But I confess that this is the work of an age, and will task all its genius. For as we have pointed out already, a general and particular experimental knowledge of the things which at any time reach any sensory, will point out the essence of the most minute things of the same degree; as also of the corresponding things of the still more simple or superior degrees; wherefore we are led into the inmost knowledge of natural things by the doctrine of series and degrees conjoined with experience. (Part I., n. 631, 632.) And to this knowledge we shall attain with greater certainty, and with mathematical truth, so soon as we have reduced the sciences to one universal science, which, by characteristic marks and letters, in their general form not very unlike the algebraic analysis of infinites, may be capable of expressing those things which are inexpressible by ordinary language. (*Ibid.*, n. 650, 651.)

139. By having in some degree explored the nature of a part, we shall be taught the action of a group of parts, or from the singular we shall learn the character of the integral and total; for the compound possesses nothing of itself as its own but what it borrows and accepts from its singulars and parts, and their accidents internal and external. Wherefore let us now proceed onwards.

140. *Since then there are as many origins of motion as there are spherules of cortical substance, it follows that when the latter are expanded, the entire mass of this conglobate viscus, (namely, the surface, the blood-vessels, and the interior medulla throughout,)*

*is constricted; and vice versâ.* We have thus, we presume, explored the origin of the animation of the brain. So great is the abundance and profusion of these origins, that we must reckon them by myriads. They form the entire circumference of the cerebrum; they occupy its amplest spaces internally; they fill the larger protuberances, as the corpora striata and thalami nervorum optidorum; they enter here and there into the smaller protuberances, as the testes, nates, and pineal gland; they penetrate the cerebellum in the form of a tree with beautiful branches; they run in layers through the medulla oblongata; they compose the entire axis of the medulla spinalis, and disappear only about the first vertebræ of the lumbar region; they are so ordinally, skilfully and wonderfully disposed, that while they all spirate and respirate unanimously, every single part of either meninx, every single twig of the carotid and vertebral arteries, every single fibre of the centrum ovale and medullary substance, and every single particle of the whole body, in whatever corner it be placed, conspires with them. There is nothing in the whole or in any part of the universal kingdom, but is set so wonderfully in the stream of this very motion, that it animates when the cortex animates. But to come to particulars.

141. From what we have stated above, it is perfectly clear that the *blood-vessels* of the cerebrum, cerebellum, and medulla oblongata and spinalis, are expanded by the constriction of the cortex, as a principal cause; for when the purer blood is not admitted into the cavities of the corcula or little hearts, the lesser and least of the little arteries, and by consequence the larger and largest of the same, must retain it; and *vice versâ*, when these numerous cavities again open. Much as in the grand heart of the body, whose auricles and arteries are dilated when its ventricles are constricted; and *vice versâ*. But how the arterial and venous vessels of the brain are everywhere so situated, both on the surface and in the internal parts, that when the cortical or cineritious substance is constricted, they are dilated in both directions; and how they then fill with new blood from the receptacles of the carotid and vertebral arteries, and throw out the antiquated blood with its serum rejected by the cortex, into the veins and sinuses;—these with other particulars

the reader will find explained in the Part on the Blood-vessels of the Brain.

142. As the blood-vessels suffer themselves to be governed by the substance of the cortex, so of course still more certainly does the *pia mater*, for it has vessels attached to it in an infinite number of places ; for the transmission of which vessels it serves as a kind of little bridge : and the more, since it not only overlies the cortex, but is continually interposed between it and its different masses, for it produces itself into septa in a serpentine manner between the windings of the cerebrum, and in a falci-form manner between the folds of the cerebellum, according to Ruysch. (Part II., n. 87.) Nay, it everywhere sends down offsets into the furrows and little spaces between not only the combined but also the simple substances, to which indeed it is affixed ; and this, in order that there may be a unanimous concordance of all the parts with the general : just as in the body, its nerves, muscles, glands, and in the members constructed of them, where the outermost and common membrane always detaches from the inside a finer membrane, and then a finest, which connects the simple fibres as the common membrane connects the fascicles. How this takes place is very evident in the cerebellum ; and indeed in the cerebrum too, although here its continuity is such that it forms a plexiform web. Ruysch and Leeuwenhoek each have a figure representing its wonderful propagation. The former shews that the inner surface of the pia mater exhibits a mossy covering of vessels which insinuate themselves into the cerebellum (*Ibid.*) ; the latter, that several arteries run down from the pia mater [of the pig's brain], and are united to each other by threads, which he calls the fibrils of the brain, and that these arteries run perpendicularly, and contain but little red blood. (*Ibid.*, n. 75.) “As the arteries,” says Wepfer, “run within the winding furrows, they supply . . . minute twigs to the pia mater, which twigs are partly woven into its substance, . . . and partly penetrate this membrane, and dip down into the substance of the brain : and this happens, not at rare intervals, but in very numerous places ; as I have often seen. . . . When I made traction upon a branch, I could pull out several considerable little arteries from the brain, besides those from the little branches abovementioned that are

woven into the pia mater, and dip down from it into the brain in the form of capillaments." (*Op. Cit.*, p. 108, 110.) And Winslow says: "These convolutions are fixed through their whole depth to the septa or duplicatures of the pia mater, by an infinity of very fine and delicate vascular filaments." (Part II., n. 98.) Thus it is evident that there is no contractive and expansive force inherent in the pia mater, except what it receives from the cortex of the brain, that is, from the brain, which does not begin to be the brain, but in this its cortical substance. Also that the pia mater is so laid upon this substance, and extended between it, that the effect of contraction redounds to the surface from the centres, but not contrariwise to the centres from the surface; and in this way also these vessels have the faculty of expanding both ways; and *vice versâ*.

143. The same is true also with regard to the *dura mater*, which, as we shewed in Part II., Chapter I., is expanded and relaxed by the brain, and raised by its arteries so as to perform a kind of pulsation; wherefore we are again brought to the truth of Ridley's assertion, "that the sinuses themselves have no pulsation other than what is communicated to them from the subjacent brain." (*Ibid.*, n. 21.) Fantoni also is with us in this matter: "The *dura mater*," says he, "*set in motion partly by the brain, partly by its own arteries*,"\* undergoes the same reciprocal movements. Hence I conjectured that the resiliency of the membrane might be useful for compressing the brain. Yet after all this cannot be the fact, for the brain collapses sufficiently by its own weight and effort, and this being the case on every side equally, so as to amount indeed to a kind of contraction, therefore the brain compresses itself. Moreover the *dura mater* does not tightly embrace the brain, but lies very loose upon it." (*Epist. Cit.*, *Op. Cit.*, p. 172, 173.) But here let us not go too far outside the brain, for in the *dura mater* the motion begins to be mixed, and coincident with the pulse of the heart (Part II., n. 55—61). Wherefore we had better turn to the interiors of the brain, or to the medullary substance.

144. It is not to be doubted that the *medullary substance* also is excited to a certain systaltic motion by the motion of the cortex alone; for the medullary substance consists of mere fibres, which are so many pervious canals; and if to each of

\* The italics are Swedenborg's.—(*Tr.*)

these a cortical spherule is prefixed, as the heart of the body is prefixed to the aorta, the fibres must beat every time with their corcula, and so also the universal substance appended to them ; and this, in such wise, that the latter must pulsate or beat when the cortex is constricted ; and *vice versâ*.

Thus everything in the brain is carried away by the animation of the cortex into a similar motion ; and so the entire mass is forced, because the several parts are forced, to undergo these reciprocations ; and in fact when this corcular substance is constricted, not only the arteries and fibres are then opened, but also all the cavities and little spaces, as those between each particle of the cortex, and those between each group and mass of it ; also the winding furrows, even the ventricles, as well as the space between the pia and dura mater ; and *vice versâ* when the cortical substance is expanded ; as will be very clearly shewn in the Parts on the Brain. For it is plain that at this moment the spaces between the single spherules, and between the groups of spherules, or the little crannies, chinks, furrows, and windings, are drawn apart, for of course they must open when the cortical substance contracts, and *vice versâ*. And thus room is afforded for the little arteries which creep in numbers through these spaces, again to fill themselves with new juice and blood. The general opinion, therefore, as cited by Fantoni, is here confirmed. "The mass of the brain," says he, "is large: the force of compression operates upon its whole surface ; and not only upon this, but also upon its inmost substance and very core." (*Ibid.*, n. 6.) "To state a general opinion, not a particle of the brain is destitute of this motion : all the glands and all the little tubes enjoy an alternate and regular compression." (*Ibid.*, n. 1.)

145. I have said that the cortical substance is the principal mover of all the other substances in the body, but I mean to include also all the cineritious substance, as for instance, all that is within the posterior lobes of the brain, and within the corpora striata, and the crura, and the other eminences of the medulla oblongata, as also within the medulla spinalis, and all that ramifies through the cerebellum ; for it is all of the same nature however differently distributed. "The substance of the cortex," says Malpighi, "is of the same character in the ventri-



cles of the brain, and at the beginning of the spinal marrow; for after boiling, it has the form and exhibits the characteristic substance of the glands, being exactly similar in these respects to those in the exterior region of the brain; . . . and in the inside of almost the whole spinal marrow, the cortex (described elsewhere) has the same glandular character." (Part II., n. 76.) And Boerhaave says: "Throughout the encephalon, wherever the minute and invisible arteries, and corresponding invisible veins are continued, . . . there also we find this cortical substance, as well in the recesses, convolutions, divisions, interstices, and appendages, as on the external surface next to the cranium." (*Ibid.*, n. 95.) Wherefore there are fibres proper to the cerebrum, fibres proper to the cerebellum, fibres proper to the medulla oblongata, and fibres proper to the medulla spinalis.

146. Truly marvels present themselves when we consider how animal nature has distributed, distinguished, multiplied, and by perpetual communications conjoined, these pulsific and vital substances. How they are *distributed* we shall shew in the sequel. How they are *multiplied*\* will be evident if we consider the abundance of them in the circumference of the brain, and in the penetralia of the cerebellum and of the two medullæ: they are a number ineffable and unassignable; so that it may in a certain sense be said, that there is a universality of the particularities of this substance; for the formative substance is bound to multiply thus these spherules, as causes of all its operations in the animal system, that effects may result with certainty thereby, and life never fail the members; so that if one, or several, or perhaps a myriad of these spherules should become extinct, or rendered incapable of acting, still the inspiration of life from the sound survivors would not cease, but would restore the estate of the others, and raise them from the brink of death. They are *distinguished*; for each spherule is surrounded with its own little space or foss, that it may roll in perfect freedom within its sphere of activity: so also are the combinations or groups of spherules collectively; thus each spherule most distinctly animates its own fibril, and influences it

\* See the *Animal Kingdom*, n. 203, and note (b).—(Tr.)



to its very end in the motive fibre of the body. They are *conjoined by perpetual communications*; namely, by the productions of the pia mater, and ultimately in the form of stamina. They are connected also by the blood-vessels, which communicate so perpetually that there is no portion of blood in any twig, that is not common to all; so that in the cerebrum and cerebellum there is an absolutely perfect community of all imported goods and fluids.\* Thus whatever the trunks of the carotid and vertebral arteries convey, any one spherule of the cortex can appropriate to itself, whence the life of one is never extinguished so long as that of its consort endures. "It is worthy of consideration," says Ruysch, "that the arteries of every convolution of the brain, anastomose and unite with the arteries next them." (*Ibid.*, n. 87.) As in the larger branches, so also in the least, according to Leeuwenhoek's figure, "representing a minute portion of a pig's brain; where we see that several arteries run down from the pia mater, and are united to each other by threads, which Leeuwenhoek calls the fibrils of the brain." (*Ibid.*, n. 75.) This is still more conspicuous in the spinal marrow, where a common sanguineous canal runs in front in a kind of long fissure, and gives off an infinity of twigs to the cineritious axis, so that there is no portion of blood in the canal but is common to every twig, and consequently to every particle of the axis. We shall bring forward innumerable confirmations of this in Part IV. And in Part III. it will be seen, that the cortical substances are conjoined by the medullary fibres, or by all that will concur to any particular action in the body.

147. *In the cerebrum these spherules are so placed and ar-*

\* See the *Animal Kingdom*, n. 184 (*u*), where the following occurs: "Every gland throughout the animal kingdom enjoys a plenary communion of its goods and fluids, as well as of its blood. Not the minutest drop floats in any artery, wherever situated, be it even in the heel or in the sole of the foot, that is not communicated, if required, to any other artery, whether in the crown of the head, or in any of the viscera, or in any of the glands. That there is such a communion of blood in the brain, and in the chest, throughout, and that there is a similar communion of chyle in the mesentery, is perfectly evident from the everlasting anastomoses between the different vessels. And we shall shew further, in the Part on the Blood, that that fluid is various in every artery and vein, in every minute branch, and in every twig. It is by virtue of this communion that the glands supply their wants and necessities from every part."

ranged, that they can perform their systole and diastole either singly, or several together, or all in common; but not so in the cerebellum, or medulla oblongata and medulla spinalis. For in the cerebrum all the spherules reside and act freely in their own little spaces, as we have just pointed out: several again consociate to form a little ball or glome, which is separated from its neighbors by its own fissures and little spaces: these glomes again associate to form larger and more general glomes, which are bounded off by little fosses; and these larger glomes again combining, conglomerate themselves into tracts not unlike the convolutions of the intestines, and discriminated by winding interstices, and comparatively wide furrows. Thus the brain by degrees grows from points into dimensions; or springs most distinctly from parts by gradations into a body; and this, in such wise that every spherule, and every conglomeration thereof, small and large, can swell and collapse either singly or conjointly. The manner in which the parts combine with each other, and form convolutions, cannot be better seen than in the boiled brains of the ox, calf, or sheep, where these little intestines may be separated from each other to a considerable depth. Ruysch, in one of his plates, has finely exhibited the appearance of the loculi or thalami of the cortical substance, within the serpentine processes of the pia mater next to the surface of the brain. (Part II., n. 87.) “Malpighi declared,” says Boerhaave, “that the cortical glands were oval, that they were rendered angular by their pressure upon each other, that they were disposed in curves, and that the smallest of them were attached to those next them to form others a little larger, that these again were combined to form others larger still, and that these latter were aggregated into a mass as it were of convoluted intestines, which immediately constituted the exterior cortex.” (*Ibid.*, n. 93.)

148. The subjacent medullary substance is compounded in the same manner as the cortical. Its single fibrils enter under a common tunic, in order to become fascicles; the fascicles again enter under a sheath, or still more common tunic, in order to become first laminæ and then nerves; as is very clearly seen in dropsical brains. “When they [the convolutions of the brain],” says Winslow, “are cut transversely, we observe that

the white substance lies in the middle of each convolution, so that there is the same number of internal medullary convolutions as of external cortical ones; the medullary representing white laminae invested and surrounded with eimeritious substance; but the cortical substance is in many places thicker than the medullary." (*Ibid.*, n. 98.)

149. A different composition and insinuation of this cortical substance is displayed in the cerebellum. In this organ it is insinuated in little circles and folds, and penetrates most distinctly, and everywhere sends out fibrils, and this, so visibly, as to present the appearance of a tree when the whole mass is divided perpendicularly. In this tree of life, in most beautiful order, and by unanimous consent, the trunk is related to the branches, the branch to the boughs, the bough to every eye or particle, and this, so wonderfully, that the common action is identical with the particular action of every part, and *vice versâ*; and thus the whole mass of the cerebellum is expanded or constricted unanimously, while the mass of the cerebrum on the other hand can expand or constrict specifically and individually; for in the cerebrum there are as many hinges and joints as there are parts or tori; but not so in the cerebellum, unless perhaps we except its inferior partitions round about the stem of the medulla oblongata. "In the cerebellum," says Malpighi, "as its productions are propagated in the way of laminae placed one upon another, and the outgoing branches are sent on both sides equally towards the external surface, so the circumjacent cortex assumes a semicircular form." (*Ibid.*, n. 82.) Respecting the ramification of the cortex and pia mater in the cerebellum, see Heister, Morgagni, and others; also our Part I., n. 560, 561.

150. That every cortical torus of the cerebrum is like a cerebellum, but capable of particular expansion; or that there are as many cerebella in the single cerebrum, as there are conglobations, each of which can act separately upon its own peduncle, and upon some of the peduncles of the one, and some of the peduncles of the other torus, as also upon all at once; so that from the simultaneous or successive action of many scattered tori upon their peduncles, a single or compound action results in the body;—all this is evident from Malpighi's description, which shews that wherever a section is made in these tori, a

similar arboreal ramification is displayed to that in the cerebellum, only on a smaller scale. "These cortical glands," says he, "tortuously placed, make up the exterior gyres of the cerebrum, and are appended to the medullary fibres or vessels arising therefrom; so that wherever the gyres are cut across, a determinate and firm mass of glands is always found overlying the medulla: and this is still more evidently the case in the cerebellum." (Part II., n. 76.) "The intermixture and combination of the nervous fibres in the cerebellum produces the arborescent appearance described by Cortesius and others, and which also I find is exactly repeated by nature in the cerebrum. For if the gyres of the cerebrum with their cortex be cut or torn across, the same appearance of a tree with its branches and bark, will be presented. This may be easily verified by making a transverse section of the entire cerebrum, or of any one of its parts." (*Ibid.*, n. 79.)

151. The case is different in the medulla oblongata, through which this substance is dispersed in patches, in order that it may distinctly afford origin and beginning to every fibre as it is about to go out therefrom into the nerves. And again, the case is different in the medulla spinalis, where this substance collectively forming a long axis, flows as it were from perpetual centres into its own proper fibres, and this, in order that it may be roused to act at the same time by the fibres of the cerebrum and cerebellum, which run through it. Again, there is a difference in different kinds of animals; and also in insects, whose spinal marrow is parted into a number of cerebella as it were, in such an order, that when one of the lower molecules acts from its cortex, it also suffers itself to be acted upon by the molecule above it, and thus principally by the highest molecule, or by the brain. Respecting the silk-worm, see Malpighi; and respecting other insects, see Swammerdam.

152. Therefore the cortical substances of both the cerebrum, the cerebellum, and both the medullæ, are so fitly subordinated and coördinated, that nothing in animal nature can be more methodical, as indeed we might expect to be the case with a substance which is the origin of the nervous fibres, and the beginning of the motive fibres of the body, and the cause of all actions both natural and voluntary. But this is not the place

to extend the enquiry further, or into the particular modes in which this substance acts upon the fibres; for this must be the subject of our next Parts: here it is our object to treat of this substance only in special, and not in general.

153. *Hence the cerebrum, according to the ordinate disposition of its substance, has the power and choice of inspiring any fibres it pleases, or fascicles of fibres, and consequently any nerves and muscles, and exciting them to act.* Thus we see why the cortical substance of the brain winds into spirals and continual tortuosities, and why it is folded into serpentine ridges and intestinal gyres surrounded by so many meningeal partitions and insulated banks. We see that this is in order that there may be all this number of brains capable of animation, and as it were of turning round on their hinges: for they have corresponding to them an equal number of fibrillary leashes in the medulla of the brain, and an equal number of fasciculated nerves in the body, and lastly, an equal number of motive fibres in the muscles. Experience and time are necessary to enable us to trace out what particular gyre and serpentine eminence in the brain respects a given muscle as its correspondent in the body. Pacchioni speaks of the liquids which creep through the burrows of the brain, and refers to Bellini and several other writers. (*Opera*, Ed. cit., p. 87.)

154. That the cortical substance is what inspires the fibres, and by its animation propels the spirit, and thus excites the nervous and motive fibres of the body, is a fact in confirmation of which the history of diseases of the head is so prolific, that a bare enumeration of the proofs would fill two of our pages. Ridley says: "When I thrust the point of a knife an inch deep into the brain of a dog, the frame was violently agitated, and the animal exhibited horrible tossings of the body, and convulsions of the fore and hind feet. (*Phil. Trans.*, loc. cit.) When the blade of a knife was passed right through to the opposite side of the skull," (that is to say, through the cineritious substance of the medulla oblongata, so as to divide the medullary fibres in its passage,) "horrible spasms were the result." (Part II., n. 1.) And Pacchioni says: "A young lad who had fallen from a height, and received a concussion of the head, and a wound on one side of it, died twenty days after the accident. We

could not discover any fracture of the skull, but a kind of not very soft mucilage covered the cortex of the brain, and like a sticky glue could not be removed either by the fingers or the probe, but required a knife to scrape it off: this was common to both sides." (Part II., n. 88.) Again he says: "A poor youth who had lain for some days in the highway, was carried to the hospital. I found him, lying on his back, his eyelids sunk, and his lips drawn a little to the left side. In answer to questions he spoke but little and seldom, and incoherently. He threw his arms and legs about in all directions, unconscious of what he was doing. . . . As while he was alive there were no signs of percussion in the integuments of the head, so after he was dead we could find none in the skull, or the parts underneath it. On proceeding to examine the brain for the seat of the disease, we at once discovered it in the dura mater. On the left side we found a considerable bladder, which at first deceived us, for opposite its convexity we saw a kind of sinuous recess in the dura mater. . . . The cortex of the brain, which was depressed and hardened, displayed a cavity answering to the bladder." (*Ibid.*) In another place he says: "I once saw a young man who died after suffering violent headaches attended with acute fever, and with spasms produced by intense study. On opening his cranium, it appeared that the dura mater had acted so powerfully upon the brain, . . . that it had detached itself from the bone, and was squeezing the cerebrum and the cerebellum as though under a press, and when it was drawn away in different places, it immediately returned towards the centre, allowing no space to exist between it and the viscus." (*Op. Cit.*, p. 94.) Wepfer relates the case of a female seventy years of age, who after exhibiting the premonitory symptoms of apoplexy for some months, suddenly lost the power of speech, and on being conveyed to bed, lost all sensation and motion. On a *post mortem* examination, a large cavity was found in the cortical substance\* of her brain, &c. (*Op. Cit.*, p. 5—11.) He also gives the case of a man of fifty, who for some weeks before his death suffered with excruciating headache, the pain of which sometimes drove him mad, so that he was not seldom unconscious of what he said

\* Wepfer does not directly state that the cavity was in the cortical substance, although it may be implied in what he says.—(*Tr.*)

and did. On examining his head after death, the whole surface of the cerebrum and cerebellum, including both the convolutions and the furrows between them, seemed to be clogged all over with a gelatinous substance, from which, when it was pricked with a lancet, genuine serum oozed out. And in fact, Wepfer could see most plainly that the very substance of the cerebrum and cerebellum had imbibed a large quantity of serum; for both these brains were extremely flaccid and soft, almost like pap; so much so, that the slightest touch broke them, &c. (*Ibid.*, p. 15—19.) Were it requisite, we might here introduce a host of observations from the *Acta Eruditorum*, all proving that when the brain's elevability and faculty of animating are gone, either in whole or in part, its voluntary action upon the muscles of the body is immediately abrogated to the same extent; as in apoplexy, hemiplegia, carus, epilepsy, catalepsy, mania, delirium, canine rabies, &c. "The most accurate and repeated observation has taught us," says Boerhaave, "that this disease [apoplexy] happens as often as those causes precede that cut off either entirely or in a great measure the efflux of the spirituous fluid of the brain into the organs of sense and voluntary motion." (*Aphorismi*, n. 1009.) And among the above causes he enumerates "all matters that effect a solution in the continuity of the arterial, venous and lymphatic vessels in the interior of the brain about the cavities, whereby liquid escapes and collects, and by its pressure injures the arched origins of the cerebral nerves." (*Ibid.*, n. 1010, § 4.) Again he says, when classifying the causes of epilepsy, that this disease happens when "the brain is morbidly affected in its integuments, surface, substance, or ventricles, by wounds, contusions, abscesses, pus, sanies, ichor, blood, or acrid and fetid lymph, &c." (*Ibid.*, n. 1075.)

155. Therefore since the cortical and cineritious substance of the two brains and medullæ, is the fountain of the voluntary and natural vital motions; and since all the other parts are channels which convey the blood to it, as the arterial vessels, or convey the spirituous fluid from it, as the fibres; or else are barriers and embankments, which hem in the cortex, and confine it within limits when about to animate, as the cranium, and the pia and dura mater; hence we may easily infer the proxi-



mate or remote cause of any particular malady, for there is a chain of causes, beginning from the substance of the cortex, and terminating in it; which substance lies so deeply and safely within its osseous and membranous walls, that it is rarely reached, unless beginning from the surfaces, or unless when the bones are contused, broken, or luxated, or the membranes inflamed, or filled with useless humor, or the vessels ulcerated or emptied, so that the mischief at last approaches the cortex, and exanthemata, pustules, schirrus, sphacelus, fistula, gangrene, and the like, invade it.

156. From these facts then, which have been ascertained with regard to the whole brain by the experience of anatomists, we come to the following conclusion with regard to the several cerebella which collectively make up the cerebrum; namely, that when one or more of these cerebella is thoroughly diseased, the contagion does not immediately extend further than to the appended fibres and subject muscles. Wherefore the cerebrum is so constructed, that either the whole may be carried away in alternate whirl, or only the half or one hemisphere of the semiglobe, or only some of the convolutions, or only a single one, or only a glome, lesser group or part of one convolution. Thus the evidence that history of diseases proffers of the whole, it proffers at the same time of the parts, and of a part of the parts. In fact, animal nature must needs so dispose the principles and causes of the motions of its kingdom in the cerebrum, as to give the soul the power and choice of compelling any fibres it will to act, or any fascicles of fibres, and consequently any nerves and muscles.

157. But perhaps you think it may be objected to me, that no fibre of the cerebrum is sent into any motive fibre of the body, but only the fibres of the cerebellum and of the two medullæ; for as to the olfactory and optic fibres, although even they arise from the beginning of the medulla oblongata, yet they are only sent out to receive sensations, and from the nose and the eye to refer them to the cerebrum: but not for the purpose of motion at all; since the motory fibres of the muscles of the nares and eyes arise from pairs that come off lower down from the medulla oblongata. This indeed I admit. But still the fibres of the cerebrum (with the exception of those that are



expended upon its chemical laboratory) run both from the superior region about the testes, and from the inferior region about the annular protuberance, to the medulla oblongata, and so to the medulla spinalis. Thus although the fibre of the cerebrum does not itself play a motive part in the muscles, yet it does play this in the two medullæ, whose fibres it disposes to act in this and in no other manner, as is clearly deducible from the anatomy of the human brain, of the brains of brutes, and also of insects. And this it does, in order that the voluntary in the cerebrum may pass into the spontaneous and natural by means of the medullæ, lest the cerebrum be carried away into profound particular motions every time an action once begun has to be continued from the ground of habit; in which case it would as often confuse and disturb the administration of its higher offices, as also in man those rational analyses which demand a particularly quiet state of the cerebrum. Wherefore as soon as ever voluntary action demands a continued series of *agenda*, the cerebrum has to be consulted, and to consent, and indeed to produce the actuality of the action. Thus to the cerebrum belongs the principal cause; while to the incinerated medullæ the secondary cause is appointed. I therefore doubt whether the scattered thalami of the cerebrum rise up every time an action once commenced is continued; and whether this be not the case only when the designed force is first impressed, or every time the will is successively continued by open declarations of itself.

158. The foregoing remarks are supported not only by the already often-mentioned versatility of the glomules and thalami of the cerebrum, but also by the astonishing distribution of the sanguineous canals, and by their confluence in those places from which the particular actions of the muscles of the body spring; as we find about the projections [umbones], and in the two superior lobes, where arteries of considerable size are seen to enter the cortical substances, and serve as receptacles to those substances which are more mobile than any other part of the cerebrum, as we may see in Ridley, *Anatomy of the Brain*, fig. V., I. *i*. Besides, there are little pools of blood scattered all over near the cortex, nay, even in the interiors, like so many ruddy stars in the hemispheres, as shewn by Vieussens, *Neurographia Universalis*, tab. vii., viii., xiii., &c., and in Ridley's

figure just alluded to. Also in the cerebellum, in order that the brains by their means may be kept determinately in a state of general expansion. And in the cerebrum, in order to be receivers and harbors for the blood which the cortex wants, when one part of it exerts itself more nimbly than another. If we could penetrate into the living brains by the microscope, and see all that is to be seen of these substances, oh! how the eye would astound the mind: but as this is hidden from us, we must rest content with what is visible in the confusion of boiled brains. *Which particular and special action exists under its general voluntary action.* See Part I., n. 287.

159. *Thus if we gain a distinct perception of the coördination of these substances, we may understand how the will is determined into act by the cerebrum.* We consider it beyond all doubt, that the cortical substance is the determinant, although not the prime determinant, of the actions of the body; because it is the determinant of the fibres, as the fibres are of the muscles, from which action results. Hence according to the nature, disposition and number of these determinants, and according to their connection with the fibres, and the connection of these with the muscles, the intended effect is produced. To these determinants, principles or motive forces, that is, to these cortical substances, such a disposition (as we have already often indicated) is allotted in the cerebrum, and to the motive fibres of the muscles such a correspondence with them in the body, that the mind at any time it chooses, with any celerity, to any degree, and over any extent of space, can call forth action by their means, and break it off in an instant, and then reproduce it in any other determinate point. The case is different in the cerebellum, and again in the medulla oblongata and medulla spinalis. Thus from a distinct perception of the coördination of these substances, and of the subordination of their fibres, and finally of the coördination of the motive fibres, we may understand how the will is determined into action. For when these substances are deprived of the faculty of expanding either singly, in groups, or all together in common, they are also deprived of the effect [of expansion], as in cases of apoplexy, epilepsy, paralysis, delirium, suffocation, strangulation, apparent death by drowning, [morbid] sleep; and in little infants,

embryos, birds in the egg, &c., all of which cases revive or are initiated into their actions, so soon as the missing faculty is restored to their brains, or procured by exercise; as experience teaches.

160. But these cortical substances, although they are determinant of the actions of their body, yet relatively are only sub-determinant and mediant, and have corresponding to them the subdeterminant substances in the body, that is to say, the motive fibres (Part I., n. 598). For by the cortical substances the will is determined into act, but the principle of the will must be sought for higher than they. According to account, the parts of this substance are woven of infinite fibrils, and like little hearts, are furnished with their own cavities; these with their own little walls and little superficial layers: and the fibrils are permeated by their own purest and most fluid spirituous blood. Hence to open and close their little cavities, a higher, sublimer, more principal and universal force is required;—a force to contain the principle of the will, which by these means is determined into act. Hence there is a spirituous fluid, in which the life resides, and consequently the soul (Part I., n. 637, 638).

161. This the purer mind dictates,—that these most subtle beds or cavities of every cortical substance or part, are not opened immediately by the effort and influx of the purer blood (Part II., n. 127): because the brain, or rather the mind, has the power and option of opening them; for animation is voluntary. The purer mind also dictates, that their finely fibrillary or parietal contexture must be expanded before the little cavity opens and enlarges, so that the same organization obtains in opening these corcula as obtains in the compound, or in the cerebrum itself, into whose expanded arteries the blood flows as if drawn up into them by a syringe, by what I have previously denominated physical attraction (Part I., n. 217, 219, 346—350, 458). The same purer mind now infers that the power and force of expansion resides in the spirituous fluid which permeates these minute fibrils. And the same mind finally concludes, that there is a soul, which dwells [*inest*] in this fluid, and whose privilege it is to determine into act.

But to consider how the soul, as such, animates and ex-

pands this fluid so peculiarly its own ; and by consequence the fibrils of the cortical contexture ; and by consequence through this the little mesial cavities of the spherules,—this is above the sphere of the present Part : as also to consider what the will is, and what its determining cause, from causes internal and external, proximate and remote. This alone falls within our enquiry,—that the will is by no means determinable into bodily acts without the mediation of such a substance, and without such a disposition thereof as we see in the cerebrum ; for were it not expansible both in single parts and in masses, the soul might will indeed, but could not do. We may also observe, that the soul, although diffused through its universal kingdom, and present everywhere in the whole and in the part, cannot determine the will otherwise than as the abovementioned mediation and disposition give the opportunity of action. Thus in whatever potency or impotence of action this substance may be, still the soul enjoys the same representation of its universe, and the same intuition of ends ; it is as wise in embryos and infants, in idiots and drunkards, as in the most sober, gifted and cultivated men. [Part I., n. 269.] For it is these mediant and subdeterminant organs alone that are either insane or uneducated ; and this, because their connection with their fellows is disturbed, or because they have admitted an immoderate influx of impure blood, or because their tender structure is fretted and beset with disorderly particles, or emptied of genuine ones, or because they are deprived of vital expansibility, either in general or in particular.

162. *How by the cerebellum.* It is the common opinion of the learned, that the cerebrum presides over the voluntary actions of the body, and the cerebellum over the natural, or as some call them, the involuntary, actions. But that the common animation of the cerebellum is equally voluntary when that of the cerebrum is voluntary, is evident from this, that the cerebellum is abundantly endowed with similar cortical substances or principles of nervous fibres. Still it differs from the cerebrum in this, that it is capable of elevation as a whole or in common, while the corresponding masses of the cerebrum, and which as minute types represent the grand mass of the cerebellum (Part II., n. 150), are elevable one by one or in part.

So that the cerebellum enjoys determinability over the reciprocations of animation, just as much as the single masses of the cerebrum. And hence it is that the cerebellum also animates synchronously with the respiration of the lungs. For wherever the cortical substance is so fitted into its organ as to be expansible with it, there determinability is enjoyed according to the same will. There is therefore a voluntary animation of the cerebellum in general, when there is a voluntary animation of the cerebrum; as during the day, whenever there is good reason that the will should be carried forwards into act by a general aid. But at night, when no particular action of the cerebrum subdistinguishes and gives perspicuity to the general action; or when nothing comes from the external organs to its distinct consciousness and intuition, it appears as if all voluntary determination had ceased in both these viscera. But there is a want in all parts of the animal system, (which want in fact is one of the causes determining the will,) that necessitates the carrying round of the spirituous fluid (in which the life of the whole consists), and consequently necessitates alternate animations. Wherefore at night, the brains,—unconscious of the common operations of the inferior body, as they are not then subdistinguished by any particulars,—draw deeper, slower and more equable breaths, acting in obscurity, and from the principle of necessity.

163. *And how by the two medullæ*; for in each a similar animable and expansile substance resides; and from the disposition of this substance, and of the fibres proceeding from it, we may conclude, that these medullæ, while they are subject to a common excitation from their own proper cineritious substances, are excited also to their animations and determinations by both the cerebrum and cerebellum; by the cerebellum to common animations and determinations, and by the cerebrum to particular ones. Thus the voluntary animations and determinations of the cerebrum are transferred to the medullæ; and by repeated exercise and frequent use, are at last rendered familiar and as it were natural: and this, principally by means of the cavities and ventricles: for the medulla oblongata arises from the corpora striata and thalami nervorum opticorum, which constitute the wall of the superior ventricles and enclose the

third ventricle; and it also obtains fibres in all directions under the fourth ventricle. And the medulla spinalis, divided as it were into two semicylinders, has its moveable and expansible cineritious substance at its axis, near the fissures and cavities before and behind; by which means the voluntary determinations of the cerebrum are transmuted into the semblance of natural determinations. (Part I., n. 574.) This is illustrated by the brains of the more imperfect animals, particularly birds and fishes, which the moment they are hatched or born, at once enter on the full possession of their nature, knowledge, and peculiar laws of action, to which they become easily habituated without any previous determination of a distinct will. "In the more perfect red-blooded animals," says Malpighi, "and in all the larger fishes that have hitherto come under my notice, I have invariably observed this cineritious substance, termed the cortex. It is not only spread round the brain externally, like the bark or cortex of a tree, which serves merely as an outer envelope, . . . but in red-blooded animals a portion of it is placed around the outermost appendages of the corpus callosum; the remaining portion being dispersed about in the ventricles, particularly at the origin of the spinal marrow, where you will find little fringe-like pieces of the medullary and white substance of the brain disseminated and enclosed." (Part II., n. 82.) But these remarks will be confirmed by innumerable proofs in the Parts on the Brain.

164. *Also how in the different kinds of brute animals.* As it is not our design to treat of this subject specifically, we here observe only in general, that this cortical substance is disposed and distinguished in a peculiar manner in the brains of irrational animals, and exactly combined and fitted to the distinctive actions and life of each; and that it is supplied by sanguineous currents quite differently to what obtains in human brains. As respects the one point of the influx of blood, it is found that in the brains of brute animals, it is with difficulty that it is restrained from rushing in at the slightest instinct and intimation, and suffusing the cortical substance; so that their determinations, which are analogous to our voluntary determinations, result necessarily from the reigning temperament of their purer blood, from its state, and from its condition as altered in con-

formity with the times and seasons of the year, and with the contingent excitations of the external senses. On the other hand, truly human brains have the privilege and liberty of keeping the blood out at the doors of the cortical substance, and holding it at a distance so long as the mind is revolving its reasons; and even of blunting the acumen of the external organs of sensation so far as to prevent distinct perception of the objects presented to them. We shall have wonders to relate on these subjects in the Parts on the Brain.

165. *The brain, by this its faculty and force of animation, extracts, as we said, a most pure essence from the invited blood, and transmits it into the fibres, as its delicate appendages; and pours upon it a new essence, conceived and excluded by a high process of generation in the finest wombs of its substance.* The majority of the learned, particularly since Malpighi, have maintained the opinion, that the cortical substance conceives and produces the spirituous fluid, or as they call it, the animal spirits, which they agree in describing as a pure fluid. This opinion is confirmed by a vast number of observations that have been made in the body, and by nearly all that have been made hitherto in the brain. "Whoever considers," says Boerhaave, "the nature of the cortex, [*&c.*, *&c.*], . . . must judge that the medullary fibres are delicate pervious canals, which receive the subtlest of all the fluids of the human body; a fluid which is prepared, secreted, and forcibly driven into these pipes by the wonderful mechanism of the cortex, and so collected from every point into the medulla oblongata." (Part II., n. 95.) Malpighi, following Hippocrates, and the followers of Malpighi, who admit that the brain is a gland not only in bulk but in part, agree that this substance, which is full of minute passages, not only sends a highly rectified humor taken up from the blood as through a sieve into the fibres, but also continually pours on a new humor, as from an everlasting spring.

But as to those who deny the existence of this fluid, that is to say, of an animal spirit proper and indigenous to every [living] kingdom, and who deny the conspirability and perspirability of all parts of the body, according to the theorem of Hippocrates, —with them, as denying first principles, I hold no disputation. Their minds, sunk in unwisdom, are entirely confined to their



eyes, and all causes with them are confused in effects : nay, the microscope is often more penetrating and acute than their rational sight. Leeuwenhoek ingeniously concludes from his microscopical observations, “that even the tender coats of the smallest of those vessels which contain the aforesaid most minute globular fluid bodies, are also full of yet far more minute vessels, than they themselves are.” (*Ibid.*, n. 71, 84.)

166. This fluid, pure beyond all imagination, is not to be conceived as generated from the essential juices of vegetables ; for animal chemistry is immensely more perfect than vegetable. Nor yet from the inert corpuscles of the earth, which are material, and endowed with no figure or power for perpetuating motion. Nor from the elements of the flesh of those animals that we eat ; for whence have these animals their similar fluid, except from some one source common to every animal that lives ? Therefore we must look higher for its origin ; and we can look no higher within nature, than the first aura of the world, which has no inertia, no materiality, so far as materiality involves inertness and gravity ; in a word, partakes of no such essence, attribute, accident and quality as distinctively belongs to the corpuscles of the earth ; for it is the force in form of nature in her most perfect sphere. (Part I., n. 638.) If this fluid be determined by this substance alone, and turn out to be the most perfect force of animal nature, we can then understand how its essence must be elevated above the essences of the visible and ultimate world, and must be abstracted from their properties. Respecting the rules for this elevation and abstraction, see Part I., n. 648—651.

167. But the wonderful art of nature whereby this fluid is elaborated in the factories of the cortical substances, can never be followed by the mind, unless it be previously instructed in the doctrine of series and degrees, and in the philosophy of universals. (See Part I., Chap. VIII.) For this science goes far beyond effects into causes, nay, even into principles of causes ; wherefore the conception and formation of this fluid are said to be eminent or transcendental. This much, however, we may see as from afar or in shadow, that the proximate cause of its conception is the soul’s representation of her universe, which to be understood must be compared analogically with an

idea which embraces at one glance the state of its kingdom, which alone is sufficient to cause the first aura of the world to be determined into such spirituous fluid most fitly corresponding to its kingdom. For this aura, formed to the forces of nature in her most perfect sphere, involves all possibility of applying itself to every inconceivable minutia of variety, consequently of concurring with every assignable determination (Part I., n. 604, 635). How much does an idea alone effect in the lower organism of the pregnant female? (Part I., n. 267). How much more in the highest sphere, or in the principles of causes? And how much more in the little factories of the cortical substance, which are at once the organs of internal sensation corresponding to the organs of external sensation (Part II., n. 191), and corcula or little hearts, of which a type is presented in the grand heart of the body, which also is a chemical organ preparing liquids for composition into blood? (Part I., n. 453—457). But I am forbidden to venture further, lest I should say what is little understood; for having no words to express my meaning, I should of course be obliged to betake myself to analogues and eminences, by abstraction from the things brought out by sense, a case in which even truths savor of hypothesis.

168. *We may thus understand the course of the circulation of the animal spirits; namely, that it is from the cortex into the universal fibres, from the fibres into the blood, from the blood into the brain, and so back into the cortex.* I do not think there is any more excellent or noble science in the universal animal kingdom than the science of the circulation of the spirituous fluid; for this fluid glances through every point, and continues, irrigates, nourishes, renovates, forms, actuates and vivifies everything whatever in its limited universe. In time and universality, and consequently in excellence, it far precedes the circulation of the red blood, (which circulation is a comparatively late discovery); for it is the cause not only of this circulation, but also of the circuits of all the other humors in the body. And this we know from the fact, that this spirituous fluid with its fibre is all in all in the whole and in every part, and is the single fluid in which life proximately resides, while in the red blood, and in the essences derived from it, life resides more re-

motely. On this account the circulation of this fluid deserves to be called the *CIRCLE OF LIFE* (Part I., n. 38, 39).

169. In order that this circulation may begin under the auspices of the brain, it is necessary that every spherule of its cortex should animate. To suppose the circulation of this fluid without a motive force, and a real expansion and constriction as a moving cause, would be the same as to imagine the circulation of the red blood through the arteries and veins without the heart. Thus unless little hearts were prefixed to all the fibres, nothing would flow in of its own accord from the little arteries, and nothing of its own accord would flow down into the fibres. Therefore the animation of the brain is the primary origin of this circulation.

170. This then is a circulation from the brains, through the fibres, into the blood, and from the blood back to the brains, and so on: so that all that is truly sanguineous, distinctly passes again into the fibres; thus this fluid does not return through any venous fibres; and in fact experience knows of none such. That the spirituous fluid passes from the brain, through the sinuses at its base, into the jugular veins; and from the fibres generally into the vessels of the body, and thence into the blood, see Part I., n. 37, 40, 41, 91, 97, 100, 150, 152, 153, 177, 370, 503, 556, 634, and the subject will be continued in our succeeding Parts. The above takes place in order that this red humor may acquire the nature of its parent, and be the soul's vicegerent in the ultimates of its kingdom. Thus and no otherwise can the fortunes and condition of animal life depend upon the nature, constitution, determination, continuity and quantity of the blood. This circle therefore is drawn from an origin mostly voluntary into the natural [origin] of the heart, and from this again into the voluntary [origin] of the brain; the first and last term of it being, therefore, voluntary, but the intermediate term, natural.

171. The fact that this circulation proceeds from the voluntary, and ends in the natural, and again returns to the voluntary, seems to be the ground on which the public and private affairs of the economic kingdom are duly administered according to nature's laws; for were this fluid totally or perpetually

subject to the decisions and desires of the cerebrum, the safety both of the whole and of the parts would be endangered ; for the will could govern the vessel of the state with no better skill than accorded with the science possessed by the cerebrum ; the will and this science always proceeding *pari passu* ; consequently would run it a thousand times an hour among quicksands and dangerous shoals ; wherefore this circulation is exempted from the will of the brain as well as from its science, as soon as ever it enters the body, or the natural circulation of the blood. And thus we clearly see what is the influx and what the connection of the voluntary motions with the natural in the body ; and *vice versâ*.

172. *We may also understand the moments of this circulation ; namely, that they are synchronous with those of the respiration of the lungs, which wonderfully concur in promoting and transfusing this truly animal juice through the nerves.* Marvels indeed occur, —I wonder they have been unobserved,—in the field of the nerves. Thus as soon as the latter have emerged from their natal soils, or from the brains and their two medullæ, they pass through the body in the manner most perfectly adapted to the expansion and contraction of the lungs, so that at the very moment they are inspired by the brains, they are also dilated by the lungs : and so the injected fluid is carried on from principles to ends by a wonderful coöperation, and in a rapid stream, or as I intimated above (Part II., n. 8), is carried on by a common aid and natural vehicle through all the pipes and fibres ; for it is the nature of the fibres as well as of the arteries to be at once dilated and extended every time they are permeated by their fluids.

173. We shall have ocular demonstration of the truth of this if we trace the nerves, (particularly those grand and most general nerves, the intercostal and the par vagum, as also the others, as the brachial, dorsal, and ischiadic,) throughout their mazy wanderings in the region of the body. For each of them adapts itself either to the trachea, or to the bronchia, or to the mediastinum, or to the pleura, or to the sternum, or to the vertebræ, or to the ribs, or to other parts which are called into play by the tumefaction of the lungs ; and this, so nicely, that

the nerve is carried by means of each lung into a state of expansion similar to that which the nature of each fibre demands.

174. And this is the reason why the beginnings of the nerves run through notches, one of which is cut in the body of an upper vertebra, and the other in that of the vertebra next below it, and which notches are fitted together to form the foramen of egress (Part II., n. 33). Also why the little ganglia into which they run, are situated immediately outside the notches, close to the vertebræ. Why the larger ganglia of the intercostal nerve are also partly affixed behind the same notches, and at the same time beside the larynx, the windpipe, and the ribs. Why the par vagum and the said intercostal are transmitted through the fleshy part of the diaphragm, which Morgagni mentions as a remarkable circumstance (*Advers. Anat. v., Anim. 12*). Why the concave lobes of the lungs lie upon the diaphragm, and why the diaphragm is continued and united to the ribs and pleura, the pleura to the mediastinum, and the mediastinum to the pericardium. Why the gratework of the ribs and of the vertebræ, with the sternum, the scapulæ, and the mammæ, is slightly elevated when it is expanded by the inspiration of the lungs, particularly when the natural mode prevails, as during sleep, at which time the necessity of renovating the state requires that the transflux of the fluid through the nerves should not be interrupted by any voluntary determination of the cerebrum.

175. Thus not only the nerves that must concur alternately with the pulmonary motion, but also the others that are transferred out of this motion into another, as into that of the heart, stomach, intestines, bladder, liver, or genital members, are so immediately brought and applied to these motions, that by their mediation they glide into similar reciprocations of expansion, as we have already observed of the cardiac nerves (Part I., n. 541), and also of the great cardiac plexus. Thus I think we have the reason why when the chick or embryo is excluded, the animation of the brains conjoins itself with the respiration of the lungs, and leaves the society of the heart. (See Part II., Chap. I.; and Part I., n. 280, *seqq.*)

176. *Since this cortical substance resides in the principle of the actions of its body, and from above contemplates the rest of the*

*system as below it, it is necessary that all things in the system should correspond to it, exactly as effects correspond to their causes. Wherefore it is right to attribute to it, by eminence, everything that performs any kind of function in this whole kingdom. Thus each part of this substance may be called by eminence a muscle.* In order that we may know whether the several cortical substances may fairly be said to be muscular in texture, and in denomination, we must first enquire of what a muscle is constructed, and hence by what determined, and what a muscle is. The answers to these questions are the premises from which the required conclusion will follow.

177. Of what is a muscle constructed, or by what determined?—Observe that by the word *determine* we here mean to construct and to endow with a form. A muscle is constructed of motive fibres; and these motive fibres of theirs; and lastly, of the simplest fibres, which by their mutual connection actually frame the muscle.

178. But inasmuch as a muscle is constructed of motive fibres, so there must necessarily be constructing or determinant fibres, by means of which every fibre of the muscle may become motive according to the mode of the action required. The determinant fibres are, 1. The simplest nervous fibre, which contains the spirituous fluid. 2. The nervous fibre composed of simplest fibres, and hence itself less simple, and containing the purer blood. 3. The artery, which is the fibre of the third degree, or the doubly compound fibre, which contains the red blood. These fibres, like the fluids that run through them, succeed each other in order, and are the determinant or constructive fibres of the motive or muscular fibres (Part I., n. 594—601, 649).

179. From these premises it follows, that the motive fibre of the first degree or order is what is determined by the simplest fibre, which contains the spirituous fluid. That the motive fibre of the second degree, or the white motive fibre, is what is determined by the less simple fibre, and contains the purer blood. And the motive fibre of the third order, or the fleshy motive fibre, is what is constructed of the vessels that contain the red blood. But how each of these is constructed or determined, is not the subject of our present enquiry.

180. Then what is a muscle?—A muscle is a compages of coördinated and subordinated motive fibres. A fleshy muscle consists of a triple order of fibres. A white muscle, as seen here and there in large animals, and throughout in minute animals or insects, consists of a double order: and a simple muscle consists only of the simplest determinant fibres that contain the spirituous fluid. Thus although it be not a sanguinous or fleshy muscle, still it does not cease to be a muscular fibre. For every fibre is determined according to the force that it is to exercise upon the subjacent and circumjacent parts. Hence the fleshy motive fibre is to exercise its force upon weights which the white motive fibre cannot lift; the white motive fibre upon lesser weights which the simple motive fibre cannot lift: each being in correspondence to its peculiar measure [of weight].

181. The question is then, whether each cortical substance should not be called a muscle by eminence, for it is constructed of the purest fibres, which contain the spirituous fluid, and which are so many least and most simple determinants. “These exquisitely fine vessels,” says Lceuwenhoek, “also displayed a red color where they were laid one upon another in layers three or four deep, without any other matter interposed between them.” (Part II., n. 71). And we have often shewn above, that the cortical spherule is clothed with an infinity of little stamina, which contain the spirituous fluid or the blood *par excellence*; consequently that it is a muscle more excellent and perfect than any other, or a muscle by eminence.

182. Nothing throws more light upon this subject, than the primitive structure of the heart, which is in all respects a muscle, and beginning from the simplest muscular texture, is carried through successive stages until it becomes a full and perfect muscle of the last order. “*After 34 hours* [of incubation],” says Lancisi, “I saw the præcordia [of the chick] still more clearly, consisting not only of the foregoing semilunar vessel, but also of certain fibres, which began to be loosely collected around it.” (Part I., n. 245, Vol. I., p. 217.) And Malpighi says: “I think. . . that these [the cardiac] vesicles, . . . constitute a true heart, surrounded as they are . . . with muscular fleshy portions that have not yet taken on opacity or redness. . . . It may seem



probable that the heart is formed out of a curved and expanded vessel, to which fleshy portions, as it were hands, are fitted externally; yet nevertheless, since at that time all the parts are so mucous, white and pellucid, that use what glasses we may we cannot see clearly into their structure; and since, as may be remarked in insects, the structures of the most advanced periods of existence have their rudiments in the primordial state; so I still find ground to doubt respecting [the priority of the blood to] the heart. . . . Hence inasmuch as successive changes in the sanguineous matter are evidenced by the addition of color to the blood, so it may reasonably be doubted whether, in like manner, the existence of the heart is not rendered evident by motion alone, and whether the heart, although quiescent, nevertheless may not have preëxisted, but in a motionless state, in consequence of its fleshy fibres not being yet formed. But it seems clear that the ichor, or matter above alluded to, which afterwards becomes red, exists antecedently to the motion of the heart; but that the heart, as well as its motion, are antecedent to the rubefaction of the blood." (Part I., n. 242, Vol. I., p. 205, 206.) Thus it is plain from ocular demonstration, that the heart, when urged into its little systoles and diastoles in its primordial stages, cannot have been destitute of muscular fibres, although of fleshy or sanguineous muscular fibres, just as this cortical spherule, which is analogous in character to the primitive coraculum. (Part II., n. 132—139.)

183. *Also by eminence a gland*: as most of the learned have admitted, after Hippocrates and Malpighi. "We therefore assert with Hippocrates," says Vicussens, "that the brain, in part at least, is glandular; . . . 'the head,' says he, 'also has its glands, namely, the brain, which is similar to a gland,'" &c. (Part II., n. 83.) See also Malpighi and the rest of our authors. Ruysch was the first to secede from this opinion, and his followers, supported by his authority, chose to call the cortical substance vascular. With a view to settle the dispute, Boerhaave makes the following able remarks on the cortex of brain: "This opinion of Malpighi is favored by the eye, and the microscope; by the fact that boiling divides the brain into molecules similar to glands; by the experiment of pouring ink upon the cortex, and then wiping it away, when the outlines of

the projecting molecules are defined, and the fissures dividing them become visible; by the case in which the cerebrum was changed into a stony concretion similar in appearance to a mulberry; by the degeneration of the contused brain into a kind of glandular fungus, sprouting up through the hole or fracture of the cranium; and by the change of the parts constituting the exterior of the brain, into manifest spherules or hydatids, in consequence of dropsical disorder. For these circumstances prove that there is the same mechanism here as in the other glands, although of a more subtle and delicate character." (Part II., n. 93).

184. But in order that we may know whether this substance in each individual part be indeed a gland, we must institute the same kind of enquiry as we did before respecting the muscles. We must ask what a gland is, and of what it is constructed, or by what determined.

185. What is a gland? A gland is a corpuscule that secretes essences from the blood; mingles or separates them when thus secreted; and transmits or sends them out for use when thus mingled or separated, or else excretes them outwards. This definition squares with every one of the glands, because it is collected from them all.

186. These characteristic operations of the glands are all performed in the cortex. For, 1. It secretes the purer essences from the blood, nay, extracts the purer blood and the purest blood from the grosser (Part II., n. 124—127); as well as all the other elements whatever that the blood-globule has in its innermost compages. (*Ibid.*, n. 128, *seqq.*) 2. It mingles the secretions, for it pours on a new fluid conceived in its little wombs and laboratories. (*Ibid.*, n. 165, *seqq.*) 3. And separates them for use, so that nothing lies in the genuine globule that it does not distinctly eliminate therefrom. (*Ibid.*, n. 128, *seqq.*) 4. And transmits them through the fibres, and around the fibres, and their fascicles, in the same place. 5. And sends them forth for use, into the blood, so that the latter may draw life from them. (*Ibid.*, n. 170, 189). 6. Or excretes them outwards; for instance, the grosser elements that entered the compages of the globule for the purpose of giving it combination, and which require so often to be renewed by the food, the inspi-

rations, and the other means of nutrition. (See Part I.) Therefore the cortical substance is the eminent gland, and the undoubted chief of all the glands, for it supplies the blood with its essences, from which the other glands educe theirs.

187. Of what is a gland constructed, or by what determined? Just in the same manner as a muscle,—of a triple order of fibres, which are its determinants; that is to say, of the simple fibre, which contains the spirituous fluid; of the compound or less simple fibre, which contains the purer blood; and of the vessels, and principally the arterial vessels, which contain the red blood. By these determinants it is built into such a form as to afford the use which I lately described. But the way in which it is constructed, is not a subject for present explanation. For the construction is everywhere various throughout the animal microcosm, because the use is everywhere various. Therefore the glands, like the muscular fibres, may in a certain sense be called subdeterminant or mediating; for there are primary glands, which are determined by the muscular fibre, to take up, discriminate, dispense, and distribute aliments to the blood and the viscus, and to make them exist perpetually as good as they existed at first; hence they enter the animal economy as inferior subdeterminants. (Part I., n. 593.)

188. All these conditions are combined in every spherule of the cortical substance, which indeed has such a form from the simplest fibres as to exhibit the most excellent use in the animal economy. For it does not cease to be a gland because it is vascular; for there are as many fibres which determine it or construct its form, as there are vessels.

189. This appears the more evidently from the fact, that these cortical glands are more perfectly conglomerated than the glands in any glandular viscus of the body, into one large gland, which is the brain; in which, as in a type, we see all the wonders of the glands; for instance, that its cavities are ventricles, in which crowds of fibres terminate, and through which blood-vessels run in the form of a choroid plexus, to pour a juice on the highly fluid spirit; that there are passages from cavity to cavity; and from the isolated middle cavity, through the infundibulum, to the pituitary gland, thence into the sinuses of the base of the cranium, and from these into the jugular veins: so

as to allow this vital essence to copulate largely with the new chyle, or with the refined lymph carried up through the thoracic duct. To say nothing of the rest of the exquisite chemical apparatus of the brain, which I shall open in the next Parts of the Work. So that the brain, as Hippocrates says, is a gland, and in the intricate and most distinct conglomeration of its simples and primitives, it is the model and effigy of all compositions and derivations, and especially of all the glands. See Part I., n. 164.

190. Hence the cortical substance is not only a gland by eminence, and a muscle and a heart, but we may also justly attribute to it every denomination of substance that performs any kind of general office in the whole of its kingdom. Thus it may be called a *lung* by eminence, coinciding by its rising and falling with the respiration of the lungs: also a *womb* or *matrix*, because in an eminent manner it conceives and excludes the only living fluid: also a *stomach*, because it is by reason of it especially, in order that the fibres may be nourished, that we hunger and thirst; &c. Hence *by eminence a microcosm, when the entire body is regarded as a macrocosm*. For it contains in a manner the universals of its body, which, according to the rules of rational philosophy, enter in successive order into all specifics and particulars whatever, that is, into all lower things.

191. *The parts of this substance deserve for the same reason to be regarded as the organs of the interior senses, and as cerebellula; for by means of the medullary substance and the blood, they receive the modes and touches coming from the external organs, and refer them to the soul as judge*. It is sufficiently certain that external sensations reach no goal beyond the cortical spherules, since these are the beginnings of the nervous and medullary fibres, beyond which if sensations proceeded, as for instance into the little arteries, or the meninges, they would transgress their prescribed limits, and fall from the centres into comparatively remote circumferences. Therefore it is the cortical substance collectively that constitutes the internal organism, corresponding to the external organism of the five senses.

192. We have ocular demonstration in the anatomy of the brain, that the visual rays flow, by means of the optic nerve, into the thalami nervorum opticeorum, and are thence diffused

in all directions over the cortex, and this, by fibres collected from the whole brain, and transmitted through the base of the fornix, and spread upon the above thalami. Also that the subtle touches of the olfactory membrane lining the labyrinthine cavities of the nares, and the consequent subtle tremulations or modifications that mount through the cribriform lamina and the mammillary processes, to the corpora striata, or to the medulla of the whole centrum ovale, do not terminate until they arrive in the periphery of the fibres, or in the cortical circumference. Again, that the modulations of air, striking upon the delicate fenestræ, sonorous membranes, and scattered circumjacent fibrils of the whole vestibule and labyrinth of the internal ear, allow themselves to be carried by the soft nerves of the seventh and fifth pairs, to the medulla oblongata, and thence towards the supreme cortex, where the contremulation of both the membranes meets it from without. Further, that the tremors excited by the touch of angular bodies in the papillary flesh of the tongue, spread themselves with the sense of taste in a similar manner by their nerves, towards the very same collective sensorium or cortical substance. And that every ruder touch whatever springs up from the surface of the whole, through the medium of the nerves, into the medulla spinalis or medulla oblongata, and so into the highly active cineritious substance, and the circumambient cortex of the brain; so that the last receiving rooms of all modes are in the cortex of the brain, which is rendered conscious of all the changes that can possibly happen in compound series and substances. (Part I., n. 609; and also *Ibid.*, n. 216, 217, 234, 268, 287, 505, 557, 574—576, 641—647.)

193. These effects could never be produced, 1. Unless the extremities of the nervous fibrils were exactly arranged into such a form as distinctly to receive every little mode of their degree with its differences. 2. Unless in every quarter there were a mutual connection and perpetual communication of the cortical substance with the medullary, as regards the fibrils and bundles of fibrils within the vertebral sheath and the cranium. 3. Unless there were fluids in the fibres modifiable like auras, and these, distinct from each other in the general sensorium (Part I., n. 602). 4. Unless the parts of the cortical substance were divided from each other, and into the same degrees and

series, as the causes of the modifications, or unless the series of cortical substances were as the series of sensations. 5. Unless there were a most perfect harmonic variety in the spherules of the cortex, so that none of them should be perfectly alike except in essentials and attributes (Part I., n. 603—605, 607). 6. And finally, unless each cortical spherule were made up of the simplest fibres, which contain the spirituous fluid, in which the life and consequently the soul resides, and without which modification could never become sensation.

Therefore no individual part of the cerebrum corresponds to any sensorial organ of the body; but the cortical substance in general corresponds, receiving the modifications of every degree according to the series in which it is disposed, and referring them conformably to the soul as the judge, which perceives, understands, and knows every mutation that arises from touch of every genus, species and degree, and invades the system and its connections, and all its parts and compounds; and appreciates every harmonic and accordant change with pleasure, every unaccordant change, disagreeably or painfully; and this, if one mode or touch involves many and innumerable simultaneously or successively.

194. These observations are confirmed by the phenomena presented in cases of apoplexy, epilepsy, catalepsy, mania, melancholy, catarrh; in headache, hemicrania, vertigo, dimness of sight, atrophy, fainting, swoon, syncope, asphyxia; in nightmare, ecstasy, dreams; and indeed also in embryos, young infants, and the young of animals, where the cortical substances of the cerebrum, and the cineritious substances of the corpora striata, are not entirely formed, but are growing up by education at once to their solidity or consistency, and to their degrees and series.

195. Therefore the cortical substances are so many cerebellula, which as least types represent the greatest, that is to say, the brain itself. For every one of them is such a sensorium in particular, as the cerebrum is in general. And the cortical spherule approaches very nearly to the oval form, or to that of the brain; and perhaps is surrounded by a superlatively pia mater, through which and under which the minutest vessels run. Every such cerebellulum puts forth a fibre circumgyrated

by almost invisible canals, just as the convoluted cerebrum puts forth a collected maniple through the medulla oblongata into the medulla spinalis. In a word, the cerebrum is a concrete of as many similar forms and natures, as there are discrete cortical parts.

196. *These truly organic parts may undergo various changes of state, according to contingencies existing either in externals and in the blood, or else in internals; thus they may become warm, hot, expanded, indurated, disturbed, chilled, constricted, flaccid, darkened, or softened, or assume other changes; just in the same manner as the auras of the world, with the changes of state in which, these mutations of the cortical substances may most fitly be compared.* Whether we speak of the external organs or the internal, they are exactly conformed in their state to the modifications of the auras of their degree; as the ear, to the modulation of the air; and the eye, to the modification of the ether; of the truth of which, acoustics and optics have abundantly informed the learned at the present day. For the more perfectly artificial organs or instruments are framed on the model of the natural art of the animal body, the more exquisitely are phenomena apprehended by their means. If the external organs are evidently adapted to the nature of the auras, how can we deny the same of the internal organs, to which no aura can penetrate, except one of a higher and more eminent power? Deny it however we may, if we think it of no consequence to deprive effects of their causes, and causes of their principles; but whether this be rational, or even natural, let any one consult the analytic powers of his mind, and judge for himself.

197. Nothing in the animal body can maintain its connections, support its form, or allow of motion, without the ministration of some aura. This is more clearly seen in the most imperfect animals, or in insects, than in the more perfect animals, since the lower and grosser auras perform the same offices for them, as the higher and purer perform for the more perfect animals. On this point Swammerdam has brought to light some remarkable circumstances, of which I will select only the following by way of illustrating this truly noble subject. In speaking of the hemerobios or ephemerus, and its aëriferous pipes or canals, he says that they “are distributed through the



whole body, in order to convey the air which they carry as well to the internal as to the external parts of the insect; . . . in the head, for instance, towards the nerves and brain; in the thorax, to the muscles of the feet and wings; in the abdomen, to the obliquely ascending and straight muscles; also to the spinal marrow; to the lactes or seminal vesicles of the male; to the hairy branchiæ or gills; to the stomach, the intestines, the skin, and the coat of the wings; to the ovary and the coat covering the ovary; to the eggs themselves; and even to the heart." (*Biblia Naturæ*, p. 250, 251.) And again he says: "The change or casting of the skin of these pipes in the silk-worm is so remarkable, that it amazes the understanding, for in the very short space of time wherein that creature casts its skin, some hundreds of pulmonary pipes in the inside of its body cast also their tender little skins, which are entirely composed of . . . twisted rings." (*Ibid.*, p. 250.)\* And the same is the case in other insects, according to Swammerdam's description.

198. The correspondence of the natural motions of the air with those of the red blood, which in the more perfect animals appears to have taken the place which the air occupies in the more imperfect, is illustrated by the single experiment of Leeuwenhoek: "When he examined blood possessing much crystalline liquor, and placed in one of his tubes, and carried it into the open air at a time when there was a pretty strong wind, he observed that the globules were agitated, like the air itself, by concussions and mutual motions; and he observed moreover another kind of motion, in that each globule gyrated round its own axis." (Part I., n. 29.) Shewing that the red blood is in a manner constructed on the model of the modifications of the air: which being the case, why should not the purer blood and the purest be constructed on the model of their aura, by means of which the animal microcosm is connected with its macrocosm or world. Truly those who attempt to scrutinize the interiors of animal nature without having first scrutinized the auras of the world, must vainly seek for the causes of things in the causates.

199. But by the mediation of the auras we are only moved,

\* See the *Animal Kingdom*, n. 391.—(Tr.)

but do not live. The principle of life must be sought for in a higher sphere than the auras. Even the most eminent aura does not live, but is the instrumental and auxiliary cause, which enables us while we live to be modified and moved distinctly. Thus and not otherwise could the will, which is the attribute of life, pass into any effect. The heavens [or the auras of the world], as Aristotle, guided by the instinct of a sound reason, observes, are indeed animated, but have only an assistant soul without intellect. (Part I., n. 635.) Wherefore we are endowed with a spirituous fluid or most pure blood, which although formed with reference to the whole amazing faculty of the first aura of the world (Part I., n. 65—68, 584, 604, 635), still could not possibly live as the soul of its kingdom, unless life were in it from the highest of origins.

200. Since therefore we possess fluids, and by virtue of these fluids, organized parts, which conspire with the auras of the world, hence we cannot but be affected in unison in a wonderful manner according to these auras, and their states: like them, for instance, we cannot but grow warm, be expanded, hardened, perturbed, grow cold, &c. Now all these general characteristics belong to the auras, but as soon as they flow from their world into the little animal world, in which the vital fluid dwells, they are instantly denominated according to the principal essence of the microcosm, which essence consists in living. Thus in the way of comparison [with the states of the auras] we are said to be indignant, to be angry, to be proud, to be in consternation, to fear, to rejoice, to be sad, &c. For the terms by which the auras and the vital fluid are expressed, coincide in this, that the affection in both cases is similar, but in the animal microcosm it is denominated, because qualified, according to the principal cause and essence that dwells in the fluid, although this essence is derived from a higher origin. And so as soon as ever the modifications of the auras enter the sphere of the living fluids, they justly assume the character of sensations; and the corresponding fluxions of the same auras are at once born into animations; and effort is born into will, and motions into actions. Which is the reason why we so often use improper terms, that are better suited to the characteristics of the auras, in describ-

ing the corresponding affections of animals ; as we know is commonly the case.

201. And for this cause it is, that we are often so marvelously affected by the temperament, vicissitudes, and states of the auras ; as proved by all sorts of diseases, and indeed by animal physiology. Also that the more imperfect living creatures derive their nature from that of the auras, and lead lives under the government of the world, and of the instincts thence arising. For the principles of the nerves, or the cortical substances, borrow the causes of many of their changes from the auras ; as Hippocrates and Galen, besides many of the great lights of the empiric art, have not obscurely intimated. “ So exquisite is the structure of the cortical glands,” says Malpighi, “ that when the atmosphere is ever so slightly vitiated or altered (as Hippocrates intimates in his book, *De Morbis Sacris*,) the brain is the first part to sympathize, and to undergo a change of state.” (Part II., n. 81.)

202. *And whatever state or animus is assumed by them, the like is at once diffused into the continuous fibres, consequently into the whole system, woven as it is of fibres and blood-vessels.* For the animal organism is so wonderfully framed, that every affection of principles passes by continuous derivation into the subject principiates ; for the fibre is the appendix and production of its spherule, which spherule occupies the place of a principle, and with its fluid is the all in all in the whole and in every part of the system, as this fluid itself is, in the blood and in all the derived liquids that aspire to life. Other things are only accessories, necessarily borrowed from the inanimate kingdoms of the world, for the purposes of composition. And the fibre draws to every point of itself, thus derived and continued, and from the very origin or cortical spherule, the disposition of its parent ; so that everywhere it has in it, as it were, a new principle of modifications towards the fibres lower than itself, and thus whether it be affected in the highest parts, or at a given point below, a corresponding affection flows therefrom to the parts subjacent, as we have frequently pointed out in Part I. of the present Work.

203. But human brains are gifted with a power of at once

restraining the efficient causes of mutations, whenever the latter invade them, and of stopping their further progress; and so moderating them as to prevent them from pouring in too largely, deeply, or strongly; and afterwards of reining and curbing them, and preventing them from passing violently from will into effects. Respecting this power, and the wonderful expedients employed in procuring it, we refer the reader to the Parts on the Brain.

204. *But still, although this cortical substance be the principal agent in its animal kingdom, yet it is not the prime determinant; for it is itself determined by, and built and woven of, the purest fibres; being thus the first determination of the spirituous fluid, by means of which determination the soul, as the universal force and substance, is able to flow into the actions of its body.* We have already often pointed to this conclusion. Thus we have shewn that every part of the cortical substance is constructed for the most perfect force, and into the most perfect form, of nature, of the last ends of the vessels and of the first ends of the fibres, by an amazing process of connection, mutual superposition, and distinct complication. Therefore not the cortical substance, but the fluid in the cortical substances, is the first determinant, and which carried to the highest power in the animal, contains all things in itself that ever come to the rational sight, and from it to the ocular sight, and to the senses of the body. Hence the nature of this fluid must be explored if we wish to explore the nature of anything else in the living body. For as the whole corporeal system is to its brain as the brain is to each particular cortical substance, so is the cortical substance to every part of this fluid, which therefore holds the highest place, from which as from a mirror on a tower, like a soul, it contemplates all other things as its inferiors in order. Because this fluid is the first, simplest and only substance that reigns in all the body, from which and according to the nature of which flow all things that are visible in that entire determined series. Consequently the spirituous fluid is the highest, inmost, remotest, most universal and most perfect substance in the animal kingdom. (Part I., n, 594—596, 613—617.)

205. That the soul is the universal force and substance, diffused, that is to say, through the whole of its corporeal system,

everywhere most present, the all in every part, the only substance that lives, and the first in its series, see Part I., Chapter III.; and I shall also proceed to demonstrate it in the next Chapter. The universal substance is the purest blood, or the spirituous fluid, but the common or general substance is the red blood. The universal and the common are very different from each other. The *universal* is what reigns everywhere in the entire series, into whatever number of degrees the series be distinguished, and likewise in the general itself. But the *general* embraces, or contains in itself, successively or simultaneously the whole series with its degrees. But let us illustrate this matter by examples.\*

The spirituous fluid is the universal substance reigning in every living system, and even in the red blood. The medullary or simplest nervous fibre in which the said fluid dwells, is the universal vessel both in the nerves and in the blood-vessels, and consequently in the whole body. The motive fibre of the first degree, or the purest motive fibres, composed of the above nervous fibrils, is the universal motive fibre, or the all in every part and in the whole of the muscle. The pia mater is more universal than the dura mater, and there is another mater more universal than the pia mater [namely, the piissima mater]; wherefore the pia mater is twofold. And so in other structures. For the universal enters into and determines lower things, to which it gives their esse and posse; from which the series principally derives its essence and nature, and by which it is distinguished from other series.

But the red blood is the common or general fluid of the animate body, for it contains in it the purer blood, and this the purest. The artery and vein, which convey the red blood, are the common vessels of the animate body. The carneo-motive fibre composed of the vessels of this blood, is the common fibre in the muscle; because it embraces and contains in it the motive fibres of a lower order. The dura mater is the common tunic of the brain, but not the universal; as the external tunic of the body is the common tunic, since it includes all the essential and

\* On the subject of the terms *universal* and *general*, the reader will find much important information in the *Animal Kingdom*, n. 312—324, and the notes.—(Tr.)

integral series, or all the viscera of its body. The same observation applies to all other things; as for instance, to the auras of the world, and to the mineral and vegetable kingdoms of the earth.

If there be a series of three degrees, the general or common of this series is what involves them all; if a series be constituted of two degrees, what in this series is called the inferior universal, is also the general or common. But if a series be simple, or only consists of one degree, in this case the general coincides with the universal. This is the reason why we promiscuously confound the general with the universal, for we rarely if ever entertain a distinct idea of degrees: although the human rational mind,—mistress of philosophy,—is perfectly acquainted with both their essences, and when left to herself and to her own powers, we being unconscious the while, in ordinary speech and expression, she very rarely substitutes the one for the other. Therefore in every series of things subordinated, in which there are three degrees, there is an inferior universal intermediate between the superior universal and the general, and so on. Hence the spirituous fluid is the universal force or substance, or the soul of its body; but the red blood is the common substance, or the corporeal soul.

206. But it is in vain to attempt to search out the stupendous and to our minds almost inaccessible properties of the parts of this fluid, unless we instruct ourselves in the doctrine of series and degrees, and perfect it by means of the mathematical philosophy of universals, by its mute terms and technic signs infinitely more loquacious than rational philosophy by its ideal prattling and indeterminate forms. (Part I., Chapter VIII.) For when proceeding from effects we ascend to causes, and to causes of causes, we come into the sphere of universals, and can hardly recognize how they enter effects; for they seem in these as it were to pass into properties, which have to be resolved by abstraction into unknown properties, higher and more universal, such as the mind, unless left to itself, that is to say, unless free from the continual and gross trickery which the inferior senses practise here, can scarcely acknowledge to be involved.

207. We have advanced so far that at the present day we

have skill enough to exalt the sensations of the ear and eye far above themselves, or above their natural acumen, by artificial organs or instruments: it now remains for us correspondingly to exalt the mind, or the rational hearing and sight. But the only way to accomplish this, is by the philosophy we have pointed out. This philosophy, however, must be deduced from a perpetual intuition of causes in causes and effects; a work truly requiring an immense exercise of the rational faculty, and a profound abstraction from those things that, as superinduced, affect the lower faculties. Indeed I do not recommend, when it is commenced, that anything should be finally committed to it until it be in fact matured. For unripe investigations, which have not been brought to an end, and evidently involve consequents and conclusions in antecedents, cannot fail to attach themselves to the grosser notions of things perceived by sense, and which, as being proper to generals or compounds, require to be abstracted; the want of which has given birth to error, confusion, verbal disputes, and the wranglings and dust of the schools on all high subjects.



## CHAPTER III.

### THE HUMAN SOUL.

208. IN Part I. I endeavored, by way of introduction to a knowledge of the soul, to expound a doctrine which I have called the Doctrine of Series and Degrees. This I did, inasmuch as for a long time I had been led to consider, and with many to doubt, whether the Human Soul was accessible to any reach of mind, that is to say, whether it was capable of being thoroughly investigated; for certain it is that the soul is far removed from the external senses, and lies in the depths of knowledge; being the highest and last in order of those things that successively reveal themselves to our enquiries. On a slight consideration of the subject, I could not but think with mankind in general, that all our knowledge of it was to be attempted either by a bare reasoning philosophy, or more immediately by the anatomy of the human body. But upon making the attempt, I found myself as far from my object as ever; for no sooner did I seem to have mastered the subject, than I found it again eluding my grasp, though it never absolutely disappeared from my view. Thus my hopes were not destroyed, but deferred; and I frequently reproached myself with stupidity in being ignorant of that which was yet everywhere most really present to me; since by reason of the soul it is that we hear, see, feel, perceive, remember, imagine, think, desire, will; or that we are, move, and live. The soul it is because of which, by which, and out of which, the visible corporeal kingdom principally exists; to the soul it is that we are to ascribe whatever excites our admiration and astonishment in the anatomy of the body; the body

being constructed according to the image of the soul's nature, or according to the form of its operations. Thus did I seem to see, and yet not to see, the very object, with the desire of knowing which I was never at rest. But at length I awoke as from a deep sleep, when I discovered, that nothing is farther removed from the human understanding than what at the same time is really present to it; and that nothing is more present to it than what is universal, prior, and superior; since this enters into every particular, and into everything posterior and inferior. What is more omnipresent than the Deity,—in him we live, and are, and move,—and yet what is more remote from the sphere of the understanding? In vain does the mind stretch its powers to attain to any degree of knowledge of the essentials and attributes of this Supreme and Omnipotent Being, beyond what it has pleased Him to reveal in proportion to each man's individual exertions. (Part II., n. 252.)

209. There is nothing, however, more common to the human race, than the wish to mount at once from the lowest sphere to the highest. Thus every sciolist and tyro aspires from the rudiments of his science forthwith to its loftiest summit; as from the rudiments of geometry to the quadrature of the circle; from the rudiments of mechanism to perpetual motion; from the rudiments of chemistry to gold and alcahest; from the rudiments of philosophy to the *substantia prima*, or first substance of the world; and from every science to the human soul. And if we turn from the love of the sciences to the love of the world, who does not long for the highest station, and who does not strive for honor after honor, for estate upon estate, and wealth and redundance of goods? Can you point out any considerable number in civil society who place a check or limit to efforts of this kind, beyond that which they receive from actual impossibility or necessity? Be their pursuits whatever they may, are not the diffident encouraged by hopes of attaining the highest possible summit of their wishes? Thus the ambition of Adam remains deeply rooted in the nature of his posterity, and every one as a son of earth still desires to touch the heavens with his finger.

210. But the more any one is perfected in judgment, and the better he discerns the distinctions of things, the more clearly

will he perceive, that there is an order in things, that there are degrees of order, and that it is by these alone he can progress, and this, step by step, from the lowest sphere to the highest, or from the outermost to the innermost. For as often as nature ascends away from external phenomena, or betakes herself inwards, she seems to have separated from us, and to have left us altogether in the dark as to what direction she has taken ; we have need therefore of some science to serve as our guide in tracing out her steps,—to arrange all things into series,—to distinguish these series into degrees, and to contemplate the order of each thing in the order of the whole. The science which does this I call the **DOCTRINE OF SERIES AND DEGREES, OR THE DOCTRINE OF ORDER** ; a science which it was necessary to premise to enable us to follow closely in the steps of nature ; since to attempt without it to approach and visit her in her sublime abode, would be to attempt to climb heaven by the tower of Babel ; for the highest step must be approached by the intermediate. They who know nothing of this ladder of nature, when they have made their leap, and think they are standing on the summit, are little aware that they are lying flat upon the earth, and will be found at last by their friends, after they have searched the globe for them, in some obscure cavern ; for instance, in some occult position, of the nature of which they themselves, and the wisest of men, are equally ignorant.

211. The doctrine of Series and Degrees however, only teaches the distinction and relation between things superior and inferior, or prior and posterior ; it is unable to express by any adequate terms of its own, those things that transcend the sphere of familiar things. If therefore we would ascend to a higher altitude, we must use terms which are still more abstract, universal, and eminent, lest we confound with the corporeal senses things, of which we ought not only to have distinct perceptions, but which, in reality, are distinct. Hence it is necessary to have recourse to a **MATHEMATICAL PHILOSOPHY OF UNIVERSALS**, which shall be enabled not only to signify higher ideas by letters proceeding in simple order, but also to reduce them to a certain philosophical calculus, in its form and in some of its rules not unlike the analysis of infinites ; for in higher ideas, much more in the highest, things occur too ineffable to

be represented by common\* ideas. But, in truth, what an Herculean task must it be to build up a system of this kind! What a stupendous exercise of intellectual power does it require! For it demands the vigilance of the entire animal mind, and the assistance also of the superior mind or soul, to which science is proper and natural, and which represents nothing to itself by the signs used in speech, takes nothing from the common catalogue of words, but by means of the primitive and universal doctrine we have mentioned,—connotes both with itself and with the objects of nature,—abstracts out of all things their nature and essence; and prepares and evolves each in the mutest silence. To this universal science, therefore, all other sciences and arts are subject; † and it advances through their innermost mysteries as it proceeds from its own principles to causes, and from causes to effects, by its own, that is, by the natural order. This will be very manifest, if we contemplate the body of the soul, the viscera of the body, the sensory and motory organs, and the other parts which are framed for dependence upon, and connection and harmony with, each other; in fine, are fitted to the modes of universal nature; and this, so nicely, skilfully, and wonderfully, that there is nothing latent in the innermost and abstrusest principles of nature, science or art, but the soul has the knowledge and power of evoking to its aid, according as its purposes require. ‡

212. That such a science of sciences may be found, many of the learned have already suspected; nay, they have beheld it as it were afar off. (Part I., n. 651.) The illustrious Locke, in his golden *Essay concerning the Human Understanding*, near the close of the work, after his profound investigation of the powers of the mind, discovers at last, as if by divination, that there is yet another and profounder science. “Perhaps,” says he, speaking of σημειωτική, “if they [viz. ideas and words] were distinctly weighed, and duly considered, they would afford us another sort of logic and eritic, than what we have been hitherto acquainted with.” (Book iv., chap. xxi., § iv.) And

\* Or general, because an infinite number of particulars are perceived as one general.—(Tr.)

† See the *Animal Kingdom*, n. 461.—(Tr.)

‡ See *Ibid.*, n. 95, 96.—(Tr.)

in another place he observes : “The ideas that ethies are conversant about, being all real essences, and such as I imagine have a discoverable connexion and agreement one with another ; so far as we can find their habitudes and relations, so far we shall be possessed of certain, real, and general truths ; and I doubt not, but if a right method were taken, a great part of morality might be made out with that clearness, that could leave, to a considering man, no more reason to doubt, than he could have to doubt of the truth of propositions in mathematics, which have been demonstrated to him.” (Book iv., chap. xii., § viii.) That to such a science, seen so obscurely, yet so desirable, any other way can lead than the doctrine of the order, or of the series and degrees, existing in the world and nature, I cannot be induced to believe ; for all the other sciences, like derivative streams, regard this as their fountain head : and as it penetrates into abstract principles, and into a field of ideas where a faculty resides that only thinks, but has no speech, and whispers no word, but beholds the meanings of words, represents them to itself, and distributes them into a certain quantity of quantities ; so it can give in a short compass, the mode, rules, and form pertaining to a certain supreme science which by mute letters will nicely designate things that can scarcely be signified by words, without periphrasis and long and circuitous periods. This is the science which I just now called the Mathematical Doctrine of Universals. The use of either we can scarcely anticipate by bare thought ; but we shall find it out by their wonderful application to examples, for they extend to everything. If judgment consist in the faculty of distinguishing one simple and compound idea from another, lest any apparent similarity or affinity lead us to mistake between the two, then we are assuredly so far destitute of judgment, as we cannot in due order separate from things simultaneous, those things that are successively involved in them, and have successively entered into them ; or as we cannot abstract causes, and causes of causes, from the effects in which these causes appear, although they appear obscurely, and never distinctly, and scarcely at all, without our having recourse to the higher intellectual powers.

213. But even were it granted, that the Doctrine of Order and the Science of Universals were carried by the human mind

to the acme of perfection ; nevertheless it does not follow that we should, by these means alone, be brought into a knowledge of all that can be known ; for these sciences are but subsidiary, serving only, by a compendious method and mathematical certainty, to lead us, by continued abstractions and elevations of thought, from the posterior to the prior sphere ; or from the world of effects, which is the visible, to the world of causes and principles, which is the invisible. Hence, in order that these sciences may be available, we must have recourse to experiment, and to the phenomena of the senses ; without which they would remain in a state of bare theory and bare capability of aiding us. Algebraical analysis, for example, without lines, figures, and numbers, applied to the objects of natural philosophy and general economy, would be only a beautiful calculus, destitute of any practical application to the uses of life. The foregoing sciences, consequently, shew their real value only in proportion to the abundance of our experience. They imitate the very order of animal nature, which is, that the rational mind shall receive instruction successively from phenomena, through the medium of the fivefold organism of the external senses ; but when it has matured its principles, it may begin to look round and enlarge the sphere of its rational vision, so as, from a few causes slightly modified, to be enabled to extend its view to an infinity of effects. For these reasons, I am strongly persuaded, that the essence and nature of the soul, its influx into the body, and the reciprocal action of the body, can never come to demonstration, without these doctrines, combined with a knowledge of anatomy, pathology, and psychology ; nay, even of physics, and especially of the auras of the world ; and that, unless our labors take this direction, and mount from phenomena thus, we shall in every new age have to build new systems, which in their turn will tumble to the ground, without the possibility of being rebuilt.

214. This, and no other, is the reason that, with diligent study and intense application, I have investigated the anatomy of the body, and principally the human, so far as it is known from experience ; and that I have followed the anatomy of all its parts, in the same manner as I have here investigated the cortical substance. In doing this, I may perhaps have gone be-

yond the ordinary limits of enquiry, so that but few of my readers may be able distinctly to understand me. But thus far I have felt bound to venture, for I have resolved, cost what it may, to trace out the nature of the human soul. He therefore who desires the end, ought also to desire the means. I freely acknowledge, that I have made use of the labors and elaborated experience of the best enquirers; and have selected but few facts from my own experience. But I would rather learn these matters from sight than touch; for I have found that those who are furnished, nay loaded, with particular and private experience, are apt to be carried away into untoward views and perverse notions of causes, more easily than those who derive their information not from private, but from general experience,—not from their own, but from the experience of others. (Part I., n. 18.) For not only does the former class both study and favor the external senses more than the mind in the senses, and hastily judge of everything that comes before them from their own partial information; but they are smitten with the love of their own discoveries and imaginations, in which they contemplate their own image as a parent does in his offspring. Hence it is that they not unfrequently look down, with royal superciliousness, upon all who pay no homage to their favorite theories, which they themselves adore to distraction. But as Seneca observes: “He is born for a limited sphere, who thinks of the people of his own time; . . . others will come after him, who can judge without offence, and without favor.” (*Epist.* 79.) See Part I., n. 13—24.

215. But there is no reason to disparage the living, or to wrong the present age; for few, indeed, are there now who contend for any system or hypothesis as a matter of faith or love. The motives are various and innumerable, that prevail upon men to profess with the lips that they believe what they do not believe; the mere enumeration of them would occupy a large space in our pages. Who is there, if he be free to confess it, that does not regard the known as unknown, the true as probable, and the probable as false? Or who, if he has not sufficient time or talent for discussing the several arguments, does not tacitly, in his own mind, come to neither affirmation nor negation upon the subject? Indeed, we may form a judgment of



the state of the human mind from this circumstance, that it is a maxim *never to give credence, or implicit assent, to anything but actual demonstration*; and should any one set himself to work in furnishing the demonstration, the opinion then is, *they must next hear the other side*. For experience teaches that there is nothing that an orator may not establish, as an aliquot part of many different series of ratiocinations, and a philosopher, of many series of facts; just as one syllable, word, or phrase, may occur in a never-ending series of sentences and discourses, or one color in an infinite number of pictures. The mind indeed may, at the time of its formation, be imbued also with principles derived from sophistical arguments, but these are not so deeply rooted as perhaps we may think; for the intellect, in its maturer age, feels that it is free, and in a state for judging from the principles received in infancy, from those since superinduced, and from others traced out by its own individual experience; the consequence of which is, it accedes only to those that display to it the greatest light of truth. For so far as we place ourselves in bondage to the judgments of others, we limit our faculties, and consign ourselves to slavery; wherefore there is no rational mind that does not aspire to the enjoyment of its own golden liberty, and with this view ranges in thought over universal nature, in order to find out the truth, and, wherever it lies, to receive it with open embrace. In things divine the case is different; since they are ever speciously inculcated according to different religious creeds, in regard to which the mind is commanded to abdicate the use of reason; so that the impressions the mind receives on these subjects remain permanently sacred and inviolate, from the dawn of intelligence to its greatest development.

216. Meanwhile, those disputes that take place among the leaders of the learned and the lights of the world, concerning the soul, to which we are eternally to transfer the happiness we enjoy in the body, and which disputes never can be settled by controversy or contention, cannot but have the effect of unhinging men's minds, and contracting their faith to a narrow compass. For it is but natural to a man not to assent to anything unknown before he has consulted his reason; and in things altogether unseen, not to believe that a thing is, unless in some

measure he knows *what* it is,—a habit more common to the learned than to the unlearned; because as the former confide more in themselves, they presume less upon the impossibility of coming to perfect knowledge. If, therefore, we deprive the soul of every predicate that belongs to material things, as of extension, figure, space, magnitude, and motion, we deprive the mind of everything to which, as to an anchor, it can attach its ideas; the consequence is, that every one is left in doubt whether, after all, the soul be anything distinct from an *ens rationis*; and whether there can possibly be an intercourse between two entities, to one of which is ascribed the privative of the other, or of one extreme of which there is no assignable notion. But I know that human minds, (which are more capable of understanding than of willing the truer aspects of things, that is, are more intelligent than we think in guessing truths out of the collision of probabilities and appearances,) do not suffer themselves to be deceived by outward shews, or yield their faith, unless common experience persuade them to it; or unless they see that the last things are demonstratively connected and confirmed with the first by intermediates.

217. We may consider it as an established fact, that when any one attains the truth, all experience, both general and particular, will be in his favor, and give him its suffrage; and that all the rules and decisions of rational philosophy will naturally and spontaneously do the same; and that various systems will so come into agreement and unity with each other, that each will be confirmed thereby: for there is no system but is built upon ascertained phenomena, and upon such principles as will enable us to reconcile the higher sphere with the lower, and the spiritual with the corporeal. When truth herself walks forth to the light, and comes upon the stage, then conjectures disappear, and the spectres seen and imagined in the dark are dissipated. There is no difficulty that she does not remove; no mortal that she fears; no rock on which she founders. To her it is given to look into the holy of holies, though not to enter it; for the truth of nature, and the truth of revelation, however separate, are never at variance. But in order that the truth may be brought to light,—a consummation which we all devoutly wish,—I would observe, that its habitation is so inward

and exalted, that it will not permit itself to be revealed to any who are still lingering in the last and lowest sphere, but to those only who have brought their minds into the habit of thinking, who can extend, and apply, their mental vision throughout the whole order of confirmatory facts; and, in the perception of consequences, remove it far from the senses and the lower affections. But this power is not granted to all, (for Cicero says: "The divine mind . . . has taken account for those only whom it has endowed with right reason" (*De Naturá Deorum*, lib. iii., § 27.)); and its exercise would at once deprive the lower faculties of their pleasant and desirable ease;—and hence many stubbornly refuse to stir a step beyond visible phenomena for the sake of the truth; and others prefer to drown their ideas in the occult at the very outset. To these two classes our demonstration may not be acceptable. For, in regard to the former, it asserts, that the truth is to be sought far beyond the range of the eye; and, in regard to the latter, that in all the nature of things there is no such thing as an occult quality; in fact that there is nothing but is either already the subject of demonstration, or capable of becoming so.

218. These remarks are not made with a view to derogate from the authority or credit due to the lucubrations of others, adorned, as they are, with genius and the sciences; for every one, in proportion as he approaches the truth, deserves his own laurel. Of what consequence is it to me that I should persuade any one to embrace my opinions? Let his own reason persuade him. I do not undertake this work for the sake of honor or emolument; both of which I shun rather than seek, because they disquiet the mind, and because I am content with my lot: but for the sake of the truth, which alone is immortal, and has its portion in the most perfect order of nature; hence in the series only of the ends of the universe from the first to the last, which is the glory of God; which ends He promotes: thus I surely know Who it is that must reward me. I will now arrange these first fruits of my psychological labors into chapters, according to the method hitherto adopted.

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## I.

219. From the anatomy of the animal body we clearly perceive, that a certain most pure fluid glances through the subtlest fibres, remote from even the acutest sense ; that it reigns universally in the whole and in every part of its own limited universe or body, and continues, irrigates, nourishes, actuates, modifies, forms, and renovates everything therein. This fluid is in the third degree above the blood, which it enters as the first, supreme, inmost, remotest, and most perfect substance and force of its body, as the sole and proper animal force, and as the determining principle of all things. Wherefore, if the soul of the body is to be the subject of enquiry, and the communication between the soul and the body to be investigated, we must first examine this fluid, and ascertain whether it agrees with our predicates. But as this fluid lies so deeply in nature, no thought can enter into it, except by the doctrine of series and degrees joined to experience ; nor can it be described, except by recourse to a mathematical philosophy of universals.

220. *From the anatomy of the animal body we clearly perceive, that a certain most pure fluid glances through the subtlest fibres, remote from even the acutest sense.* Of this fluid we have already discoursed at length in the present and in the former Part ; in the sequel also it will continue to occupy our attention ; for there is nothing in the body that does not confirm its existence ; so that we can by no means doubt of its actuality, or of its efficient power, whenever an effect appears. It is for the sake of investigating and becoming acquainted with this fluid, that I have applied myself with all possible diligence to the study of the economy of the animal kingdom ; therefore, to avoid travelling over the same ground again, it will be sufficient to refer my readers to the Parts themselves. (Part II., n. 122, 123, &c.)

221. *That it reigns universally in the whole and in every part of its own limited universe or body.* For the sake of this fluid it is, principally, that the animal body is called a kingdom. *And*

*continues everything therein*; for it is educed where it is conceived, out of the cerebrum, the two medullæ, and their perpetual origins or cortical substances, and transmitted by continuity into the entire body as their subject and adject, so that whatever does not exist and subsist from it, is no part in the unanimous system. It *irrigates*; for it is most perfectly fluid, so that the greater and more excellent is the portion of it that the blood possesses, the more fluid is the blood to be accounted. (See Parts I. and II.) It *nourishes and forms*; whence it is called the formative substance (Part I., n. 253, *seqq.*, n. 271), the mother and nurse of all the others, present in the minutest particulars of the body (Part I., n. 258, 259), capable of adaptation to every little pore, passage and form. Wherefore also it *renovates* and repairs every deficiency in the connecting parts, and thus perpetually continues and pursues its work of formation. It *actuates and modifies*; for by its action we live, and by its life we act: it is present in a moment in the motive fibre of every muscle at the intimation of its brain, and in a moment transfers the forms of forces, and the images, from the particular sensoria to the general sensorium: and wherever it glances through its fibre, it is analogous in its nature to the auras. (See Part I., Chapter III.; Part II., Chapter II.)

222. *This fluid is in the third degree above the blood*; or to speak more clearly, it is in the first degree, since the red blood is in the third, as we have already ascertained from experience. But it is of great importance to have a clear idea of order, or of a series, and of the degrees in a series; for which purpose see Part I., Chapter VIII. But since we are so often repeating, that this, or the other thing, is in a superior or inferior, in a prior or posterior degree; or what amounts to the same, is more simple, more universal, more internal, more remote, more perfect, &c.; and since these things imply a distinct notion of division, it may not be amiss again to explain the relative terms superior and inferior. Let the idea be taken from the subject before us, or the blood. The blood is called an animal fluid of the third degree, and whether it be a large volume, as in the heart, aorta, vena cava, or sinus of the brain; or whether it be a smaller, as in the minute vessels; or whether it be only part of a volume, as in the capillary arteries and veins, it never ceases

to be blood of its own degree. Thus in whatever manner its volume be divided, whether it be into a part, or whether the parts be multiplied into a larger volume, it is still blood of its own degree, and retains the nature of its part, which is the least image of a volume; for it is its unit, whose numbers are aggregates of several units.\* But if we divide this part or globule of blood into its primordial or constituent particles, then the result and offspring of this division is a different kind of blood, namely, a purer, prior, superior, simpler, more universal, internal, remote, and perfect blood; for the red blood does not derive its nature from itself, but from other bloods prior to itself, into which it again returns; or as we term it, ascends, since the blood, as a compound, dies. That the red blood suffers itself to be divided into pellucid spherules, which continue their flow through the vessels, or the stamina and fibres of the vessels, is a fact which may be so distinctly ascertained by the microscope, as to leave no room for doubt. These pellucid spherules of the divided red blood, whether they constitute a volume, or a fine streamlet, or only a part, nevertheless do not cease to be the purer blood, or blood of the superior degree. And that each spherule is again divisible into others immensely smaller, may again be verified by the microscope. (See Parts I. and II., *passim*.) Wherefore there are units of it also, the number of which probably surpasses, beyond all imagination, those perceived by the highest microscopical powers. In order, therefore, to arrive by this purer or mediate blood, at the next higher blood, let us divide a part of it, in thought, since we cannot divide it by sight, into its prior, that is, its constituent or primitive elements; and we shall then come to that purest fluid, which is said to be in the third degree above the blood; or in the first when the red blood is put in the third. A similar law prevails in all other things; since there is nothing in nature but is a series, and in a series. (Part I., n. 584, 586.) Unless this idea of division and composition be familiarized to the mind, we shall perceive nothing distinctly in the various objects of nature, but confound with sense those things that nature successively and distinctly involves, and successively and distinctly

\* See the doctrine of units or unities illustrated in the case of the vesicles of the lungs, in the *Animal Kingdom*, n. 532, note (p).—(Tr.)

evolves. (See Part I., n. 37, 38, 40, 41, 91, 97, 100, 150, 360, 370, 503, 556, 630, 634, 637; Part II., n. 117—132, 153—162, 165, 167—172, 204—207.)

A *series*, therefore, is whatever contains substances, or what is the same, the forces of substances, thus disposed or flowing forth according to degrees: thus there are series of two, three, four, or more degrees. According as these series are mutually conjoined and communicate, so are they the series of an *order*. Properly speaking, these are series and orders of successive things. But there is also a series and order of simultaneous things, or of substances or forces of one and the same degree, as between a largest and least volume; which are of the same kind as that existing between numbers greater and less, down to the unit with which the numbers are homogeneous. (Part I., n. 629.) But we must beware lest we confound the degrees of these series with those of things successive, of which we have already treated. We are thus supplied with an explanation of the subsequent clause, namely, that *this fluid is in the third degree above the blood, which it enters as the first, supreme, inmost, remotest, and most perfect substance and force of its body, as the sole and proper animal force, and as the determining principle of all things.* See the articles cited above from both Parts.

223. It only remains for us to consider what is signified by the *force* that is attributed to this fluid; for it is called the substance and force of its body. The term force is used in a very wide sense, and for this reason perhaps with the less degree of precision. It has been employed to signify whatever produces any visible and perceptible effect. Hence the expressions, force of soul, force of thought, force of imagination, force of memory, force of sensation, force of action, force of motion, force of elastic and non-elastic bodies; and also the terms active and passive force, &c. It is a word, therefore, associated with everything in which we perceive any active state, and the judgment rarely discerns whether it be itself a substance, or whether it only belongs to a substance. But a substance is the subject of all its accidents, and consequently also of all its forces. Before a force can result from a substance, an acting cause must precede, in so far as the substances are kept in equilibrium; and no force



can exist except by mutation, without which it is a nonentity ; nor can it be abstracted, except in thought. From mutation, modification or motion flows ; wherefore there are as many species of forces, as there are of mutations, and of modifications or motions thence resulting ; and there are as many series and degrees of forces as of substances. Respecting the order in which efforts, motions, and modifications succeed each other, see Part I., n. 169—175, 304—306. Meanwhile fluids are what represent the forces of nature, because they produce them ; for fluids are the things that can make effort, and undergo modification and motion ; each fluid perfectly or imperfectly, according to its essence and form ; for the quality of forces is relative to the state of the substance. Thus the fluids of the earth, as water, oil, spirits and mercury, represent forces in one manner ; the fluids of the world, as air, ether, or the auras, represent them in another manner ; and the animal fluids, as the red blood, and the purer, and the purest blood, again represent them in another manner ; &c. In general, fluids are intrinsically more perfect the higher they are in their series, (Part I., n. 615, 616,) and the more their parts are by nature accommodated to the variety of all mutations ; also the more expansile and compressible they are, and the less coherent ; hence the more modifiable ; the less they suffer any loss of the forces impressed ; thus the more fully they represent at one extreme of a series the images and differences of the other ; the more they act by elasticity rather than by non-elastic force or gravity ; the more equally they press in every direction, namely, from the centre to the circumferences, and from the circumferences to the centre ; so that one and the same part may seem to be at once in the centre, in any radius, in any circumference, and in a thousand of these successively and simultaneously : whence they are found, each according to its nature, touching, pressing upon, and actuating every point in the most perfect manner. Such are the forces of the auras of the world ; and such are those of the purest animal fluid. Hence the fluid substances which produce these results, may justly be called the forms of nature's forces, which never exhibit themselves to view, either in part, or as sometimes is the case, even in volume, except by their effects. Common modification perceived by a sen-

sory organ manifests the form, and hence the nature of a part ; inasmuch as a part is the smallest volume of its whole, (Part I., n. 629—633,) and the forces are the numbers or amounts of parts, that affect the organ of sense. Thus the forms spoken of by the ancients coincide with the forms of substances ; for unless they resulted from substances, they would be mere *entia rationis*. In this respect the purest fluid in the animal body is the substance and force, and the most perfect nature of its little world. But the subject of forces is so extensive, that it cannot be distinctly understood without traversing universal nature generally and particularly ; and whoever will undertake this task, may find this rule of service, that substances discover what they are by the mode of their forces. Respecting the force of the present fluid, see below, Part II., n. 338—341.

224. *Wherefore, if the soul of the body is to be the subject of enquiry, and the communication between the soul and the body to be investigated, we must first examine this fluid, and ascertain whether it agrees with our predicates ; that is to say, whether its attributes agree with those of the soul. Hence if we grant that the soul, as ours, is to be sought in ourselves, anatomical experience by its evolution presents this fluid as the highest and most inward to the mind of the anatomist ; and then hands it over to the philosopher to be discussed, and for him to settle whether what he knows from his own axioms, and from the rules of analytic order, should be attributed to the soul, be predicable of this fluid. For the anatomist proceeds no farther than the above step, unless he at the same time assume the character of a philosopher. Something of this kind seems to be taken as the fixed boundary of their ideas by Aristotle and his followers ; the former of whom treated systematically of the parts of the soul, and the latter, of its physical influx. Wherefore, if the animal fluid and the soul agree in their predicates, no sound reason will reject the fluid as disagreeing ; if otherwise, no sound reason will embrace it.*

225. *But as this fluid lies so deeply in nature, no thought can enter into it. We may indeed approach it so far as to know that it exists, but not as to know how it corresponds with the blood to which it is adjoined, and with the body over which it presides, much less to know what it is in itself, without auxiliary*

sciences, which may serve as our clue to assist us in threading the mazes of this most intricate labyrinth; that is to say, *except by the doctrine of series and degrees joined to experience.* (Part II., n. 210, 213; and Part I., Chap. VIII.)—*Nor can it be described, or defined, genetically, except by recourse to a mathematical philosophy of universals.* (Part II., n. 206, 207, 211, 212; Part I., n. 256, 297, 650, 651.) Towards this I have made some progress, though as yet I have not advanced far beyond the first and fundamental principles. (Part II., n. 207.)

## II.

226. Yet this does not prevent us from perceiving, solely by the intuitive faculty of the mind, that such a fluid, although it be the first substance of the body, nevertheless derives its being from a still higher substance, and proximately from those things in the universe on which the principles of natural things are impressed by the Deity, and in which, at the same time, the most perfect forces of nature are involved. Hence that it is the form of forms in the body, and the formative substance, that draws the thread from the first living point, and continues it afterwards to the last point of life; and so connects one thing with another, and so conserves and governs it afterwards, that all things mutually follow each other, and the posterior refer themselves to the prior, and the whole with the parts, the universal with the singulars, by a wonderful subordination and coördination, refers itself to this prime form and substance, upon which all things depend, and by which, and for which, each thing exists in its own distinctive manner.

227. *Yet this does not prevent us from perceiving, solely by the intuitive faculty of the mind, that such a fluid, although it be the first substance of the body, nevertheless derives its being from a still higher substance, and proximately from those things in the universe on which the principles of natural things are impressed by the Deity, and in which, at the same time, the most perfect forces of nature are involved.* The intuition of the soul, which is like

a light in the rational mind, (Part II., n. 289—291,) infuses into us many things happily without the aid of auxiliary sciences, or so enlightens us with its beams, that we can immediately tell whether those things that come from the judgments of others are true or not. This is the reason that the truth often manifests itself spontaneously, and assures us of its presence, and this, without any help from far-fetched arguments. The cause of this is, that the doctrine of order, and the science of universals, are sciences of the soul herself, according to which she views her objects altogether apart from *a posteriori* demonstration. (Part II., n. 270.) If it be a question, for example, whether the spirituous fluid be the first of all substances; whether, therefore, it be immediately infused, and whether it act without any communication with the first substance of the world, (with other questions touching its actuality,) enlightened reason leads us to believe that it is not the first of all substances, although it be the first in its own animal series. This the reader may see further explained above, where it is stated, that each series has its own first and proper substance (Part I., n. 592); but which depends for its existence on the first substance of the world (*Ibid.*), for that there is only one first substance of all things in the created universe, from which the others flow (Part I., n. 590), on which, as a principle, the principles of natural things are impressed by the Deity. (Part I., n. 591.) If the universe embrace singulars, it follows that it contains them under itself as if in itself; from this the order of things is derived, and the rules of that order. The case would be otherwise, if we could suppose the universe to be an assemblage of universals; that is to say, if we could suppose its substances and successive series of substances, independent in their existence and subsistence of the first substance of the world; for then the conflict, discordance, and strife among so many independent universals, would oblige us, in order to reconcile them, to be perpetually resorting beyond the bounds of nature, to some miraculous interposition of Omnipotence. In these views the mind is confirmed by various arguments of probability which occur to it. It finds, for instance, that this fluid is enclosed within the body, and circumscribed by the spaces of the body; that it keeps within fibres, which are in general the essential determinations of its volume;

whence the form of the whole; that a large volume of it may be seen by the aid of the microscope; that it excites the motive fibres and general muscle of its body into palpable motions; that it suffers itself to be modified just like the auras of the world; and to copulate with corpuseules of another kind, and thus to enter the blood and the vessels (Part I., n. 37—102); that by a high process it is conceived within, and excluded from, the exquisitely fine wombs of the cortical substance (Part II., n. 165—168); that the mutability of its state is the perfection of its nature (n. 312—316); with many other particulars noticed in both our Parts, and the ultimate causes of which are to be sought in this substance. Hence, in relation to its body, it is a substance which forms; but in relation to the prior universe, it is a substance which is formed; and this, by the substance in which there are the most perfect forces of nature; consequently, by that better ether which the ancients called the celestial aura. (Part I., n. 635; Part II., n. 206.) Thus this fluid may be approached by anatomy, but not entered without auxiliary sciences.

228. *Hence that it is the form of forms in the body.* The form of the parts of this fluid results, as we have just shewn, from the essential determinations of the first aura; hence the high powers involved in the aura, are transferred into this fluid as its offspring: also this, that it can play the first part in any series of organic substances in any body, just as the aura plays the first part in its own world, or great system: wherefore the former acts in the microcosm in the same manner as the latter acts in the macrocosm: thus it follows, that both the one and the other is a formal, forming, or informing cause, as it is variously called; that is to say, it is the formative substance of all the posterior or inferior things in its universe or kingdom. (Part I., Chap. III.) This secondary little world of the animal body, is so composed of organic forms, mutually subordinated and adjoined to each other, that there is not a single part which, when surveyed either in a particular or general point of view, does not strike with silent astonishment the most cultivated mind; for so annexed is one part to its associate, and so subjected to its prior, as to appear to be born not for itself, but perpetually for something else, for the advantage and use of which it develops itself not simultaneously, but by successive intervals.

Thus the lungs arise after the heart, the heart after the spinal marrow, the spinal marrow after the brain, the brain after the individual substance of the cortex, and the cortex after its own parent, and the common parent of all, or that purest fluid which is the first in the order of things successive; for there is no real effigy of the greatest in the least, and in the germ no type of the future body,—no type which is simply expanded. (Part I., n. 249—252.) That which informs and conforms every particular is, therefore, I think you will admit, that which acts in the minutest fibrils. If so, it must be a most pure fluid, which, producing as it does such wonderful effects, must involve a nature, that is to say, a power and force of acting in one peculiar and distinctive manner. If it be said that it is some higher nature implanted in the fluid, to which, as to its first principle, this fluid is subservient as an instrumental cause; still, whichever it be, it is manifest that we must search for it in this fluid, and consequently in the form of this fluid. Thus it follows that such a fluid is the form of the organic forms of its body. (Part II., n. 191—196.) This form, flowing from the determinations of its matter, or from essentials, is a substantial form; from this results the form of its forces and modifications, or, to speak more universally, of its accidents. (Part II., n. 223; I., n. 619—623.) Thus this fluid, in relation to the organic substances of its body, and to the modifications of its substances, is the form of forms. But, not to dwell upon terms too universal perhaps for ordinary comprehension, we shall proceed to demonstrate in what follows the manner in which this fluid assigns their form to the organic parts, and to the modes of the animal body proceeding from them.

229. *And the formative substance, that draws the thread from the first living point, and continues it afterwards to the last point of life (Part I., n. 253); and so connects one thing with another, and so conserves and governs it afterwards, that all things mutually follow each other, and the posterior refer themselves to the prior, and the whole with the parts, the universal with the singulars, by a wonderful subordination and coördination, refers itself to this prime form and substance, upon which all things depend, (Part II., n. 160, 161, 204, 207, &c.; I., n. 252, 260, 261, 265—273, 594—612, 636, &c.) and by which, and for which, each*

*thing exists in its own distinctive manner.* The first substance of every series is its most simple substance, which reigns through the entire individual series. (Part I., n. 594.) And from this first substance, and according to its nature, proceed all things that are seen determined in the entire series. (*Ibid.*, n. 595.) And from this substance, by order of succession, through conjoining mediates, more compound substances are derived, that act as its vicegerents in the ultimates of the series. (*Ibid.*, n. 596.) And in this way the bodily system is constructed, in which one thing is so subordinated to and coördinated with another, that all things are mutual correlatives and interdependents (*Ibid.*, n. 608); so that whatever of mutability there be in compound series and substances, the simpler substances are rendered conscious of it. (*Ibid.*, n. 609.) And whatever is determined into act, is effected by the simpler substances either determining, or concurring, or consenting (*Ibid.*, n. 610); and this according to a natural order, from the lower to the proximately higher, or from the higher to the proximately lower; but not from the highest to the lowest, except through the intermediates. (*Ibid.*, n. 611.) If all these positions be correct, the inevitable consequence will be, that this first substance is that through which, and for which, posterior things exist in their own peculiar and distinctive manner.

230. Thus we deduce the fact, that the corporeal system is derived continuously, as it were by the regular descent of this fluid into its series and forms. But that the system itself exists *for the sake of this fluid*, this, as it is a matter pertaining to a wider field of use, cannot so well be obtained in the way of conclusion from a concatenated series of arguments. For every one will not think that it can be so, although he admits the above chain of reasoning: wherefore arguments, arranged in the form of a series, will either diffuse the mind over the whole of possible knowledge, or else involve it in a dilemma, from which it will not know how to extricate itself but by giving a blind assent to all particulars. But that the inferior organic textures exist solely for the sake of their first substance or spirituous fluid, is more manifest from examples than from principles. Thus the ear is not formed merely for the purpose of hearing, but for referring what it hears to an ulterior



faculty, whose office it is to perceive and imagine ; nor is this faculty merely for the purpose of perceiving and imagining, but for the sake of a higher and intellectual faculty, from which the mind may think and judge ; and finally the soul represent to itself what conduces to its own and the public weal. Thus the ear and hearing are for the sake of the soul ; and so also are touch, taste, smell, and sight. A muscle does not exist merely for the sake of being put in motion, but to refer itself to the will, whose servant it is ; thus also the will, which is the conclusion of the judgment, refers itself to the intellect, and the intellect to the soul ; wherefore action is regarded from the will, the will from rational reflection, and finally from the determining principle of reason. Thus the soul is the principal cause, and all things that follow in order to the ultimate effect are its vicegerents and instrumentals. Thus then all things in the organic body are formed in relation to this its fluid, and are so fashioned to the image of its operations, as to take on themselves modes, and operate forces, in a manner adapted to the forms of the nature of the universe. Whatever is prior, and capable of existing and subsisting without the posterior, does not exist and subsist for the sake of its posterior ; but if the prior produce the posterior, it is for the sake of a use, which it applies to itself by the mediation of the posterior. A similar law prevails in all things ; for we everywhere else find a like chain of subordination ; nay, even in the forms of governments, for the king is a king, for the sake of law and order in society, which are prior in right, although not always in fact. Thus *ends always ascend when nature descends*.

### III.

231. But as this most pure fluid, or supereminent blood, has acquired its form from the first substances of the world, it can by no means be said to live, much less to feel, perceive, understand, or regard ends ; for nature, considered in itself, is dead, and only serves life as an instrumental cause ; thus is altogether subject to the will of an intelligent being, who uses it to promote ends by effects. Hence we must look higher for its

principle of life, and seek it from the First Esse or Deity of the universe, who is essential life, and essential perfection of life or wisdom. Unless this First Esse were life and wisdom, nothing whatever in nature could live, much less have wisdom; nor yet be capable of motion.

232. *But as this most pure fluid, or supereminent blood, has acquired its form from the first substances of the world, it can by no means be said to live.* (See Part I., n. 635.) The auras of the world do not manifest life, but force and motion. They are not susceptible of sensation, but only modify and are modified; they belong to physics, which, according to the philosopher, contemplates nothing abstracted from matter. It is a self-evident truth, needing no argument derived from probabilities, that matter, or any part or extense of matter, cannot think; although even this truth, by the lengthiness of arguments derived from partial and disconnected facts adduced in support of it, is frequently darkened, rendered doubtful, and finally denied. If matter cannot think, neither can it feel, hear, see, taste, or smell; for all these are properties of the soul. The eye, merely as an eye, is but a piece of workmanship, or optical camera, accommodated to the forms of the modifications of the ether; that which gives it its visual life must in fact be added to it, or exist above it and within it. And the same kind of observation applies to all the other sensories.

233. *Much less to feel, perceive, understand, or regard ends.* As this follows from the foregoing remarks, we shall proceed to the next clause.

234. *For nature, considered in itself, is dead, and only serves life as an instrumental cause; thus is altogether subject to the will of an intelligent being, who uses it to promote ends by effects.* Let us consider the subjects of this article separately, and shew, 1. That life is one thing, and nature another. 2. That nature, in respect to life, is dead. 3. That life is what regards ends, but nature what promotes ends by effects. 4. Hence that there is an Intelligent Being who governs nature suitably to ends.

235. 1. Life is one thing, and nature another.—Since the mind is in a natural subject, and partakes both of life and

nature, it can hardly see either the one or the other in itself, or disjunctively. But if it descends a little into the phenomena of its body, or if it expatiates upon the objects of the earth, it immediately perceives, by means of the senses, that the two are perfectly distinct; for we often know the eye to be either wholly or partly deprived of sight, the ear of hearing, the tongue of taste, the brain of sense, and the mind of understanding, just as organs are deprived of their forms, mutual connections, and the determination of their fluids. All pathology, all medical art, whether relating to the body or mind,—an art which is no other than that of restoring to the several natures of both their declining life, and of uniting those things that begin to separate,—bears witness to the truth of this observation; for it both teaches us the means between the two, and applies them. Every person who has once seen the organic body a corpse, at once acknowledges that life has departed from it. The objects on the earth, as minerals, waters, vegetables, &c., demonstrate the same truth to the sight. The air and ether, or the circumambient world, with all its modified sounds and images, do not in the least partake of life, before they flow into the organic world, or into an animated system. (Part II., n. 199, 200.) But when they do this, modifications at once become sensations, and images ideas, which for the sake of distinction from intellectual images, or those of a higher life, are generally called material ideas. Therefore, life is one distinct thing, and nature is another.

2. Nature, in respect to life, is dead.—This follows from what we have already stated. But let us ascend still higher. If nature lived, it would live either from itself, or from some other thing, or by some other thing. *If it lived from itself*, then that would live, which we clearly see does not live; and nature would destroy itself, whenever it destroys its forms, in which, and according to which, life exists. So also it would not only be the principle of its own causes and effects, but also the principle of its principle; or else this principle would convert itself into nature, in order that it might be enabled to be what it is not; which every one sees to be opposite to common sense. But nature itself, by its degrees and moments, in every motion, form, and time, more particularly by its mutations, inconstancies, relatives, opposites, and contraries, manifestly declares

that it does not live of itself, but is so emprinced as in a manner to move of itself. Nature, says the philosopher, is that, by the primary inexistence of which anything is generated; also the *materia prima* [?]; it likewise expresses the substance of those things that exist in nature. (*Metaph.* lib. v., cap. iv.; *Natur. Auscult.*, lib. ii., cap. i.) It is a principle and cause of motion and rest in that thing in which it is . . . *per se.*" (*Natur. Auscult.* lib. ii., cap. i.; lib. viii., cap. iii.) And Wolff says: "By universal nature, or nature simply so called, we mean the principle of mutations in the world,—the principle intrinsic to the world.—Since nature is intrinsic to the world, it cannot be a distinct entity from the world.—Universal nature is an aggregate of all the motive forces that there are in the bodies coexisting in the world taken collectively." (*Cosmologia*, § 503, 504, 507.) If nature does not live of itself, it does not follow from this that it so lives from another as not to be relatively dead: but this will be discussed below in sec. V. For it is apparent from visible phenomena, that life corresponds as a principal cause to nature as an instrumental cause. For what is motion in nature is action in a living subject; what is modification in nature is sensation in a living subject; what is effort in nature is will in a living subject; what is light in nature is life in a living subject; what is distinction of light in nature is intellect of life in a living subject; what is cause and effect in nature is end in a living subject; and so on with other things. See Part II., n. 200. Thus the natural *esse* respects the vital *esse* as an instrument respects its principal cause extrinsic to itself.

We have remarked that the human mind can hardly see these two in itself, or disjunctively; for the faculty of feeling appears inherent in the organs: therefore we represent it to ourselves as like a light that disappears with the setting sun, like a flame that is extinguished when deprived of its fuel, or like a fine exhalation that vanishes when its source is withdrawn. But oh! how cunningly are we deluded by the servants and messengers of the intellect, which is so dependent upon the senses as to be obliged to form its judgments only according to what they first perceive. So hidden under ashes lies the intellectual spark, that we believe nothing without first consulting

the inferior organs, and if the mind cannot form an abstraction from them, it is buried in their shadows, into which it has so far descended that it cannot any more ascend.

236. 3. Life is what regards ends, but nature, what promotes ends by effects.—On a slight reflection upon the operations of the mind, it may be seen, that we regard ends in effects; not that they are inherent in these effects, but still that they appear to be in them. For in the mind we embrace an end first abstractedly from means, then we form and as it were create means, that the end may be provided and obtained by physical effects or instrumental causes. Thus the same end, taken abstractedly or disjunctively, continuously follows the progression of means, or the ordination of effects. In this we see a certain representative of creation, in that the end is prior and nature posterior, through which [nature] effects are produced, and in these as means the end is regarded, and a certain order of them is required that the end may be obtained. Hence it follows, that whatever is natural is also finite; and that only the end out of nature is not finite. It follows, also, that we can be said to live only in so far as we regard ends out of ourselves; and that all animals live only in so far as they provide as it were intelligently, howbeit unconsciously, that intermediate ends may be carried to a higher end. Thus, in human subjects, there is a more excellent and greater life, according to the degree of intellect that is brought into play in the regard of the more universal ends.

237. 4. Hence there is an Intelligent Being who governs nature suitably to ends.—“To act for the sake of an end,” says Grotius, “is the distinctive mark of an intelligent nature. Nor, indeed, is anything ordered with a view only to its own particular end, but also with a view to the common end of the universe. . . . But this universal end could not be intended, or the power to carry it out communicated to things, except by an intellect, to which this universe is subject.” (*De Veritate Religionis Christianæ*, lib. i., §. 7.) Who, as He is Wisdom itself, is, for that reason, the End itself, whose means He embraces when He regards the end.

Oh! how does the mind degrade itself, when dimly illumined by a few scanty rays of life, it thinks from blind nature,

and contemplates the order of nature as not order! Tell me what is the order of nature, what is contrary to that order, and what is above it? Nature flows in perfect accordance to its own true order, when according to the will of God, who is essential Life and Wisdom, and whose order is, that effects should flow conformably to ends foreseen and provided from eternity. We see this clearly in ourselves, who are little worlds, involving the order of nature; for whatever the soul intends from the very germ of existence, the nature of the universe spontaneously advances into effect. Thus the soul intends to proceed from the prior world into the posterior, and in this case the whole macrocosm ministers to it as a servant; for whether the elements that will serve for the connection of forms, be floating and scattered in the air or in the ether, or whether they be fixed in the three kingdoms of the earth, they are present in the ovum in such coördination, that they are ready for supply at the slightest intimation of a want. And when we are born, the ways by which the elements can penetrate into the blood, are so wonderfully constructed by the formation of appropriate ducts, that if one will but wisely consider them, one must marvel at oneself, as a mass of miracles. (Part I., Chap. III.) Moreover the soul intends that the circumambient universe should serve it as a means for obtaining wisdom; and for this end calls into play the most recondite laws of the arts and sciences of nature, and thus sees, hears, tastes and feels; and also builds a brain, in order that the things perceived by the senses may penetrate even to itself, the soul. And why may we not presume the same in regard to all the other particulars of the human body, any one of which, or any part of any one, or any part of that part, if viewed by the rational vision, will lead us to see, that the order of particular nature in ourselves is so formed in the universal order, that all things flow to ends through effects, at the pleasure of an intelligent soul. So also does the universe at the command of the wise Creator; the heavens, for instance, with their mighty bodies and spheres; as the sun, stars, planets, moons, and vortices, all of which move in their proper order, when they conspire to their proper end. Consider then what is life and what is nature, what is order and not order, and what are miracles.

“It follows,” says Grotius, “that there is an eminent mind, by whose command the celestial bodies and luminaries minister unweariedly to man, placed though he be so far below them. And this mind is no other than the architect of the stars and the universe. . . . All of which loudly declare that they came not together by chance, but were formed by an understanding, and this, of the most transcendant order. Who can be so great an idiot as to expect anything so accurate from chance? As well might we believe, that stones and timbers come together by chance into the form of a house, or that an accidental concourse of letters produces a poem.” (*Op. Cit.*, lib. i., §. 7.)

238. Hence we must look higher for its principle of life, and seek it from the First Esse or Deity of the universe, who is essential life, and essential perfection of life, or wisdom. Unless this First Esse were life and wisdom, nothing whatever in nature could live, much less have wisdom; nor yet be capable of motion. God is the Fountain of Life, the Sun of Wisdom, the Spiritual Light, the very Esse, and I AM; in whom we live, and move, and have our being; from whom, by whom, unto whom, or for the sake of whom, are all things; who is the First and the Last. This we are forbidden by Holy Scripture to doubt; we are forbidden also by sound reason, for the ancient philosophers acknowledged it out of the mere light of their own understandings. “All men,” says Aristotle, “have some notions respecting the gods, and all who believe in the gods, . . . assign them the supremacy.” (*De Cælo*, lib. i., cap. iii.) Life belongs to God, and the action of God is life. (*Metaph.*, lib. xiv., cap. vii.) “The operation of God is immortality, that is, perpetual life.” (*De Cælo*, lib. ii., cap. iii.)

239. In shewing what are the dictates of sound reason upon this subject, it is incumbent on me to cite the words of this distinguished philosopher, as of one, whose mind was supported upon no other basis than right reason; not that I mean to derogate from the just merit of Christian philosophers, highly instructed as they are out of the Holy Scriptures; but that in consulting pure reason, we may consult that philosophy which does not appear mixed, nor says other than it thinks. Not to mention that some, although stored with the right information, yet dare to rebel against the dictates of God as well as of



reason ; but these are not the persons intended by the philosopher, when he says, “ God has adorned prophets and philosophers with the spirit of divine wisdom.”<sup>x</sup>

## IV.

240. This life and intelligence flow with vivifying virtue into no substances but those that are accommodated at once to the beginning of motion, and to the reception of life ; consequently into the most simple, universal, and perfect substances of the animal body ; that is, into its purest fluid ; and through this medium, into the less simple, universal, and perfect substances, or into the posterior and compound ; all of which manifest the force and lead the life of their first substance, according to their degree of composition, and according to their form, which makes them such as we find them to be. On account of the influx of this life, which is the principal cause in the animate kingdom, this purest fluid, which is the instrumental cause, is to be called the spirit and soul of its body.

241. *This life and intelligence flow with vivifying virtue into no substances but those that are accommodated at once to the beginning of motion, and to the reception of life.* By a thorough investigation of nature, we may find out how substances can be accommodated to the beginning of motion. The sun is the beginning of motion in its universe, and there are mediant and determinant auras to enable it to flow with its virtue and light into the objects and subjects of its world ; and hence, by the mediation of the first aura, into this fluid ; and by the intervention of successive auras, into the whole animal system produced by the determinations of this fluid. But before we can explore this subject intimately, we must know the principle of action in the sun, and the principle of reception and transference in the auras. This we may comprehend if we diligently evolve causes from the phenomena of effects. See Part I., n. 66—68, 169—174 ; and my *Principia*. But how these fluid substances can be accommodated at the same time to the reception of life, see

Part II., n. 252, which will in some degree prevent obscurity. For whatever is in God, and whatever law God acts by, is God (*Ibid.*, n. 253). If we adjoin anything to God, it must be borrowed from nature, and added to Him who is above nature. He is the wisest of mortals, who comprehends this alone with certainty, that he can know nothing of God from himself.

242. *Consequently into the most simple, universal, and perfect substances of the animal body; that is, into its purest fluid.* In the subsequent pages we shall institute a comparison (as far as we may) between the principle\* of motion and the principle of life; and therefore we will here also speak by comparatives. For the sun, which is the universal principle of motion, or that from which all motion or mutation in the world naturally begins, flows into, and is received by, nothing more perfectly, than the simpler substances, such as the auras and other most minute forms; for which reason nearly all these forms are pellucid: for the simpler they are, the more ordinally do they dispose themselves for its influx or operations. As the philosopher says: "The nearer anything is to the first cause, the more simple it is."<sup>x</sup> See Part I., n. 615, 616. But the less simple substances are, the more imperfect they are, and the more remote as it were from the real truth of nature; that is to say, below the causes of real rules, and within the relatively contracted sphere of unequal and inconstant forces. This is the reason that in the less simple substances the light is variegated, reflected, inflected, and even confounded in all sorts of different ways. How these things befall substances in their successive derivation, cannot be understood except by the doctrine of series and degrees. To speak by comparison, something similar ought, it seems, to be understood respecting the influx of life into substances, which according to their priority and elevation, or their accommodation to natural truth, are also capable of accommodation to the reception of life; for natural truth and spiritual truth, distant from each other although they be, yet are never at variance. (Part II., n. 217.)

243. *And through this medium, into the less simple, universal, and perfect substances, or into the posterior and compound; all*

\* The words *principle* and *beginning* are convertible terms in the translation.—(Tr.)

*of which manifest the force and lead the life of their first substance.* For in respect to the beginning of motion, they exercise force, and in respect to the reception and application of life, they exercise life. Anatomy plainly shews that the first substance of the animal system, or the spirituous fluid, flows into all the other substances; for it enters all things as the first substance of its body, the only and proper animal substance, and the determining principle (Part II., n. 222): it is the form of forms of its body (*Ibid.*, n. 228), by which and for which other substances exist in their own distinctive manner (*Ibid.*, n. 229): the intermediate organisms are only its determinations (*Ibid.*, n. 283), as the reader may see in the course of our Parts. It may therefore be defined as a substance, which has principles imprinted upon it, as being itself the principle of all things of the body.

244. *According to their degree of composition, and according to their form, which makes them such as we find them to be.* Both ancient and modern philosophers subscribe to the axiom, that everything derives from its form its peculiar and distinctive character or quality. "Each thing," says the philosopher, "is called a thing in virtue of its form."<sup>x</sup> "By means of the form of an entity," says Wolff, "we understand why that entity is of one particular genus or species, or of one quality rather than another; and why it is adapted to act in one particular manner: consequently the law of these predicates is contained in the form. The form, therefore, is the principle of the entity, upon which its peculiar existence depends; consequently, it is the cause of the entity." (*Ontologia*, § 947.) But what is form?—this as well as other terms is distinctly explained by the doctrine of order, which as it ascends through degrees, so it arrives at higher abstractions. In the lowest degree, form means the structure of a body, both internal and external. "The form of everything," says the philosopher, "is perceived by the sense of sight."<sup>x</sup> The form also means the structure of other things; and thus we speak of forms of government, forms of motion, forms of words, or forms of speech, &c. In a higher degree form means image, for such as it is successively represented to the ear or the eye, such is it simultaneously represented to the animal

mind abstractedly from matter. In a still higher degree it means barely form, or according to some, idea; for figure, magnitude, situation, motion, or the limit of these, are abstracted from it. In a still higher degree it means the universe, as the complex of all and singular things, and in this respect indeed it is the form of natural forms. To ascend beyond this to forms still higher would be to climb both above and beyond the universe, where the mind's intuitive power perishes, and language with it; so that to discourse of such forms would be to utter empty terms. When therefore the purest animal fluid is called the form of forms (Part II., n. 228), we are to conceive of it in this respect as being a representation of the universe; and thus as involving things which we cannot bring to mental representation; for there is nothing in the universal body that has not relation to some higher correspondent in the universe and all its parts: of which we see a very imperfect idea in its first determination, or in the cortical substance. (Part II., n. 176—195, 204—207; Part I., Chapter III.).

245. *On account of the influx of this life, which is the principal cause in the animate kingdom, this purest fluid, which is the instrumental cause, is to be called the spirit and soul of its body.* It is well known, that when we examine effects, and even causes, we do not abstract the principal cause from the instrumental, but represent the two together to our minds as a single cause. The instrument indeed is considered by itself, apart from force of acting, although not apart from power of acting; and when it is acted upon, it is as though it acted, and it is called the instrumental cause. In conversation we constantly attribute to the instrumental cause what should be attributed to the principal; for we speak according to the senses, which have not power to separate the one from the other. In living bodies, this instrument we speak of is no longer termed an instrument, but an organ (Part II., n. 199—202): thus the tongue is the organ of taste, the ear is the organ of hearing, and the eye is the organ of sight. Although these organs enjoy the power of feeling [*sentiendi*], yet they are destitute in themselves of the principal force that produces action. Now as this celestial human fluid cannot possibly be said to live, much less can it be said to feel, perceive, or understand. "To live," says the phi-

losopher, "is to feel and understand." (*De Moribus*, lib. ix., cap. ix.) For nature in herself is dead, and only serves life as an instrumental cause. (Part II., n. 234.) But if this fluid be regarded as the purest of the organs of its body, and the most exquisitely adapted for the reception of life, then it lives not from itself, but from Him who is self-living, that is from the God of the universe, without Whom nothing whatever in nature could live, much less be wise. (*Ibid.*, n. 238.) *This fluid*, in this light, is to be denominated the *spirit* and *soul* of its body; and therefore in what follows, we shall call it the *spirituous fluid*.

246. Out of a certain general consent of human minds, naked truths come often forth to light, which are afterwards destined to be confirmed by a long series and elaborated chain of causes and effects; and such is the case with the present truth, that this fluid is the spirit and soul of its body. For the learned in general, and anatomists in particular, call it by common consent the *animal spirit*, and describe it as running through the finest threads of the nerves; as calling out the forces of the muscles; as being sublimated from the blood; and as having its birth in the brain, which they term the mart and emporium of the spirits. Nay, very many of them go so far as to assert that it is conceived and born in the cortical substance of the brain. What is more usual than to say that these spirits are the emissaries and ambassadors of the soul, and that without their ministrations the soul would in vain attempt to exert her forces: which shews that every one who touches upon this fluid, also in thought more or less touches upon the soul. But it would seem that they have none of them dared to call it the soul; for fear they should come unawares into some dangerous quicksand, or philosophical dogma, from which they are conscious that no powers of theirs would suffice to extricate them: for properly speaking, the nature [or indwelling power] of this fluid is the soul. Meanwhile, the general opinion is, that the will is determined into act by this animal spirit; and if it be asked by what spirit the will itself is determined, before it becomes the will, we still need not go far from this fluid, for what is called the will is really a conclusion of the judgment, as we shall see presently. Now the will so concurs with its determinant [fluid], that it must be sought for either in its nature, or

without it. If *in it*, the determinant concurs with the will, hence with the judgment and intellect, and so of course with every sense; for volition and sensation constitute not two souls, but one. If it has to be sought *without it*, thought will altogether diffuse itself into some non-permanent accident, or perhaps into some essence for which we have to search far and wide in the universe, when all the time we ought to seek in ourselves. But not to obscure what is clear by reasons brought from too high a sphere, we may take it for certain, that if this fluid and the soul agree with each other in their predicates, the fluid must be accepted as the soul; and if otherwise, rejected, (Part II., n. 224); in fact, the more any one loves the truth, the more forward will he be under the latter circumstances to reject it as repugnant.

247. Hence it follows that every one has his own individual and proper soul; circumscribed in regard to substance, by the same limits as the body; in regard to intuitions and representations, by the same limits as the universe. Hence that habitation and place, also part, magnitude, force and form, are predicates that suit the soul as a substance, provided only that the properties be abstracted that are generated in compounds, both in so far as they are compounded, and in so far as they borrow from other series many things that necessarily enter them for the sake of composition. But that still the soul appears incomprehensible, and in a manner continuous, to the eye of the body, however assisted by all the powers of art, and in short to every one of the inferior sensories. (Part I., n. 623.)

248. That sound reason dictates that the soul is such as we have described it, we are confirmed by our philosopher, who has arrived at the same conclusion as the result of his thoughtful meditations. "The soul," says he, "is that by which we first live, feel, and understand." (*De Animá*, lib. ii., cap. ii.) "The substance of each body is its soul." (*De Generat. Animal.*, lib. ii., cap. iv.) "The soul exists in our inner part." (*De Sensu.*, cap. ii.) "The soul is the part of man in which life is first contained." (*Metaph.*, lib. v., cap. xviii.) "The soul, inasmuch as it is a part of man, is an object of physics; man being made up of the connexion of the body and soul."\* As he here declares that the soul is an object of physics, and is a

part, it will be well to ascertain from him what he understands by *physics*, and what by *part*. Physics, he says, contemplates nothing abstracted from matter. (*De Animá*, lib. i., cap. i.) “Physics treats of things that are separable in form, but yet exist in matter.” (*Natur. Auscult.*, lib. ii., cap. ii.) To unfold the law of the form from matter, belongs to the province of metaphysics. (*Ibid* [?].) “Physical relations are seen in those things that contain within them the beginning of motion and state.”<sup>x</sup> “Wherefore it belongs to the physical philosopher to treat of the soul.” (*De Animá*, lib. i., cap. i.) With respect to *part*, he says: “A part is what is taken separately in place.” (*Natur. Auscult.*, lib. iv., cap. iv. and vii. [?]) “Upwards, downwards, &c., are the parts and species of place.” (*Ibid.*, lib. iv., cap. ii.) He even suspected that a certain pure fluid enters the organism, and produces sensation. “Sense,” he says, “must be completed by exquisitely fine parts supplied with a very pure blood,” (*De Partib. Animal.*, lib. ii., cap. x.): by which he not obscurely intimates, that the blood may be exalted to the purest degree; and I am disposed to think, that had not our philosopher fallen into the opinion that the fibres were “solid and earthy” (*Ibid.*, lib. ii., cap. iv.), but had first adopted that of Hippocrates, that “everything in the animal body is conspirable and transpirable,” he would also have openly acknowledged the existence of a pure fluid in the simplest fibres; for he says, that “the fibres run from the nerves to the veins, and back again to the nerves.” (*De Histor. Animal.*, lib. iii., cap. vi.); just as we have stated above, Part II., n. 168—172, and Part I., *passim*.

249. But he distinguishes the *animus* from the *anima* or soul, and acknowledges the former as the principle by which we live, and as the form according to which we are found to live. “All natural bodies,” says he, “are the instruments of the *animus*.” (*De Animá*, lib. ii., cap. iv. See above, Part II., n. 245.) The *animus* is not the body, but is the first perfection of the natural body, having life in potency. (*Ibid.*, lib. ii., cap. i.) “The *animus* is the cause and principle of the living body.” (*Ibid.*, lib. ii., cap. iv.) “It is the spring and principle of living things.” (*Ibid.*) “It is the form of the body, that is, it is what animates it, and gives being [*esse*] to a compound subject.”<sup>x</sup>



“The *animus* does not undergo motion in place.” (*De Animá*, lib. i., cap. iii. iv.)\*

250. But the *mind* or *mens* he describes as a higher *animus*. Thus he says, “the mind for us is the perfection of nature.”<sup>x</sup> It alone is divine and a divine principle. (*De Generat. Animal.*, lib. ii., cap. iii.; *De secret. part. Divin. Sapient.*, &c., lib. i., cap. iv.; *De Moribus*, lib. x., cap. vii.) “It alone is immortal and eternal, and the form of forms.” (*De Generat. Animal.*, lib. ii., cap. iii.; *De Animá*, lib. iii., cap. ix.) “True life is the action of mind.” (*De Moribus*, lib. x., cap. vii.) Those things live in which there is mind, sense, local motion, order, accession, or recession. (*De Animá*, lib. ii., cap. ii.) “To live is to feel and understand.” (Part II., n. 245.)

## V.

251. But to know the manner in which this life and wisdom flow in, is infinitely above the sphere of the human mind: there is no analysis and no abstraction that can reach so high: for whatever is in God, and whatever law God acts by, is God. The only representation we can have of it, is in the way of comparison with light. For as the sun is the fountain of light and the distinctions thereof in its universe, so the Deity is the sun of life and of all wisdom. As the sun of the world flows in one only manner, and without union, into the subjects and objects of its universe, so also does the sun of life and of wisdom. As the sun of the world flows in by mediating auras, so the sun of life and of wisdom flows in by the mediation of his spirit. But as the sun of the world flows into subjects and objects according to the modified character of each, so also does the sun of life and of wisdom. But we are not at liberty to go further than this into the details of the comparison, inasmuch as the one sun is within nature, the other is above it: the one is physical, the other is purely moral: and the one falls

\* In all the instances in n. 249 to which a reference is appended, the word translated *animus* by Swedenborg, is the Greek  $\psi\upsilon\chi\eta$ , *anima*.—(Tr.)

under the philosophy of the mind, while the other lies withdrawn among the sacred mysteries of theology ; between which two there are boundaries that it is impossible for human faculties to transcend. Furthermore, by the omnipresence and universal influx of this life into created matters, all things flow constantly in a provident order from an end, through ends, to an end.

252. *But to know the manner in which this life and wisdom flow in, is infinitely above the sphere of the human mind : there is no analysis and no abstraction that can reach so high.* The doctrine of abstracts does not extend beyond its own series, in which there are degrees ; in short, it cannot ascend beyond nature to a Being that cannot be finited in thought, and still less can be circumscribed by ontological terms or vocal formulas. Our human thought seizes upon some fixed object in nature, and when it takes sublimer wing, it contemplates the universe as the ultimate object, yet with a boundary, end or limit ; and it is overpowered when it asks itself what there is beyond the universe, and finds that it cannot separate even this further goal from ideas of space. And the case is the same in all other instances, such as in things of the purest nature ; for when the mind concentrates itself in the contemplation of any exquisitely minute object, it breaks the thread of its own accord, and knows no better what is beyond or within that object than what is beyond the universe. For the mind, as we before said, cannot understand anything, except so far as it is attached to some natural thing, as the subject of its thought when thinking is natural, and it derives its state from ideas that come from the phenomena of the world and its nature through an *a posteriori* channel, or by way of the external senses : wherefore to go to the Deity is above its powers. No one can enter into God except God himself, whose will it is that our thoughts should terminate in a certain infinity and abyss of things, which should throw us into a state of holy amazement, and so give rise to a profound adoration of his being and a sacred unbounded ascription of honor to his name. Then it is that he receives us, takes us into his confidence, and stretches forth his hand to save

us lest we perish in the deep. It will, however, be well by a few reflections to confirm our ideas that whatever is in God is infinite and boundless. Our soul, although circumscribed by the body, nevertheless, in its representations and intuitions, is only limited by the created universe (Part II., n. 247),—as we shall prove in the sequel,—consequently it is as it were indefinitely finite; for it cannot in its mind comprehend the boundaries of the universe. Now if the soul, which is within nature, and below the first substance of the world, is of indefinite intuition, what must be the case with the Supreme Being, who is above nature, and whose essence is life and wisdom. It is impossible to think of Him as limited and within the universe, for necessity dictates that He is that to which no limits can be assigned; in other words, that He is infinite. But since in this Divine Abyss there is nothing but what is eternal, infinite, illimitable, holy,—away and away, we exclaim, with reason and philosophy, which long before they arrive at the verge of this fathomless deep, fail, and are forced into silence from the inability of language. They, then, who by the guidance of mental philosophy dare to attempt this abyss, become the devoted victims of their rashness; they return as it were paralyzed and faltering, like persons who have looked over sheer precipices into the vast profound; or else blinded, like those who have gazed upon the sun; and ever after, as I have often deplored, some spot or shadow flits before the eye of their reason, which at all times is dull enough of itself, so that they are blind in broad daylight, and live at the mercy of their own phantasies; a just punishment for their presumption. (Part I., n. 297.) If an expression must be used to signify this Almighty Being, there is no other than the word Jehovah, the I AM and the I CAN, yet understood in himself and above all nature: but if expressed within nature, he is called God, and omnipresence, omniscience and omnipotence are attributed to him, although the mind cannot define these attributes except from the finite sphere and the all thereof; so that it gains no idea of the infinite. This very I AM, or esse, is life, the life is wisdom, the wisdom is all for the sake of the end, that the esse may be the first and the last end, for the sake of which, or for which, every finite end in the universe exists. “It is the unfailing

condition of all lower being," says Grotius, "that it cannot comprehend anything that is higher and more excellent than itself. The beasts cannot comprehend what man is; and much less do they know by what means mankind establishes and governs states, measures the courses of the stars, and navigates the ocean." (*Op. Cit.*, lib. i., § 2.) Our philosopher also places God above all categories. "The first cause," says he, "is above every name that is named, and is the esse of created things."<sup>x</sup> Now if we cannot penetrate into the first *esse* of the animal kingdom, or into the first *esse* of the created universe,—("for the first substance," says the philosopher, "cannot be recognized in the nature of things except by analogy and similitude, and must therefore be considered apart from form and accidents,"<sup>x</sup>)—how shall we attempt to penetrate into the mystery of an esse that is altogether supernatural.

253. *For whatever is in God, and whatever law God acts by, is God.* For whatever is in Him, cannot be separated from his Esse, although what is in us is separable; so that our esse is not our own except from and by him who is the I AM and the necessary Being. Grotius has the following as his conclusion from a variety of considerations: "That which exists *per se*, or necessarily, is one; whence it follows, that all other things have originated from something different from themselves; now whatever things have arisen from an extrinsic source, have all in themselves, or in their causes, originated from that which itself never had an origin, that is, from God." (*Op. Cit.*, lib. i., § 7.) Thus in vain do we endeavor to find, except from revelation, how God acts, and how he communicates with our souls, because the action of God is God himself. "The operation of God," says the philosopher, ". . . is perpetual life." (Part II., n. 238.)

254. *The only representation we can have of it, is in the way of comparison with light.* We are not forbidden to approach the divine sanctuary by the path of comparison; for since it is he for whom we exist, and whose we are to be, and with whom we are conjoined by love, so in order that we may understand his attributes, he has willed that we should understand them through nature; consequently, through signs, by the help of which the principles of our minds are formed. There is nothing more usual, even in the Holy Scriptures, than a comparison of the

Deity with the sun ; of his life with light ; of his wisdom with the distinctions of light ; of his operation with its rays ; and the ascription of clearness to the human intellect, according to the degree of its elevation ; and of shade, darkness, and thick darkness, according to its degree of privation. Therefore let us go on in the path of comparison, remembering always that although comparison illustrates, yet it does not teach the nature of that with which the comparison is made.

255. *For as the sun is the fountain of light and the distinctions thereof in its universe, so the Deity is the sun of life and of all wisdom.* Wherefore as the sun of the world by its light illuminates the universe, so does the sun of life with the light of his wisdom : for the presence of the one may in a manner be compared, using due caution, with the omnipresence of the other. For the author of all things has so constituted the world, that in it we may contemplate his being and his power. (*Romans* i. 20.) Unless the sun flowed in unceasingly, all things formed out of nature would perish, and nature herself would return to her source : unless the Deity flowed in unceasingly, all things gifted with life would die, and the universe would be annihilated : for whatever exists, must subsist by that from which it first existed. As the sun flows universally, that is to say, most singularly, (Part II., n. 205,) into the substances of its universe, and constantly so emprinciples them as to enable them to exist after a natural manner ; so the Deity flows most universally, and hence most singularly, into all things, and constantly vivifies them ; and those things which he has not endued with sensual life and intellect, he nevertheless so directs that they flow obediently to the ends of his providence. Inasmuch then as God is life and wisdom, it is improper to term him the soul of the universe, for the word soul involves the idea of a natural subject, accommodated at once for the beginning of motion and for the reception of life.

256. We have said that it is a dictate of sound reason that God is the life of the universe, as the sun is the light of the universe, and we are convinced in this position by the testimony of the chief philosopher of the Gentiles. God, says he, has filled the universe with his harmonies. (*De Generat. et Corrupt.*, lib. ii., cap. x.) “ God has kindled the mind as a light

in the soul." (*Rhetoric.*, lib. iii., cap. x.) "The animus is the spring and principle of living things." (Part II., n. 249.)

257. *As the sun of the world flows in one only manner, and without unition, into the subjects and objects of its universe, so also does the sun of life and of wisdom.* That the sun inflows in one only manner, although not in a similar degree, is clear in respect to its light; and there are some considerations which induce us to think that comparatively the same may be predicated in respect to the influx of life into created things. For that which is one thing, cannot be any other thing; that which is necessary, cannot be contingent; for whatever is in God, and whatever law God acts by, is God. (Part II., n. 253.) Wherefore to act as God is to act in one only manner. Of this we are convinced by arguments derived both *a priori* and *a posteriori*: for as God is wisdom, all things flow from an end, through ends, to an end; he himself is the last end and the first, to the intent that the intermediate ends, and those of all creation, may conspire to one end. One only mode of influx follows of necessity from a necessary Being. Our philosopher has thought the same. "The first cause," says he, "exists in all things according to one disposition." (*De Mundo*, cap. vi.) "The first cause induces its goodness upon all things, by one influxion." (*Ibid.*) The first cause, whatever may pertain to it,—and our philosopher acknowledges it as the veriest esse,<sup>x</sup> and declares that "in things eternal esse and posse mean the same," (*Natur. Auscult.*, lib. iii., cap. v.),—the first cause, I say, to us who are better instructed, cannot be any other than the Supreme Being.

258. But that God flows in with his virtue without any essential unition, is indeed so high a position, that we cannot be persuaded of it by mere comparison. That it is thus the sun flows in with his light, is clear as day; as for instance, into the eye, producing sight, which ceases at once on the absence of light; and into other objects and subjects, whose distinctions, occasioned by light and shade, and whose different colorings, disappear at once with the solar beam. With respect to God, the source of vital light or life, we cannot doubt that he may by his spirit be essentially united [with man] as he was with Adam before the fall; but the mind hesitates whether it may

dare to affirm, or whether it may be proper to say, that God is in the same manner united with corruptible, imperfect, and so far as regards state, mutable souls. For were life implanted in us, it would be communicated from this divine fountain and source; hence it would be, together with its subject, incorruptible, perfect, and immutable, so long as it was thus within us. "In eternal natures," says our philosopher, "there is no evil." (*Metaph.*, lib. ix., cap. ix.) "God is a law in us, equably infused, and admitting of neither correction nor mutation." (*De Mundo*, cap. vi.) How then the mutable and immutable should at one and the same time be conceived as existing in us, I do not know: at least it is more than I can understand. For if it flowed in after one only manner, it would also exist in us in one only manner; were its inexistence granted. If we distinguish between life and wise life, then we deduce life from a fountain that may admit of degrees like those in nature; and the same if we suppose nature so created as to live of itself: whence arises the error that nature can also of itself live more and more perfectly, even to the attainment of wisdom; when yet nature considered in itself is dead (Part II., n. 234—238), which it would not be if life were in it essentially. Wisdom may indeed leave us, and yet life continue, for persons live who are yet insane. The eye may lose the power of perceiving distinctions, and yet it may not lose the sense of sight, for it may retain a perverted sense of distinctions; while nevertheless the real distinctions which we see, and the perverted distinctions, are both of them observed in one and the same light.

259. But let us see what the sound reason of the Gentile philosopher, and what the illuminated reason of the Christian philosopher, dictates. "The former says: The first cause governs all created things, but beyond this is not mixed with them. (*De Mundo*, cap. vi.) "Bodily action does not communicate at all with the operation of the mind." (*De Generat. Animal.*, lib. ii., cap. iii.) With regard to what he means by mind, see above, Part II., n. 250, where he says that "it alone is divine and a divine principle," and that "it alone is immortal and eternal;" and that "true life is the action of mind," and that "the action of God is life," &c. (*Ibid.*, n. 238.) "The mind alone is divine," says he, "and comes from without." (*De Generat. Animal.*, lib.



ii., cap. iii.) “The intellectual soul is infused by divine power, and has no communication in its operations with the body, because it does not result from the power of the body, but is of nobler and higher extraction.”<sup>x</sup> And Grotius says: “The first cause cannot be deprived of any perfection; neither by any other being, because what is eternal does not depend upon other things, nor suffers at all from their action; nor yet by itself, because every nature desires its own perfection. . . . No nature communicates anything to God.” (*Op. Cit.*, lib. i., § 4, 5.) With regard to brute animals, he says that, “they perform actions which are so well ordered and directed, that they always seem as if they proceeded from a kind of reason . . . ; but that they do not possess the power of discovery, or of judging between different things, appears from the fact, that they always act in one and the same manner: wherefore it follows that these actions proceed from an extrinsic reason, either directing them, or impressing its efficacy upon them. And this reason is no other than God.” (*Op. Cit.*, lib. i., § 7.) With regard to the difference between the souls of brutes and of men, the reader is referred to the sequel.

I confess however that while I am lingering on this threshold that conducts me almost beyond the bounds of nature, or while I am daring to speak of the union of God with the souls of his creatures, I feel a certain holy tremble stealing over me, and warning me to pause; for the mind thinks it sees what it does not see, and sees where no intuition can penetrate; nor can it tell whether what it thinks enters in the *a priori* or *a posteriori* direction; if by the latter, life appears to be inherent; if by the former, it appears to be not inherent, or not essentially united to us. And what increases this awe is, a love of the truth, which that it may hold in my mind the supreme place, is the end of all my endeavors, and which, whenever I deviate from it, converts itself into a representation of justice and condign punishment, or into that fear which an inferior being is wont to feel towards a superior; so that I would rather resign this subject into the hands of others more competent than myself. This alone I perceive most clearly, that the order of nature exists for the sake of ends, which flow through universal nature to return to the first end; and that the worshippers of nature are insane.

260. *As the sun of the world flows in by mediating auras, so the sun of life and of wisdom flows in by the mediation of his spirit.* It is evident from natural physics that this is the case with the sun; see Part I., n. 86—89, 65—68, and also my *Principia*. I scarcely know how to mark the condition of those who maintain that light in itself is an afflux of material atoms, when nature in all her phenomena demonstrates the contrary. That the sun of life flows into created things by the mediation of his spirit, which is therefore often compared with the purest aura, is a truth which we may learn from the Holy Scripture.

261. *But as the sun of the world flows into subjects and objects according to the modified character of each, so also does the sun of life and of wisdom.* All things, observes our illustrious philosopher, receive the goodness of the first cause according to the capacity of their nature. (*De Mundo*, cap. vi.) This is evidently the case with light; for although it inflows in one only manner, yet it is not received in one only manner by objects; for some objects reflect it; some infraet it; others variegate it in divers ways; some absorb and darken even its meridian lustre; and on the other hand, all the simpler objects are pellucid, because of their regular transmission of its rays. (Part II., n. 242.) To speak by way of comparison, we may observe, that the objects in animate beings are the most simple fluids, so intrinsically fashioned as to be adapted for receiving the eminent light of the first cause, but that by reason of the freedom of action with which they are endowed, they can reflect, infraet, variegate, yea, even darken this light; and on the other hand, according to their faculty of acting, and of suffering themselves to be acted upon, and of disposing themselves, they can admit, exalt and enkindle it (Part I., n. 610); but the means of so doing must be sought from revelation. Not indeed that we ourselves are able of our own will and pleasure thus intimately to dispose ourselves, and enkindle this light, but that it is in our own will to use the means by which it may be done, and to pray that we may be illuminated, enkindled, and even compelled. For it is an eternal law that our will calls forth the divine consent, not that his will compels us to act. On this subject, however, the reader is referred to the sequel, where we treat of free will.

262. But what are we to think of those who are deprived of this light, or of wisdom ; of those depraved natures that are altogether blind and in the dark, and that nevertheless, as our comparison shews, are surrounded by the same illumination. Not to travel beyond our comparison, we would say that the eye is the organ and subject for distinctly perceiving the solar radiations, but from some accidental injury in the determination or disposition of its essentials, it may become debilitated, vitiated, darkened, or blinded, while the goodness and power of the light remain unchanged ; nay, when it is injured, the pain it suffers is the greater in proportion to the greater intensity of the rays. Light is not communicated and poured into it once for all, but is constantly communicated and poured in, every time the earth is illuminated ; and hence we have the sense of sight. Moreover there are some living creatures that can out of their own natures raise up a light in the dark when they are inflamed with desire.

263. Let us then complete this subject before we leave our comparison. Sound must not be in the ear itself, to enable it to hear, but for that purpose must come as an accident from without. Light must not be in the eye itself, to enable it to see, but for that purpose must come as an accident from without. Life must not be in an organic substance to enable it to live and understand, but for those purposes, to speak comparatively, it must come as an accident from without.

264. Furthermore, sound, with all its variety, is received by the ear according to the form of the latter, and according to the state induced by nature and habit. Light, with all its variety, is received by the eye according to its form, and according to the state induced by nature and habit. Life, with all its variety, is received by the organic substance according to its form, and according to its state, induced by nature and habit.

Moreover in order that sound with its variety may be received according to the form and state of the ear, the very variety that flows in must be formed from without, and not in the ear itself. In order that light with its variety may be received according to the form and state of the eye, the very variety that flows in must be formed without, and not in the eye itself. In order that life with all its variety may be received

according to the form and state of the organ, the very variety must be formed without; that is, above and not in, the organic substance itself. An application of this law to the phenomena furnished by physiological experience will be made in the following Parts of the Work. See the *First Epistle to the Corinthians*, xii., 4, 6, &c.

265. *But we are not at liberty to go further than this into the details of the comparison.* We may not speak, for instance, of the manner in which the degrees of this light are to be compared, in respect of their exaltation, force and presence. We cannot say with what power, according to what laws, and in what manner, the subject reflects, infracts, diminishes, and intercepts these rays, opposes to them its own mists, and beclouds itself; how again when these mists are dispersed, it emerges into the light; how it warms with zeal; and, on the other hand, how it cools from want of it; in what way it is illuminated by reflection; with many other things which, as I before said, transcend the limits of the comparison. The reason now follows:

266. *Inasmuch as the one sun is within nature, the other is above it: the one is physical, the other is purely moral: and the one falls under the philosophy of the mind, while the other lies withdrawn among the sacred mysteries of theology; between which two there are boundaries that it is impossible for human faculties to transcend.* For the mind, which is within nature, there is no path open beyond and above nature; consequently none by which its philosophy can penetrate into the sanctuary of theology. No human faculty of perception can possibly understand of itself its own essence and nature; much less the essence and nature of anything higher than itself. Thus no sensitive organ can understand what perception is: no organ of perception can understand what intelligence is: nor can intelligence, so far as it is merely natural, understand what wisdom is. The higher power must judge of the lower. (Part I., n. 623.) Therefore the lower exists as it is by means of the higher. Let us therefore on no account venture beyond bounds, nor rashly trespass upon sacred things with our reasoning powers. All that it is lawful to do is to kiss the threshold, that we may know that there is a Deity, the sole Author and Builder of the universe, and of all

things in the universe, who is to be revered, to be adored, to be loved; and that the providence of our reason is respectively nothing, while the providence of his wisdom is all in all. But what his Divine Nature is; how he is to be worshipped; in what way he is to be approached; by what means he is to be enjoyed,—this it has pleased him, immortal glory be unto him, to reveal in his holy testaments and oracles. Only supplicate his pardon, use the appointed means, weary him with prayers, speak from the soul, not from a heart covetous of the world, and surer than certainty he will open to you the sanctuaries of his gracious favor. (Part I., n. 298.)

267. *Furthermore, by the omnipresence and universal influx of this life into created matters, all things flow constantly in a provident order from an end, through ends, to an end.* See Part II., n. 236, 237, 364. For this life is wisdom itself, and hence in the present, views and comprehends the future and the past; that is to say, at the same time views and comprehends the last end or the first, and the intermediate ends also. Most stupendous is the order and connection of all things in the world and its three kingdoms. All things flow from an end, through ends, to an end. There is a most universal providence in the veriest particulars, to recount the arguments in proof of which, would be to impose an impossibility upon the most untiring tongue by reason of the infinite evidences with which creation overflows. To be lost in silent astonishment, therefore, at this display of Divine Wisdom, is more becoming our nature, than to overburden ourselves with proofs of its existence. In all the heavens there is nothing, throughout the whole earth there is nothing, but exhibits in most palpable signs the presence of a superintending Deity; so that he who sees nothing in all these evidences, is blinder than a mole, and viler than a brute. (Part I., n. 296.)

268. Our philosopher\* saw this too by virtue of the mere light of his understanding. “God,” says he, “holds the beginning and end, and the means of all things.” (*De Mundo*, cap. vii.) “God contains the world, and the world is from him.” (*Ibid.*) “God and nature do nothing at all in vain.” (*De Cælo*,

\* Whenever THE (OR OUR) PHILOSOPHER is mentioned in this Part, Aristotle (“the chief philosopher of the Gentiles,” Part II., n. 256) appears to be the author alluded to.—(*Tr.*)

lib. i., cap. iv.) “Nature makes those things that being continually actuated by an internal principle, arrive at a given end.” (*Natur. Auscult.*, lib. ii., cap. viii.; *De Part. Animal.*, lib. i., cap. i.)

Whether therefore in the very beginning, or at the creation of things, there may have been an essential union of the spirit of God with created subjects, as in the first man; and afterwards an influxion of virtue, so that things created might thus conspire most perfectly to the end of the universe; is a question too lofty for the human understanding, and it would therefore be more prudent and proper to entertain no determinate thoughts upon such a subject.

## VI.

269. There are then two distinct principles that determine this spirituous fluid assumed as the soul; the one, natural, by which it is enabled to exist and be moved in the world; the other, spiritual, by which it is enabled to live and be wise: of these a third, as properly its own, is compounded; namely, the principle of determining itself into acts suitably to the ends of the universe. But this principle of self-determination regards the ultimate world, or the earth, where the determination takes place; and hence the soul thus emprincipled must descend by as many degrees as distinguish the substances and forces of the world: and by consequence form a body adequate to each degree in succession. There are, then, sensory and motory organs; both of which are distributed into four degrees. The first of the organs is the spirituous fluid or soul; whose office it is to represent the universe, to have intuition of ends, to be conscious, and principally to determine. The next organ under the soul is the mind; whose office it is to understand, to think, and to will. The third in order is the animus, whose office it is to conceive, to imagine, and to desire. The fourth or last is constituted of the organs of the five external senses, namely, sight, hearing, smell, taste, and touch. So also the motory

organs, of which the muscles are the last. These and the sensory organs constitute the body, whose office it is to feel, to form looks and actions, to be disposed, and to do what the higher lives determine, will, and desire. Although there are this number of degrees, yet the animal system consists of nothing but the soul and the body; for the intermediate organisms are only determinations of the soul, of which, as well as of the body, they partake. Such now is the ladder by which every operation and affection of the soul and body descends and ascends.

270. *There are then two distinct principles that determine this spirituous fluid assumed as the soul; the one, natural, by which it is enabled to exist and be moved in the world; the other, spiritual, by which it is enabled to live and be wise.* From what has gone before it is clear, that the principle of motion, or the natural principle, flows in after one manner; and life after another: in fact that the natural principle in this eminently organic and perfectly fluid substance, possesses its coöperant or mediant, namely, the first aura: but not so the latter, if there be no essential union with the spirit of life; so that the relation is as between the operation in it and the operation upon it.

271. *Of these a third, as properly its own, is compounded; namely, the principle of determining itself into acts suitably to the ends of the universe.* That is to say, which can naturally determine itself into acts by the mere aspiration of life, which inflows in one only manner, according to the modified character of each particular subject. (Part II., n. 261—264.) This determination into acts takes place according to the influx of nature, whose true order is, that all things should constantly flow from an end, through ends, to an end. (*Ibid.*, n. 267.) Both systems (namely, the great system of the universe, and the little system of the body,) have their own first substance; but the first substance of the body depends for its existence and subsistence upon the first substance of the world. (Part I., n. 592.) From it, and according to its nature, flow all things which have a visible determination in the entire series. (*Ibid.*, n. 595.) Thus the soul determines itself into acts of itself, and regards ends beyond itself.



272. *But this principle of self determination regards the ultimate world, or the earth, where the determination takes place; and hence the soul thus emprincipled must descend by as many degrees as distinguish the substances and forces of the world: and by consequence form a body adequate to each degree in succession.* The auras are the forces of the world, because they are the forms of the forces of the universe, as we have often shewn above. The phenomena of the world plainly declare that these auras are four in number, perfectly distinct from each other, and one prior and superior to the other, and more universal and more perfect than the other. Thus that there is an air by which we are surrounded, is incontestably proved by hearing, respiration, the air-pump, and the whole range of experimental physics. That there is an ether or subtler air, is proved by the sight, as well as by the air-pump, for light and shade are still distinct, and colors survive, although the air be exhausted from the receiver. That this ether is a real but higher atmosphere, is demonstrated in its own light by the organism of the eye, and by the whole of optical experience; for the matter of the organ is seen to be exactly determined to the form of its modifications; in order that it may be suitably touched, modified, and affected; for a vacuum admits of no affection, and has no organic forms corresponding to it. That this aura is prior to the air, is also evident from the fact, that it can subsist without the air: that it is higher and more perfect than the air, is clear from the fact, that the sounds of the ear correspond to the images of the eye, or of the animus. Modified forms are also similarly reflected, infracted, are resilient at the angle of incidence, possess the highest elasticity, contain crowds of effluvia, carry about and agitate them, giving rise to phosphoric appearances, wandering meteors, and many other phenomena, which, from their mysterious nature, carry away the rational sight into a sort of ignorant astonishment, and occasion perpetual discordance in accounting for their origin, so long as we deny the existence of such an aura: &c. That a still purer ether or higher aura exists, distinct from the ether just spoken of, is evident from the magnetic force (see my *Principia*), also from the vortex of our earth, within whose sphere the moon is carried round, and which great vortex has lesser vortices circumgyrating exactly in the same

manner as itself; for from the form, nature, and mode of acting of aggregates, are discoverable the form, nature, and mode of acting of their parts, (Part I. n. 631); each part being a type of its universe. (*Ibid.*, n. 105, 159, 306; and above *passim*.) The existence of this aura is proved also by the instincts of brute animals, whose purest fluids owe their origin to it, and are affected by it; for they know how to turn accurately to the quarters, and by the sole guidance of a natural force to return to their homes many miles distant, by ways they have never before smelt or tried; they know how to extricate themselves at once from labyrinthine mazes, and so they act as living magnets; not to mention innumerable other circumstances. That a yet purer aura exists, which is in fact, the first, the highest, the most universal, and the most perfect,—this position is the consequent of the antecedent positions, because the aura itself is the antecedent of the consequent auras. Now if the aura just mentioned describes vortices around the earth and the planets, there must be a vortex, or corresponding universe, embracing and directing all other vortices or universes, and this grand vortex, and that previously spoken of, must mutually correspond with each other in the relation of superior and inferior. So too if the magnetic aura just touched upon affects the fluids of brute animals, there must be a superior aura that affects the higher human fluid, for without the mediation of such an aura, no light from the sun, much less from the stars, would ever reach the eyes of the inhabitants of our earth; for, as we before observed, a vacuum, or what is the same, nothing, admits of no affection. And without this supreme aura the minutest forms could not be held together in connection, nor could effects flow from their first causes according to the order of nature. (Part I., n. 66—68, 584.) But perhaps I am telling tales to the deaf: should such be the case, my audience is well described by an Englishman of fine genius. “If,” says Locke, “assent be grounded on likelihood, if the proper object and motive of our assent be probability, and that probability consists in what is laid down in the foregoing chapters, it will be demanded, How men come to give their assents contrary to probability? (*Op. Cit.*, book iv., chap. xx. § 1.) [There are some men] who, even where the real probabilities appear, and are plainly laid before them,

do not admit of the conviction, nor yield unto manifest reasons, but do either ἐπέχειν, suspend their assent, or give it to the less probable opinion. And to this danger are those exposed, who have taken up wrong measures of probability. (*Ibid.*, § 7.) There is nothing more ordinary, than childrens receiving into their minds, propositions . . . from their parents, nurses, or those about them: which, being insinuated into their unwary, as well as unbiassed understandings, and fastened by degrees, are at last (equally, whether true, or false) rivetted there, by long custom and education, beyond all possibility of being pulled out again. For men, when they are grown up, reflecting upon their opinions, and finding those, of this sort, to be as ancient in their minds, as their very memories, not having observed their early insinuation, nor by what means they got them, they are apt to reverence them, as sacred things, and not to suffer them to be profaned, touched, or questioned. (*Ibid.*, § 9.) Next to these, are men, whose understandings are cast into a mould, and fashioned just to the size of a received hypothesis. (*Ibid.*, § 11.) [There are] those who want skill to use those evidences they have, of probabilities; who cannot carry a train of consequences in their heads, nor weigh exactly the preponderancy of contrary proofs and testimonies, making every circumstance its due allowance. (*Ibid.*, § 5.) The fourth . . . wrong measure of probability . . . is . . . giving up our assent, to the common received opinions, either of our friends, or party, neighborhood, or country. . . . If we could but see the secret motives, that influenced the men of name and learning in the world, and the leaders of parties, we should not always find, that it was the embracing of truth, for its own sake, that made them espouse the doctrines they owned and maintained. This at least is certain, there is not an opinion so absurd, which a man may not receive upon this ground. There is no error to be named, which has not had its professors: and a man shall never want crooked paths to walk in, if he thinks that he is in the right way, wherever he has the footsteps of others to follow." (*Ibid.*, § 17.)

273. If therefore the auras of the world are four, and if these are so many forces of the nature of the universe, the soul must descend by the same number of degrees, and adapt itself to each, and form an organism corresponding to all; and this,

according to natural order, from the higher degree to the proximately lower, but not from the highest to the lowest except through the intermediates. (Part I., n. 611.) *There are, then, sensory and motory organs; both of which are distributed into four degrees.*

274. *The first of the organs is the spirituous fluid or soul; whose office it is to represent the universe, to have intuition of ends, to be conscious, and principally to determine.* In the consideration of this subject, the following positions must be examined one by one; for they form the prime thread on which rational psychology depends.

The spirituous fluid is the first of the organs, or the supereminent organ, in its animal body. And as it is the soul, it is seated so high above all the other faculties, that it is their order, truth, rule, law, science, art. Consequently its office is, to represent the universe; to have intuition of ends; to be conscious of all things; principally to determine. It is a faculty distinct from the intellectual mind, prior and superior to, and more universal and more perfect than, the latter. And it flows into the intellectual mind much after the manner of light. Consequently a notion of it can hardly be procured while we live in the body.

Let us now consider these clauses one by one.

275. *The spirituous fluid is the first of the organs, or the supereminent organ, in its animal body.* See Part II., n. 198, 199; Part I., n. 65—68, 594, 604, 635. In order to be an organ, there must be in it a series of things, and a form of things. See Part I., n. 260, 261, 586. That it is the form of forms, see Part II., n. 228; Part I., n. 253—256. However obscure our idea may be, yet we shall clearly perceive by a little attention, that the stupendous machine of the animal body could by no means have come together without a positive directive force; and we shall acknowledge at once, if we think up to causes and origins, that such a directive or formative force is not without but within the chick or embryo; and that it must exist within that substance that was the first in the ovum, and

that has life or soul within it. Now if we consult the anatomy of bodies, particularly those of early foetuses, or those that are still in the egg, we shall meet with a certain most fluid matter, that from the first stamen, by a wonderful determination, successively projects, delineates and describes the entire image of the future body. Surely then we must grant, that this directive force is seated in this fluid, and if so, we must also conclude from the infinite variety of particular effects, that it involves a certain wonderful form in the whole and in all its parts; for if not, mighty miracles of formation would result from mere chance. Hence it follows that this substance is the form of forms, or the supereminent organ of organs. To suspend our belief in this until the microscope shall visibly present it to the eye, is only to appeal to future generations, which will certainly cheat our hope. Is it not enough that an army of effects expounds it to the rational sight; and that at the same time the doctrine of the order of the universe declares that all things are involved more perfectly in first substances; and that the first substance or force of every series plainly exhibits its own nature to view in the posterior sphere; as we have often and often shewn in the preceding pages? Thus this fluid wears the name and prerogatives of a supereminent organ.

276. *And as it is the soul, it is seated so high above all the other faculties, that it is their order, truth, rule, law, science, art.* Order itself is truth, according to philosophers. He that investigates the essential order of nature, investigates truth; and he that investigates truth, investigates the rules and laws of order. For the discovery of these we require science and art, together with advancing years; for laws and rules are reduced to a science by the mature powers of the mind. Whoever will mount from the posterior to the prior sphere, must inevitably advance through sciences and arts, and through their rules and laws; just as the human mind, which must attain wisdom in the *a posteriori* way, or by experience and the use of the external senses. But those who descend from the prior or superior sphere to the posterior or inferior, stand in no need of sciences and arts, but are above them, and act from their principles; and when they descend, pass actually through the intimate and secret rules and laws of the sciences. Such is the

case with the human soul, or the force directive and formative of the lower things of its body. But let us be instructed on these subjects by effects, for we ought to be taught analytically, in the same order in which our minds are instructed, whether what is said be true or not. We know from sight that the eye, with its coats, humors, retina, nerves and fibrils, is constructed exactly on the type of the modifications of the ether: the ear, with its ossicles, tympanum, fenestræ, canals and cochlea, exactly on the type of the modifications of the air: the tongue, with its complicated fibrils, papillæ, glands and motive forms, on the very model of the whole variety of flowing, touching and titillating parts in the food: that the muscles are constructed to represent the series of all the actions of the body; the lungs with their numberless pipes and vesicles, for the reception of the smallest volumes of air: the organs of conception and reception, I mean, the genital organs in both sexes, for fresh births and new formations *sui generis*, from the first stamen and ovum, &c., &c. Now if all these and other wonders of animal nature proceed from their own directing force, or from their soul, they must necessarily proceed from a force or soul that is placed above all the sciences and arts of its own world; or that is itself essential science, art, rule, law; that is, truth and order. For did the slightest particular that lies in any science escape it, assuredly it would have been unable to begin, much more to continue and complete, the stupendously ingenious web of the animal structure. Hence while the soul acts from science she acts from herself; while she reduces and directs her posterior microcosm into order, she reduces and directs it from order, that is, from herself. She herself is unaware of her own character and greatness, since she naturally *is* as she acts. In order to know this, she must reflect upon her inferior spheres, when they are out of the order and truth in which she herself is; thus by way of representation, when she observes contrarieties. Unless the soul were the very law and perfection of her own animal nature, or of herself were conscious of all things in her universe: it would be impossible for her at the first approach and contact at once to gain a complete knowledge of the harmonies and disharmonies of natural things; of pleasant and unpleasant in touch, taste, smell, hearing, and

sight; of undelightful and sorrowful in the animus; of anxiety in the mind; pain in the body; and other things; which she at once perceives as repugnant, when they happen without a suitable reference to her order. In a word, unless the soul were science itself, there could be no sensation, no volition, that is, no affection. That we possess a soul with more knowledge than we believe, is obvious from the very nature of the mind, in which a kind of highly rational philosophy, and a peculiar logic appears as it were connate from the first beginning of our sensations, and which is perfected in proportion to the growth of the understanding. If we would acquire these sciences, and cast them into the mould of learning, we must enter into ourselves, and diligently reflect upon all the operations of our minds; then the more deeply we reflect, the higher we shall penetrate into their secrets. Thus the more we are instructed out of ourselves, the wiser philosophers do we become. Must there not then be that within us whose activity is essential science, and whose action embraces all science: I say all, because the sciences so respect and touch each other, that if one be wanting, a link is immediately deficient in the chain. On this subject the illustrious Loeke speaks as follows out of his own reflection. "This," says he, "... I call intuitive knowledge; which is certain, beyond all doubt, and needs no probation, nor can have any; this being the highest of all human certainty. In this consists the evidence of all those maxims, which nobody has any doubt about, but every man . . . knows to be true, as soon as ever they are proposed to his understanding. In the discovery of, and assent to these truths, there is no use of the discursive faculty, no need of reasoning, but they are known by a superior, and higher degree of evidence. And such, if I may guess at things unknown, I am apt to think, that angels have now, and the spirits of just men made perfect shall have, in a future state, of thousands of things, which now either wholly escape our apprehensions, or which, our short-sighted reason having got some faint glimpse of, we, in the dark, grope after." (*Op. Cit.*, book iv., chap. xvii., § 14.)

*Consequently its office is, to represent the universe.* Inasmuch as the soul is order and truth, and in the prior sphere of all the



posterior things of its system,—that is to say, in the principles of sciences, and in the cause of causes,—so it is also in the representation of itself in the universe, and of the universe in itself; that is, of the microcosm in the macrocosm. In a similar representation relatively to its universe is the first substance of the world, on which, as a principle, the principles of natural things are impressed by the Deity (Part I., n. 591): so also every prior substance, whether of the universe, or of any system in the universe, represents its posterior substances. Thus the first aura represents the second; the second represents its ether; and the ether, its air. The case is the same in the animal body, of whose degrees we shall treat in the sequel, and every one of which is represented by the degree prior to it. This representation extends as a cause to all causates or effects, and as an antecedent to all consequents, and from past things to future; so that effects, consequences, and futurities, may be said to exist potentially in their prior, like the proportions and analogies in an equation, into which they are successively insinuated, and then simultaneously exist in it, and are successively unfolded and evolved from it. But it is to be noted, that the posterior may properly be said to represent its prior; yet as the power and force of self-representation in the posterior belongs to the prior, the formula will be true whichever way we turn it.

But the soul not only represents the universe naturally, as also do the entities of the inanimate world, but also intellectually; for the soul lives; wherefore *it represents the universe to itself*; and thus not only represents effects from itself as a cause, and consequences from itself as an antecedent, and future things from itself as *a priori* or previous, but it also represents the ends, on account of which all things flow in their order; for it is the mark of an intelligent being to respect ends. (Part II., n. 236, 237.) Wherefore the first ends, as well as the middle and ultimate ends, according to which causes follow in provisory and given order till they arrive at the ultimate effect, appear to be present to it, and inherent within it, simultaneously and instantly. (Part I., n. 260.) And it represents to itself the state about to be formed, just as if it were a state already formed; and indeed the state already formed as a state about to be formed. (*Ibid.*, n. 261—271.)

But as the soul is science and not wisdom, for God alone is wisdom, and as the soul is within created nature, hence it cannot of itself represent to itself any ends but such as are bounded by the created universe; hence it can only represent the order and rules of the universe in itself, and its order and rules in the universe; and in this faculty we have the origin of the sciences. Thus its operations are bounded only by the universe, although the soul itself as a substance, is kept within the limits of its own body. To illustrate this point; the eye, which stops in the scale of perfection far below the soul, although shut up within its orbit, can nevertheless extend its vision to the sun, and even go forth beyond our own system to the stars of heaven: and the rational mind, with its thought or higher vision, can range still farther. What then must be the case with the soul, which is a higher mind? Truly when we regard the soul from below, and from the sciences, we can never be induced to believe that it lies so deep within us, and that our veritable essence is so high above that which we think to be our all. "In every system," says Wolff, "of explaining the intercourse between the soul and body, it is necessarily supposed, that the essence and nature of the soul consist in the power of representing the universe, according to the place of the organic body in the universe, and suitably to the changes that happen in the sensory organs." (*Psychologia Rationalis*, § 547, 62.) Therefore it follows that *it is the office of the soul to have intuition of ends; to be conscious of all things; principally to determine.*

277. *It is a faculty distinct from the intellectual mind, prior and superior to, and more universal and more perfect than, the latter.* When we say that the soul is above the intellectual mind, or is not identical with it, we are well aware that we are going against the stream of a general opinion, but what matter is this, if all the facts we know in the animal kingdom with one accord confirm the truth of our position. Surely there is no one who enters into his own mind however superficially, and views its operations by reflection, but must acknowledge at once, that something flows into it from above, and enables it to understand, think, judge, will, speak, and to do many other things that are the exclusive privileges of man. Not one of these is in the mind itself; for the mind grows in perfection with our

advancing years. It is nothing in the infant ; less than nothing in the embryo : nay, even in adults it is in a state so far below truths, that it often studies to acquire them by means of the sciences, and not unfrequently with vain attempt. Nay, we sometimes see the mind become insane, and afterwards return to healthy knowledge ; and yet in the very midst of its insanity, all the economic functions of the body proceed according to laws in the truest order. The government would be utterly at an end if the soul were insane at the same time as the mind. In fact the first thread of life in the egg and the womb would be unable to proceed a single line in the formation of the exquisitely elaborate woof of the body, if something did not live above the mind, and while the latter lay in ignorance, did not dispose everything and all things universally. Unless this soul flowed in from science, while from itself, into every point of our intellect, it would be impossible for us to perceive anything in order, or to reduce anything we had perceived to order ; we should therefore look in vain for understanding in intellect, or judgment in thought. Every form of words plainly shews that an intellectual light is poured from above into the sphere of our minds, by means of which we are enabled to derive instruction from ourselves. The prattling boy receives a sublimer analysis from nature than the illustrious school of Pythagoras from art. As this light is universal, and everywhere most present, therefore it is comparatively remote from our perception. (Part II., n. 208.) But many corroborating remarks upon this subject may be seen below, *Ibid.*, n. 294. And that the mind is the first determination of the soul, and that a way of communication requires to be opened, in order that the light of the soul may flow in, will also be shewn in the sequel.

*Consequently a notion of it can hardly be procured while we live in the body.* For if the soul be above the intellectual mind, it is also above our comprehension ; for things that occupy a superior place are incomprehensible to the sensory of inferior things. (Part I., n. 623.) And it is also above the sphere of words, for words are only applied to ideas, which ideas belong to the mind, or else to things which are placed under the mind. This is the reason that in expressing the nature and life of the soul, we are obliged to have recourse to the use of words that

are scarcely intelligible; and to speak, for instance, of the representation of the universe, the intuition of ends, the consciousness of things, the determinant principle of reason; which hardly allow of being expressed and explained, save by the mute signs of a universal mathesis. (See Part II., n. 211, 212.)

278. *The next organ under the soul is the mind; whose office it is to understand, to think, and to will.* The mind is a distinct faculty from the soul; namely, posterior and inferior to, and less universal and more imperfect than the latter. (*Ibid.*, n. 276, 277.) The one can act separately from the other, and can act conjointly with the other. (*Ibid.*, n. 281.) The mind is the first determination of the soul, and partakes at once of the soul and the body. (*Ibid.*, n. 305.) There is a difference between the two, as great as between the forms of words that appeal to the ear, and the images that appeal to the eye; or as between the material ideas of the animus, and the intellectual ideas of the mind. (*Ibid.*, n. 290, 291.) The mind must be imbued with principles by the mediation of the external senses, that is, *a posteriori*, and illuminated with the light of the soul, that is, *a priori*, in order to understand and think. (*Ibid.*, n. 293—301.) Not to mention that the whole series of effects confirms the same thing, it is well known that it is the office of the mind to *understand*, or to perceive or apperceive those things that enter by way of the senses. Also that its office is, to *think*, or to revolve its intelligible materials according to the order of the nature of things: this it does in order that it may know of their existence, and know what they are, what their nature is, and why they are. It learns *their existence* from the bodily senses, of touch, taste, smell, hearing, and sight; or if not in this way, then it discovers it by analogy with things perceived by the sense; and when the existence of a thing is ascertained, then the mind regards it as something. Then and thence comes thought, enquiring *what things are, and what their nature is*. If our senses or instructors do not teach us this, the mind itself ranges through all its analysis and natural logic; and in this state admits *a posteriori* the objects of memory, and *a priori*, or from the soul, a light by which the said objects are intellectually or ordinally reckoned up, computed and combined: this constitutes the operation of *judging*. After a while, when judg-

ment is exact, the mind regards the subjects of its thought, and asks *why they are*, which is the very characteristic of life in the intellect, for it enters *a priori*, since it judges of the end from the whole progression of means, or of the whole progression of means from the end, which end is the first end of the thoughts, the continuous end in the means, and identical with the last or ultimate end. Then it becomes the office of the mind *to will*, which act is the conclusion of the judgment, or the closing point of the thoughts.

279. *The third in order is the animus, whose office it is to conceive, to imagine, and to desire.* The existence of a more general or common faculty, very distinct from that of the mind, and which we call the *animus*, is a fact more evident to us than the existence of a soul distinct from the mind: the reason of which is, that those things that occupy an inferior place, are comprehensible, and appear to the sensory of superior things as contiguous (Part I., n. 624.); whence we gain a notion of degrees and moments, or of space and time: but still more evidently from the fact, that ideas at first enter *a posteriori*, or by way of the senses, as material ideas, before they are born into the higher ideas that we term intellectual or immaterial. The aforesaid material ideas are not unlike the images of the eye, for they appear under a limited form, or with figure, magnitude, situation, place, and time, but as soon as they enter the sphere of the mind, their gross coverings are taken off, and they are contemplated apart from their former limits. This will be recognized as a clear and undoubted fact, if we will but ask ourselves what imagination is, and what thought: no one will say that they are one and the same; for all must confess that thought is a higher or more sublime imagination. This is confirmed by reflection upon the nature of animals, for we know them to possess imagination, but not thought; their nature being distinguished in this respect from human nature. Each of these faculties may act without the other, or disjointly; and also with the other, or conjointly. (Part II., n. 281.) The affection of the cerebrum, which is the common sensorium, is the *animus*, and the operation of the soul in the organic cortical substance is the mind. (*Ibid.*, n. 304—309.) Therefore this, as the inferior sensorium, has its own peculiar terms belonging to it. Thus it is said to *con-*

*ceive* or take in those things that the organs of the body feel; its conception being therefore an inferior or middle kind of intellect. It is said likewise to *imagine*, as the external senses represent objects. Also to *desire*; for instance, to long for pleasant things for taste, smell, hearing, sight, and touch; to rejoice, to be cheerful, to be sad, to be indignant, to be angry, to fear, to envy, and the like, all of which conditions constitute the desires and passions of the animus. But to desiderate anything for the sake of an end, to kindle the intellect and the will by the love of an end, and frequently with this view to curb the cupidities of the animus,—these, and other similar states are affections of the mind alone.

280. *The fourth or last is constituted of the organs of the five external senses, namely, sight, hearing, smell, taste, and touch.* That these senses are distinct from internal sensations seems not to be doubted. The only question is as to their communication with them, and as to their elevation into the corresponding higher sensations, of which subject we shall treat in the sequel; we would here only premise, that this communication is effected according to natural order, from a lower faculty to the proximately higher faculty, or from the higher to the proximately lower; but not from the highest to the lowest except through the intermediates. (Part I., n. 611.) For in this way the corporeal system is constructed and perfected, and one thing is so subordinated to, and coördinated with, another, that all things respect each other mutually, and depend upon each other mutually. (*Ibid.*, n. 608.) And thus whatever change occurs in compound series and substances, the simpler substances are rendered conscious of it. (*Ibid.*, n. 609.) Thus then the soul descends by as many degrees as distinguish the substances and forces of the world, that is to say, the auras; and by consequence forms a body adequate to each degree in succession. (Part II., n. 272, 273; 289—291.) But we can form no judgment respecting the influx of sensations except from the connection of organic substances. (*Ibid.*, n. 302—311.) *So also the motory organs, of which the muscles are the last.* Of this we shall speak in other Parts of our Work. *These and the sensory organs constitute the body, whose office it is to feel, to form looks and actions, to be disposed, and to do what the higher lives deter-*

*mine, will, and desire.* Thus the body has pleasures corresponding to the cupidities of the animus.

281 We have said that there are as many organic forms or sensitive faculties in the human corporeal system, as there are forms and forces, or auras, in the universe, but this is best seen when we consider each faculty in itself. For in order to discover and recognize what in a superior degree corresponds to a given thing in an inferior, we must thoroughly understand. 1. Whether the thing in the superior degree be a reigning universal in many of those things which are under it; or not only in the one which is proximately inferior, but also in those which are below it. 2. Whether it be so distinct that it can exist together with it, and can exist also separately by itself without it. 3. Whether it be so distinct that it has to be signified by an entirely different name. 4. To constitute it an entity, superior or inferior, of a given series, there must be a connection between the two by means of substances, and an influx according to the connection; otherwise there would be no dependence of the one upon the other, and no mutual relation between them. (Part. I., n. 648.) Let us then institute an enquiry according to these rules.

It is plain from actual fact that the sensations of the body are distinct from the sensations of the animus, or the external from the internal; for the external are deprived of their acumen in proportion as the internal are sharpened and intensified: in sleep indeed the external are perfectly dormant, while the internal are awake. The imagination survives even where sight, hearing, or any of the other senses are extinct. On the other hand, all external sensation perishes when internal sensation perishes, because the latter reigns universally in the former. The motive forces also prove that the two are distinct activities; for the body itself can act without consulting the animus, as in the agony of death, and in epileptic fits, and other dire diseases: action often proceeds from habit, even though such action be unimagined, and still less ordered by the will; the forces of the muscles are excited after death; the lungs are raised by inflation; the heart is excited by injection to systole and diastole; after life has departed the stomach often rolls in long-drawn volumes, as though it were still demanding



or working the food. Thus the two are so distinct that according to our rule, the one can exist either with the other or separately by itself without it.

It is also evident that the animus is a distinct faculty from the mind. This is clearly shewn in somnambulists, in whom, as in brutes, the corporeal machine is set in motion without any light flowing in from the sphere of reason. So also in many who may be compared to somnambulists, as being led solely by the instinct of the animus, and by little or no instinct of the understanding. There are, for instance, some persons who rush blindfold into actions from mere lust or cupidity, and after the fact appeal to the mind as the judge, and bring reasons from it to justify themselves to themselves and others from the charge of irrationality. Indeed so separate are these powers, that the one may either restrain or incite the other: the mind often rejects the imaginary delights of the animus as uncongenial to its own desire of ends; sometimes it combats with the animus as with an enemy; and as it were shuns its very self, and fights for victory. Those things then that may be either hostile or friendly, are of course in these circumstances either disjoined from, or conjoined with, each other, according to our rule.

It is plain also that the mind is a something distinct from the soul, and this, not only from the arguments already brought forward, but also from the conflict of the mind as it were with itself; also from a certain intimate consciousness, that twinges and solicits from principles unknown; very often even in merely natural things, originating deeply from self-love. It is also evident from our being frequently, though most unconsciously, carried by a kind of fatality into events, by a law as regular as that by which the silk-worm passes out of one condition into another; whence the terms fate, accident, chance, fortune; for the mind is profoundly ignorant of the manner in which the soul disposes and wields her commonwealth, not only before but after birth, and even in adult age; it knows nothing of what it has derived from its immediate parent, from its ancestors, from itself, from others, or from the current of the reigning cause. This one thing is clear, that there is in us an internal man that fights with the external; a manifest proof, that as the mind may be in collision with the animus, so

may the soul with the mind, and the essential life that comes from the spirit of God, with the soul.

282. The existence of four different faculties, has also, I find, the sanction of Augustin, a Father distinguished for his enlightened judgment. "When anything," says he, "is seen with the *eyes*, straightway an image of it is formed in the spirit, but the formation of this image is not discovered unless the eyes are taken off from the object, which through their medium we saw in the *animus*. And although the spirit be irrational, as in the case of brutes, nevertheless the eyes make their report to it. But if the *soul* be rational, then the image is announced to the *intellect*." (*De Trinitate*. ) "So far does the *soul* operate, and it judges of the innumerable differences of tastes, smells, and forms, by tasting, smelling, hearing, and seeing. No one denies that the soul in beasts can do all these things : therefore it rises *to the third degree*." (*De Animá*.<sup>x</sup>) See also *Deuteronomy*, vi. 5. We gather from these words of Augustin, that he separated the intellect or faculty of the mind from the *animus*, and the *animus* from sensation, which belongs to the body, and maintained that the soul presides over all ; exactly according to our proposition.

283. *Although there are this number of degrees, yet the animal system consists of nothing but the soul and the body ; for the intermediate organisms are only determinations of the soul, of which, as well as of the body, they partake.* We have hitherto been stating what the soul is, but, pray, what is the body? It is quite necessary that we should know what the latter is, because the soul and the body are like two opposite extremes, between which the organisms are intermediates : they are indeed so opposite, that the body may be said to be deprived of that of which the soul cannot be deprived. The body, in so far as it lives, is actually the soul, because the body is the ultimate organic form of the soul ; but in order to live in the world, and inhabit the earth, it must undergo motion conformably to terrestrial conditions ; and in order to undergo motion, the soul must descend to the earth by essential determinations, according to the series of the forces and substances of nature. (Part II. n. 272, *seqq.*) In order to descend elements are requisite, borrowed from the earth's three kingdoms. (Part I., n. 4, 43—45, 49—57, 91,

92, &c.) These elements, whatever they be, for instance, saline corpuscles of all kinds, aqueous, serous matters, inert and gravitating, terrestrial and material, void of life, because taken from the bosom of nature, summoned for the purposes of combination and connection, constitute that which is merely corporeal in an animal. Thus, properly speaking, the body is this earthy loan; but apart from these borrowed matters it is the ultimate form or organism of the soul, that is to say, it is the soul itself; hence the body is both what the egoists describe it, and what the dualists describe it: see further remarks on this in the sequel, Part II., n. 301. This form, termed the body, must necessarily undergo destruction—what is called death—before the soul can issue as a Phoenix from the entanglement and chain of those terrestrial elements that clip it in and clog its flight, and be left to itself to lead the life not of the lowest but of the highest world.

284. Thus there is nothing in the whole animal body but an organic form determined by the soul according to the degrees of the forms and forces of the circumambient universe: the determinants are the fluids, and in order for them to flow determinately, there must be fibres. (Part I., n. 597.) The motive or muscular fibres are mediant and subdeterminant. (*Ibid.*, n. 598, 599). By these the essential and proper series that constitute the integral series, are combined and connected (*Ibid.*, n. 600, 601); in a word, the mere determinations of the soul are what are called the body. When these determinations are destroyed, the soul is deprived of the power of putting in action its forces, and receiving sensations in the ultimate world: it cannot however be deprived of life, but must necessarily live that life which is properly its own.

The first determination of the spirituous fluid is the organic cortical substance; the next is the brain, consisting of mere prime determinations, or cortical substances and fibres: the third or last is the body itself, with its sensory and motory organs (See Chapter IX.); or what amounts to the same thing, the first determination of the soul is the mind; the second is the animus; the third is the essential body in respect to looks and forms of action; according to the positions of this Chapter. These determinations or organisms participate of

the body only in so far as the derived fluids, as the red and the purer blood, and their fibres, participate of particles borrowed from the earth; and they are imperfect in proportion as they recede by successive composition from the supreme degree. (Part I., n. 615, 616.) So that it is not the soul of which greater or less perfection is to be predicated; but the organism, which is perfect or imperfect in proportion as it participates more or less of earthly dregs, and in proportion as it descends into the posterior or inferior world. Indeed the form of every degree admits of its own degrees of perfection according to its integrity, but however deformed or depraved the organism may be, the soul still persists in the representation of its universe, in the intuition of ends, in the consciousness and determination of things, as being itself order, truth, rule, law, science, art. (Part II., n. 274—277.) If then we cannot predicate degrees of perfection or imperfection of the soul, much less would it be proper to predicate such degrees of life.

285. It follows then that it is the soul that understands, thinks, judges, wills, desires, imagines, lusts, remembers, sees, hears, tastes, smells, feels, speaks, acts; or that the soul is the all in its whole, or the singular in its universal. Other things, such as we call bodily or corporeal, are accessory, and in themselves dead, and only serve life as an instrumental cause, thus are altogether subject to the will of the intelligent soul, which uses them to promote ends by effects. (Part II., n. 234.)

286. Nothing in the created universe is *anything* except by its form; or what amounts to the same thing, there is nothing in the world but is a series and in a series. (Part I., n. 586.) Anything considered without form is without predicates and relation, consequently is an entity altogether apart from order or rule, in short a nothing, whether it be called a simple, an element, an atom, or a primitive without form. Matter, according to the philosopher, desires form as the female desires the male, (*Natur. Auscult.*, lib. i., cap. x. [?],) and form cannot be abstracted from matter except in thought.<sup>x</sup> Truth itself, which is said to be perfectly simple, and is depicted naked, still is not acknowledged, and does not please, without form; the Graces are not seen in their beauty without form: but these virgins are easily clothed in becoming forms of words; for they themselves assume

such forms and fit them on ; and they will not brook to be arrayed in false garments, or at least they shine through all such coverings.

287. *Such now is the ladder by which every operation and affection of the soul and body descends and ascends.* Sensations ascend from the body to the mind ; the soul descends with its light and virtue into the mind also : thus the mind is a centre, to which there is an ascent from the lowest sphere and a descent from the highest. Its activities, and the executive acts of the will, perpetually descend, for in order that any determination may take place, there must be a descent into the ultimate region of the world. But the end for which this ascent and descent is made, is in itself one or single ; for life or wisdom, that is, God, is the end of ends, or the first and the last. From Him descent is said to be made, when we descend into the cupidities of the animus and the pleasures of the body, as ends ; while on the other hand ascent is said to be made to Him, when we ascend from these cupidities and pleasures, or even when we descend to them, regarding them but as means to the end of ends. Now when we thus ascend we necessarily ascend to truths, consequently to the very sciences themselves, or to the soul, which is order, truth, science, art, rule, and law ; and from these the ascent is then easy to life itself, which is wisdom, or above the truths and sciences of nature ; for then [wisdom] itself conspires as with a subject accommodated to the reception of life. Thus to ascend is to ascend above ourselves ; for then the love of self stands far below ; and above it stands the love of country ; and above this the love of God. They who so ascend are they that live as true men, others are but human cattle ; the former are heroes among mortals ; the latter are the lowest of all mortals, however they may be accounted heroes. Nature is like a circle, which, wherever it runs, respects its centre. This circle of nature is made up of perpetual other lesser circles ; and these, of least circles ; nor is there a point in any circle but respects its centre ; and by this, the common centre of all the circles ; so as to be in its circumference. Thus these points are in a manner running centres, each running through its own periphery. Any one of them then that in its little gyre of the universal gyre,

does not respect its own common centre, and the common centre of all, that is to say, the common end, flies off, and of its own accord is rejected as spurious. Thus now every operation and affection of the soul and body ascends or descends.

## VII.

288. The genuine progression in descending and ascending appears to be in this wise. As the forms of the modulations or sounds of the air in the ear are to the forms of the modifications or images of the ether in the eye, or in the animus; so are the latter to the forms of the superior modifications in the mind, which forms are termed intellectual and rational ideas, in so far as they are illuminated by the light of the soul; and so again are these forms of the mind to similar supreme forms, inexpressible by words, in the soul, which forms are termed intuitive ideas of ends, in so far as they are illuminated by the life of the first cause.

289. *The genuine progression in descending and ascending appears to be in this wise. As the forms of the modulations or sounds of the air in the ear are to the forms of the modifications or images of the ether in the eye.* With a view to distinguish between the modifications of the air and the ether, we shall call the former *modulations*, as becoming *modulamina* in the ear. In the meantime with respect to the nature and quality of the forms or ideas of any of the degrees, as of the sonorous ideas of hearing, the material ideas or images of the eye, or of the animus, (which amounts to the same thing as the eye, because the two are in the same degree,) or the intellectual ideas of the mind, and the representative and intuitive ideas of the soul; and with respect to the relation between the one of these classes and the other; and to the order and manner in which they intermarry, and act successively and simultaneously, as well as to the generic difference of perfection in each; with respect to all these subjects we cannot be better instructed than by the auras of the world: for the soul has formed the body adequate to each in succession (Part II., n. 272, 273, *seqq.*); thus the

microcosm teaches us the nature of the macrocosm, and the macrocosm of the microcosm. Consequently ideas, whether called material or immaterial, are real essences, just like the forms and modifications of the auras. But the moment the latter touch the vital or animate fluid of any sensorium, they are at once exalted in nature, and enter as ideas, because in a moment they participate of the principal essence of the soul, that is to say, of its life. (Part II., n. 234—238.) And this is the reason why the order of the universe teaches us the sciences, or why the phenomena of the world are experiences infixed in our little memory under the forms of images, which cause the mind to understand. But let us confine ourselves to the modifications of the air and ether, as perceived by the ear and eye; because they fall under the understanding of the mind, and are subject to its intuition. (Part I., n. 624.) The difference between the modes of the ear and the modes of the eye, is evidently, from the first glance of reflection, almost indefinite; for when we extend our gaze over woods, groves, palaces, cities, crowds and armies of men, herds of cattle, &c., we take in at a glance more than the tongue has power to represent to the ear in half a day, by articulate modes and a succession of words; and even when they are represented, the mind, not infixed in words, but in the forms and series of words, views all and singular things previously under the idea of images, before it educes from them an intellectual meaning. From this comparison we may judge the difference between the modes or ideas of the animus and of the mind. For *so are the latter to the forms of the superior modifications in the mind, which forms are termed intellectual and rational ideas, in so far as they are illuminated by the light of the soul.* But as for the nature of these ideas, and the respect in which they are distinct from inferior ideas, and how they marry them,—this does not come to our consciousness, because it does not come within the imaginative sphere of the animus: for they borrow their light from the soul, which resides so high, or is hidden so deeply, that the mind, in seeking it, must rise above itself. Those things that occupy a superior place, are incomprehensible to the sensory of inferior things. (Part I., n. 623.) In order then to arrive at this point, a guiding science is required to accompany us on the



way, viz., the doctrine of order and the science of universals. (Part II., n. 210—212.) “The ideas that ethics are conversant about,” says Locke, “being all real essences, and such as I imagine have a discoverable connection and agreement one with another; so far as we can find their habitudes and relations, so far we shall be possessed of certain, real, and general truths,” &c. (*Ibid.*, n. 212.) But as these ideas do not fall within the sphere of images, or come to the evidence of the animus, they are called immaterial ideas, being considered incomprehensible; although they coincide with the modes of the superior ether, or of the aura of the second order, which the moment they enter the sphere of the mind, at once partake of the life of the soul, and are called intellectual or rational ideas; as the inferior ideas already treated of, are called sensual ideas. Thus, I think, the materialist will understand his ideas, and the idealist, his.

290. *And so again are these forms of the mind to similar supreme forms, inexpressible by words, in the soul, which forms are termed intuitive ideas of ends, in so far as they are illuminated by the life of the first cause.* But these ideas are said to be representative of the universe, inasmuch as they are actuated by the first and purest aura of the world, of which our animate fluid is the admirably ornate and noble progeny. (Part II., n. 222, 227, 272—277.) By this successive comparison which we have given, we may in some measure illustrate the indefinite perfection of the soul, and its representations and intuitions, relatively to the inferior sensations. But in order to perceive it by comparison, we must perforce remain in substances themselves, and not dwell on the modifications of substances, because the latter are only their mutations or rather accidents (Part I., n. 619, 621, 622), which cannot possibly in the slightest degree extend beyond the sphere of substances. (Part II., n. 293.) Now if we cannot ascend from a substance of an inferior degree to a substance of a superior degree, except by the division and as it were destruction of the unit of the inferior degrees (*Ibid.*, n. 222), it follows that the elevation from one degree to another does not take place in a simple ratio, or in a duplicate ratio, but in a triplicate ratio, like that of a cube to its root. (Part I., n. 619 [?].) Hence we perceive the incredible and almost unassignable difference between the two. Let us suppose,

for example, that one sound, mode or form of modified air or articulate voice consists only of, a simultaneous or successive variety or series of 10 constituent modes; it will follow that in the fourth degree, which is the degree of the first aura, or of the soul, it will have corresponding to it 1,000,000,000,000,000,000,000,000,000 supereminent modes, hardly expressible by myriads of myriads, which enter that lowest mode as universals, and create its consonance or harmony. Thus in the same moment, or in the same degree, which is the least of the ear, we must conceive all these moments and degrees of the concurring soul. For to hear, and to judge of concordances, is the office of the soul, executed of itself, and from its own truth and law. (Part II., n. 276, 285.) For it grasps the lowest things at the same time as the highest. From these observations we see very plainly the nature and quality of the harmonies, pleasantnesses, nay, pleasures, of the senses of the body, relatively to those which constitute the happiness of the soul, its joy, gladness, &c., which in the body constitute agreeableness and recreation: we see that they are comparatively mere discord under apparent concord, and that in following them, we are only deluded by a fond insanity; and that the soul, after leaving this earthly life, will look upon them, in its sublime mirror, as so many grand mistakes of the lower sphere. (Part II., n. 360.)

291. Lastly, as we have so often repeated that the soul flows with its *light and virtue* into the reasoning faculties of the mind, we must explain what its light is, lest in the use of a universal term, we should seem to be immersed in occult qualities. What this light is, cannot be declared except by analogy with similar things occurring in the lower sphere. We already know what hearing is, and sight; also that the things received by hearing, for instance, articulate sounds, are immediately perceived by the imagination, and next by the intellectual sight. Thus the light of sight flows at once into the forms of hearing, and causes them to be apperceived more abstractedly and sublimely, viz., by the mind. So in the same way the soul, which is in the supreme degree, flows with its light into the forms and ideas of its mind. This influxion must be signified by a universal term; for otherwise,—such is the defect of language,—we cannot express its virtue, which is to the last degree intellec-

tual, flowing from its ideas representative of the universe and intuitive of ends.

## VIII.

292. The soul, from the very initial stages of conception, which it derives in the first instance from its parent, is born accommodated at once to the beginning of motion and to the reception of life: consequently to all its intuition and intelligence, and it takes this intuition and intelligence with it, from the first stamen and the earliest infancy, to the most extreme old age. But not so the mind, which before it can be illuminated by the light of the soul, must be imbued with principles *a posteriori*, or through the organs of the external senses, by the mediation of the animus. Thus as the mind is instructed, or the way opened, so it is enabled to communicate with its soul, which has determined and provided, that the way leading to it should be opened in this order. Hence it follows, that there are no innate ideas or imprinted laws in the human mind, but only in the soul: in which unless ideas and laws were con-nate, there could be no memory of the things perceived by the senses, and no understanding; and no animal could exist and subsist as an organic subject participant of life.

293. Before we consider the general topics of this chapter in detail, we are bound to enquire *whether any modification, or what is the same thing, whether any idea, ever extends beyond the continuity of substances, or beyond the continuity of their fluxion.* Experience in conjunction with sound reason at once shews that such extension is impossible; for modes are accidents of which substances are the subjects; and to dream of accidents without subjects, is tantamount to dreaming of something without anything, or to conceiving modification in a vacuum or nonentity. Sound reason, even without the aid of experience, at once rejects the idea as repugnant, and shrinks from it as destructive of itself and of all nature: thus reason refuses to admit testimonies

from the storhouse of causes and effects, to dissipate visions of something in nothing: for instance, from the air, the ether, and other fluids, whose parts, unless they were naturally accommodated to every variety of mutations; that is to say, unless they were expansile, compressible, perfectly elastic, suffering the least possible loss of impressed forces, &c. (Part II., n. 223); and at the same time, perfectly contiguous in points, could never communicate ought of mutation existing in one to the others near them; still less to those distant from them: hence no modification could exist, that is, no mutation of each part or substance in a volume, which mutation ceases at the bounds of the part or substance to which it belongs, unless taken up by those next it, and continued further. Wherefore the perfection of modification increases with the perfection of substances, and up to the ultimate natural degree in the purest animate fluids and in the first inanimate auras, according to the rules of order. If no modification goes beyond the sphere of substances, so neither does any idea; every idea being a modification of the purest animal fluid participant of life. (Part II., n. 200, 201, 234—237, 289.)

Now if no modification extends beyond the continuity of the fluxion of substances, it follows, that a modifiable substance has the power to extend all its force and virtue whithersoever itself is continued. Thus the spirituous fluid has the power to extend its force and virtue within its fibres to every point of the body; that is, to pour forth, form, continue, renovate, and determine, its organic machine (*Ibid.*, n. 221), according to every representation and intuition whatever that exists within it; for it flows along its fibres into the blood-vessels, and along the vessels into the fibres, in a continual circle, which we have called the *circle of life*, and have described above. (*Ibid.*, n. 168—172.) This fluid then is the spring of all those prodigies that we admire in the anatomy of the body, in the first evoking of the body from the stamen and ovum, in its economic administration, in the executive acts of the will or wills, or the influxion into the motive forces of the muscles; and in other things that do not transpire on the outside of the fibres, or within reach of our mental consciousness or intuition. (Part I., Chap. III.) Therefore the soul, thus emprincipled, can descend

by as many degrees as distinguish the substances and forces of the world: and by consequence form a body adequate to each degree in succession. (*Ibid.*, n. 272, *seqq.*)

If continuity of modification supposes continuity in the fluxion of substances, it follows again that the spirituous fluid or soul of the body cannot flow so [much] into the sensations or perceptions of its organs, as into the formation and motive forces of its body; that is to say, it cannot pour forth its virtue into both equally; for the fibres, or little tunics of the fibres, are opposed, forming so many distinct partitions, to hinder the free transflux of its virtue. We all know that the modifications of the circumambient world,—the forms of the air and the images of the ether,—must impinge on the little coats and membranes, or on the little fibres, of the ear and eye; and thus mediately affect the fluid: so also through the same all the virtue of the said fluid must flow, which virtue is tempered by the nature and state of the parts constituting the little tunic of the fibre. It follows, then, that this fibre or distinct partition must previously be accommodated, not only to receive sensations *a posteriori*, but also to transmit the forces of the soul, namely, *a priori*; for the particular continuity of substances determines the continuity of modifications also. We must therefore distinguish well between its *operations within the fibres* and its *operations without the fibres*; and observe that the *way of communication* through the fibres must be opened before we can feel, perceive, and understand; and that our faculties are perfected in so far as the mediate substances, constitutive of the fibres, are adapted. From these premises we may now proceed to explain the several positions of this Chapter.

294. *The soul, from the very initial stages of conception, which it derives in the first instance from its parent, is born accommodated at once to the beginning of motion and to the reception of life: consequently to all its intuition and intelligence, and it takes this intuition and intelligence with it, from the first stamen and the earliest infancy, to the most extreme old age.* The soul is at once initiated into its intelligence from the first animation in the ovum, while it is no more than a punctum saliens; although its mind is not born so much as into a single idea. This is in fact a conclusion from the reasons which prove that otherwise no animal could

exist or subsist as an organic subject participant of life. For the force that directs and builds a body which is to be governed according to all the intelligence of the future mind, must preëxist in an intelligence above the mind. Otherwise there would be no memory of things perceived by sense, and not a glimmer of intellect, and still less would brute animals be born to every condition of their life; for they bring with them from the egg or womb their own perfections, which must be derived from no other source than from their souls; and these souls, being of an inferior degree, can immediately communicate their powers to the organs, as we shall shew in Chapter XI. It appears then that both those who advocate the doctrine of connate ideas, and those who oppose it, may base their arguments upon the same facts; shewing that the controversy is not about the truth, but only about the mode in which the one truth or the other is to be explained. For if ideas are connate in the soul, and if ideas are procured to the mind, then the two opinions agree, and their reconciliation comes from the same demonstration as that which shews the communication between the operations of the soul and of the mind. Locke has abundantly proved by clear and weighty arguments that there are no innate ideas in the mind, not even ideas of moral laws. (*Op. Cit.*, book i., chap. i.—iv.) This author has traced the interior operations of the mind with as much care as anatomists have examined the structure of the body, but after having pursued them to their origin, he remarks that it must be acknowledged, that something flows in from above, by which the mind is rendered capable of reflecting upon ideas acquired *a posteriori*. His words deserve to be quoted, and are as follow: “The other fountain, from which experience furnisheth the understanding with ideas, is the perception of the operations of our own minds within us, as it is employed about the ideas it has got; which operations, when the soul comes to reflect on, and consider, do furnish the understanding with another set of ideas, which could not be had from things without; and such are perception, thinking, doubting, believing, reasoning, knowing, willing, and all the different actings of our own minds; which we being conscious of, and observing in ourselves, do, from these, receive into our understandings as distinct ideas,

as we do from bodies affecting our senses. This source of ideas every man has wholly in himself; and though it be not sense, as having nothing to do with external objects, yet it is very like it, and might properly enough be called internal sense. But as I call the other, sensation, so I call this, reflexion; the ideas it affords being such only as the mind gets, by reflecting on its own operations, within itself. . . . These two, I say, viz. external, material things, as the objects of *sensation*; and the operations of our own minds within, as the objects of *reflexion*; are, to me, the only originals, from whence all our ideas take their beginning." (*Op. Cit.*, book ii., chap. i., § 4.) I have deemed it proper to add these observations to the arguments above stated, proving that the soul is a faculty distinct from the mind, and is born into such perfection as to be the order, truth, science and art of its kingdom. (Part II., n. 275—277, 281.) But nothing declares this more clearly than the very life itself that we possess from the first moment of our being. For what is life unless intelligence be taken together with it? Our life is a universal resulting from absolute singulars. To affirm life without intellect, is to affirm a general without parts, or light without rays, time without moments, motion without degrees, and number without units; consequently, the body without the soul, which latter contains the veriest singulars of life. Thus life is the universal essence of singulars, and is the greater and more perfect in proportion as it is the more singular. Our very affections, which are many in number, almost never appear in their singulars, but only in their general, as joy, love, hunger, thirst, and the other appetites; yet would they be as none, unless they were composed of most minute particulars, which present themselves under a general form to our senses. Thus the soul of an infant has the same intelligence as the soul of an adult; and the soul of an idiot as the soul of a sage; but the ways of communication, from which the mind arises, are not similarly opened, but are still closed in the infant, and distorted and deranged in the idiot. Yet for all this we will not cease to pride ourselves above our fellow-mortals whenever we receive a few false rays by influx from the soul; and to judge of the souls of others by their bodies.

We may thus in a measure apply to the soul, relatively to



the mind and to sensations, the observation above applied to life itself relatively to the soul; namely, that the soul flows into the subjects of its universe in one only manner and without essential union (Part II., n. 257); but according to the modified character and capacity of each subject (*Ibid.*, n. 261—264); or according to its form, which makes it such as we find it to be. (*Ibid.*, n. 228, 244.) And that the soul has assigned to it, within its own little corporeal world, a certain species of omnipresence, power, knowledge and providence: but that the Author of Nature has reserved to himself the supremacy over it and all things, both in regard to power, presence, knowledge and providence, which supremacy he exercises according to the law, that so far as the soul is dependent upon him, so far it is perfect in every faculty, and conducted to universal and absolute ends, and its lower powers and degrees, by its means, are the same. (Part I., n. 258, 259.)

295. It is evident from our general definition of the soul, that the soul of every offspring is derived from its parent, and the souls of all from Adam, who received his soul immediately from the Creator of the universe. For if the soul is the spiritual fluid, or the purest natural essence of man, then it comes from no other place than the soil of its birth,—the place where the organs are situated by means of which this fluid is extracted from the blood and the juice of the nerves, and copulated with other matters highly suitable to its nature, in a word, prepared in form and for use; for instance, received, fostered, and agitated by the womb; then opened up and unlocked in the same manner in which it was put together or combined; after which it suffers itself to be transferred by wonderful winding channels, without escape or loss, to the birth soil of the recipient ova, and to be planted and rooted in them. Oh! miracles of miracles! But of this subject we shall speak in the Part on the Organs of Generation.\* Thus the soul is not derived from the mother,† in whom there are no incernicula for the purpose,—none, we mean, for extracting, refining, coagulating or preparing; but

\* See Dr. Svedbom's Memoir in the Appendix to the *Animal Kingdom*, where there is an account of Swedenborg's Manuscript on the Organs of Generation.—(*Tr.*)

† Aristotle maintained the same doctrine. "The body, . . ." says he, "is from the female, the soul from the male." (*De Generat. Animal.*, lib. ii., cap. iv.)—(*Tr.*)

only for receiving, reducing, conveying, applying, nourishing, carrying and excluding. From the soul or spirituous fluid proceeds the peculiar prevailing similitude of bodies and minds in each generation, which though it seems frequently extinct in next of kin, yet revives sooner or later in their posterity. How this fluid takes increase from the initiaments in the ovum, and is in an eminent manner conceived and born anew perpetually in the cortical and cineritious substance of the brains, in order to subserve every state both of the system to be formed and already formed, may be seen in Part II., n. 165—167; Part I., n. 261—269. Wherefore if it be the same soul that emigrates from the parent to this new man as to a colony, it follows that it is not less intelligent in the one than in the other; as we have just pointed out. See also Part II., n. 310.

296. *But not so the mind, which before it can be illuminated by the light of the soul, must be imbued with principles a posteriori, or through the organs of the external senses, by the mediation of the animus.* It is perfectly clear that no mortal is born with an understanding of the things of the world or of himself: the innocent infant is brought upon the stage of life profoundly ignorant of the character it has to perform; next, with advancing years, by the aid of the external senses, (principally of the eye and ear,) which with the internal senses make up the series of sensations and perceptions, it is instructed what the world is, what the human race is, and what itself is. Generals first enter; then particulars under generals; and afterwards individuals under particulars; and the more and the better the human being can go on individualizing them, the more perfectly does he begin to understand what generals are. Thus the infant grows up from universals to singulars, or from life to intelligence, coming ever nearer to the soul, which in its turn advances by a like gradation to meet him. From the meeting arises the intellectual mind, which is in a manner the centre, to which the sciences of things ascend by way of the senses, and to which the soul descends as essential science. Every one then must perceive, that something is successively opened between the inferior sensories and the supreme sensory or the soul, in order that there may be a way of communication. But what is it that is thus to be opened? It is well known that the animal fluids, as the blood,

and the purer essences of the blood, circulate within their vessels and vessels of vessels or fibres; also that whatever happens without, does not immediately touch the fluid, but only the tunic of the vessel, or the little tunic of the fibre, within which the fluid is contained: so that the soul feels the forces and modes of the outwardly-acting world by the mediation or intervention of the fibre. Now in order to ascertain where this way of communication is, that has to be opened, we must examine the little tunic of the fibre, which acts as a partition not only as regards the general texture, but also as regards the particular parts of the texture. For such as the tunic is, such is the exterior force or accidental mode represented to the fluid which acts within; as clearly appears from sight, hearing, taste and smell; and also from the brain, or from imagination, memory and perception: this we may all learn from the presence of contraries, or when the organs are injured. With regard to the general texture of the organ, namely, what it is, and ought to be; this we may learn from a careful anatomical investigation; but with regard to the particulars of the texture, this we shall learn by the intellect in the analytic way from a close examination of the general. As *first*, we shall learn the material of which the little tunic of the first or purest fibre consists; namely, that it consists of the very material of the fluid, which is the mother and nurse, because the formative substance, of all things in the body. *Secondly*, if we would ascertain the nature of the mutation or metamorphosis by which from being perfectly fluid it can be so fixed as to form a coherent tunic:—this also may be known, if we attend to the principal natural power of this fluid, which lies in its ability to undergo accidental mutations in infinite ways, or to be expanded and compressed; which mutation is the very perfection of its nature (Part II., n. 223; and Chapter X.): by virtue of which it is accommodated to every necessity and use: therefore the closer and more compact the form into which it is reduced, the less fluid it is, and at length it is reduced into a form in which, when the purest elements combine, it assumes or aspires to something like continuity. Let us then grant for argument's sake, that the material of the fibre is taken from the material of the fluid, and let us designate the assumption algebraically

by the letters *x* or *y*; as marking that it is at present only assumed, and not known to be a fact: circumstances, proved or known, must declare afterwards the value of these signs. Now if this fluid, in order to become a continuous tunic, be reduced from a more expanded, or from a more free and perfect form, into a more contracted and imperfect form, it follows, that it changes into one in which it is not able to lead a perfectly distinct, but only a kind of general life: but nevertheless the essence, with the attributes, remains, although the modes are varied; consequently every part of the fibre still lives, yet only an obscure life. Thus then we have in some measure ascertained the nature of the little tunic of the fibre: let us now treat our deductions as principles, and proceed onwards from them. Modifications, of whatever kind they be, for example, of the air and ether, first reach some such tunic or fibre, by the mediation of which they cause their quality or nature to be perceived. Now as the constituent parts of the tunic accommodate themselves to external and internal forces, so the tunic is adapted to receive sensations from the world, and to transmit the purest by the spirituous fluid, assumed as the soul. In order to be thus accommodated, modes must continually flow in *a posteriori*, and also continually *a priori*; thus it is that what is intermediate is accommodated to reciprocal receptions and transmissions: consequently in proportion as those things that are insinuated *a posteriori* approach to the nature and essence of those that exist in the spirituous fluid, the more is the way of communication between the two opened. Principles, therefore, which belong to the sciences, and which are in agreement with the order and truth of things, are what approach most nearly to the nature of the soul, which is science, order, and truth. By these means the fibres return and are expanded into the condition and state of their fluid; yet not so as themselves to become fluent, for in this case the nexus and determination of parts would be destroyed. In order that these circumstances may obtain, the general state of the fibres must first be so informed or adapted, that particulars can insinuate themselves successively and suitably in their own and the natural order under generals, and individuals under particulars. Thus we see how important it is that general notions should be rightly

formed ; for singulars enter under them, and primal or absolute singulars under these again, as the principles of generals, and fit in or insinuate themselves only in proportion as the common or general state allows, which state in adult age is with difficulty reformed. The delight and desire of learning conspire to render insinuation easy, because they expand singulars, and thus exalt the life ; and therefore it is most wisely provided by the Creator that our first years should be sportive and joyous.

297. If we do not grant, yet let us suppose, as I said, for argument's sake, that the material of the fibre is taken from the material of the fluid, or from the fluid itself, and in the meantime let us express this algebraically by the letters  $x$  and  $y$ . Now let us select from the stores of experience a few effects, to serve as evidences or data whereby to institute our analytic calculus. Let us select for example *memory* and *intellect*. No one, we presume, supposes that the images of things perceived by sense are laid up within the brain in little cells or boxes, and there remain as pictures and delineations : still less that this is the case with those species that exist in the memory under no bounded or limited form ; as those, for instance, that are purely philosophical and rational. To overlay and cram the brain with all these pictures, one upon another, one beside another, and one under another, would be to drive all its rays of light into a general shadow, or to compel its universe into one undigested chaos : and at the same time to deprive the soul of the power to evoke again the several forms in order according to the disposition of present things, and from each to take some part which may enter as a simple idea into the compound idea, and to reject the parts from the rest that are not in agreement. If then the memory be not such as it appears, and yet before things are fixed in it, the fibre be affected, it follows, that it is only the affection and adaptation of the fibre that cause them to approach nearer to the nature and perfection of its fluid, and that thus the way of communication is rendered more open ; viz., in order that the soul may act as a mind in singulars, and as an animus or sight in comparative generals ; and as hearing, touch and taste in positive generals. For we have lately indicated, that the force of the soul is but one force, or inflows in

but one manner, and this, according to the modified character or disposition of the parts in the fibre. These results, however, could not be brought to pass, unless there were a perpetual harmonic variety of all the parts in the fibres, and at the same time of all the organic or cortical substances in the two brains and the two medullæ; not to mention other circumstances of which we have spoken in Part II., n. 193. See also Part I., n. 604—606. Without a variety of substances there would be no variety of modifications; hence no memory, no imagination, no perception, no thought; for all distinction and relation perish in equality; because all difference of things: in this case the mind could evoke no more than simply one thing from the storehouse of the memory. And anatomy indeed shews that the fibres of the brain are softer and more fluent than all the rest, while the fibres of the body are very firm indeed. For the brain is raised to such power, that it is enabled to will and determine the things imagined and thought, into act: consequently where the principle of action is, there the intellect also is; for the brain is divided into congeries, least, larger and largest; which are respectively circumscribed by interstices, furrows, and winding channels or spaces (see the preceding chapter), so as to allow themselves to be expanded and constricted *ad libitum* according to every necessity and contingency; and consequently also the most particular fibres to be expanded and constricted with the common substances: whence the very faculty of thinking resides principally in that part of the brain which excels in expansibility, for instance, about the anterior lobes or umbones, or as they are called the *prora cerebri*; and the other appendages serve these as ministers of the common ideas that conclude the compound. Furthermore this memory of things is not impressed on the fluid itself, but on the fibres of the fluid; for the fluid performs its continual circle, which we have called the circle of life, and almost in the same instant that it is in the brain, it is present in any motive fibre of the body, and never puts forth any representative or intuitive force in any place but where the substances of the fibres are in correspondence with it, or are accommodated for its reception and transmission: thus in the body itself it puts forth none but the most general force. Such then is the *coestablished harmony* between the soul and the

body. From these observations we may now in some measure derive the value of the signs of the unknown  $x$  and  $y$  in this rational analysis; namely, that it is a mere condition of the parts constituting the fibres, which gives the sensations and perceptions the power of concentrating themselves in a certain intellectual mind. It would be foreign to our purpose to adduce further arguments upon this subject, although innumerable others are at hand, because in the present article our only design is, to treat of the illumination which the rational mind receives from the light of the soul, and of the principles with which it is imbued *a posteriori*. See below, n. 312, 313.

298. *Thus as the mind is instructed, or the way opened, so it is enabled to communicate with its soul, which has determined and provided, that the way leading to it should be opened in this order.* It is said to have determined, because it has formed its organic body in entire accordance with the succession, correspondence and harmony of the forces and substances of the world; and because it has let itself down as it were from the highest region to the lowest; that is, from positive knowledge or science to ignorance. For we are born in a state of darkness and insensibility: our organs are opened by degrees; they receive at first only obscure images and notions; and if we may be allowed the expression, the whole universe is represented to the eye as a single indistinct entity or chaos; yet in process of time all things become more distinct, and at length are laid open before the reasoning tribunal of the mind: thus it is late before we are rendered rational; a most evident proof that we have been driven in a manner headlong from heaven to earth, and have fallen from a golden age into a rude and iron one. The soul itself, which is not the wisdom but the science of the world, from the first stamen involves itself in threads and fibrils, which are so many veils and enclosures; as though it did not wish to touch or behold the world it has fallen into, but only to permit it, with all its harmonies and discrepancies, to play around it at a distance: and to enable itself to feel pleasure in the former, and displeasure at the latter, it has furnished its body with sensitive organs, that it may thoroughly feel everything according to its nature; harmonic things with delight, and inharmonic things with undelight. Moreover lest it should be



ensnared by false delights, it provides that the sensations should in the end be perfected by the judgment.

Now in order that from dense ignorance we may mount back to wisdom, or from the floor of the earth to heaven, all possible means are provided. The age of adolescence is prolonged, for we are twenty years and more in passing from childhood to man's estate; a period as long as the entire life of many animals, and three or four times longer than that of some: the more imperfect and low animalcula attain their utmost dimensions and consistence within a few months, or even within a few days, or hours. We have also sciences provided as aids to growing wise, and we are instructed by them throughout our course of growth. Then again we are furnished with a capacious brain, for the human brain is thrice or four times larger than that of the ox. And in our brains the arteries are more prudently distributed and distinguished than in animal brains; the red blood, for instance, is more finely warded off from the purer, and the purer from the spirituous fluid (Part I., n. 602, 603, 269): in order that the mind may be enabled to sum up in one total all the powers and reasons of the understanding; and to divide them into quantities, or subtract and balance them aright; not to mention infinite other things, of which we treat where we speak of the anatomy of the brain. No one can be so insane as to believe that these and similar things are determined and provided principally by the soul itself: we must admit that they are determined and provided, through the medium of the soul, by Him who is essential wisdom, that is to say, by the Creator of the universe, by whose omnipresence and universal influx all and singular things flow constantly in a provident order.

299. It appears to be enjoined by the most grave and necessary reasons, that as soon as the soul, which is science, begins to lead a bodily life, it shall cover itself with veils to induce ignorance, and shall only at a late period, or at an advanced stage of life, uncover itself a little of their darkness. For God is a necessary Being, and whatever is in God, and whatever law God acts by, is God. If we were born at once in full possession of the perfection and science of the soul, it may fairly and reasonably be doubted, whether the human race could be

propagated by natural generation ; and whether it would not be most distinctly conscious of its own formation, and by a foregone will overrule all the details of its growth in the womb, and from the first breath of life continually aim at a more perfect state. But granting that under such circumstances natural birth would be possible, still there is good ground to doubt whether decline and death would be so. In the former case, the earth would not be peopled ; in the latter, a thousand earths would not suffice for human proliferation. Moreover, in a general state of integrity, there would be a perpetual communication of thought ; and therefore little or no speech ; and speech indeed could never enunciate what the soul represented to, and beheld within, itself. The soul would look down continually as from a heaven upon its own earth ; nor ever cease to raise itself above itself ; and then it would require a fresh miracle every moment of its life in the body, to prevent it from exalting itself above God. The least delinquency would be absolutely indelible ; and this would give rise to a general perversity and lamentable state : in which there would be no room for grace ; because the evil would spring from the very soul as the centre, and not from a mind intermediate between the soul and the body. Furthermore, there would be one general equality between all bodies and souls ; consequently no society, because no form of society, either in this or in the future life ; for all distinction, and all relation resulting from distinction or difference, perishes in equality. Joy, happiness, good, would not be predicable, because not representable relatively to their opposites. And there are innumerable other consequences besides, to shew that it has pleased the Deity that the perfection of the whole should result from the variety of the parts ; which variety therefore must be regarded as a necessary means to the ultimate end of creation. Wherefore it is enjoined that the way between the soul and the body should be closed, but to be opened successively as we become adult. But the reader will find this subject continued in the sequel, where we treat of free-will.

300. *Hence it follows, that there are no innate ideas or imprinted laws in the human mind ; but only in the soul : in which unless ideas and laws were connate, there could be no memory of the things perceived by the senses, and no understanding ; and*

*no animal could exist and subsist as an organic subject participant of life.* I shall not dwell longer upon this head, because it has been explained above, Part II., n. 293—295.

## IX.

From the foregoing considerations we may infer the nature of the intercourse between the soul and the body: for those things that are superior flow into those that are inferior, according to the order, and suitably to the mode, in which the substances are formed, and in which they communicate, by their connections, with each other. If the operation of the spirituous fluid be the soul; and if the operation of the soul in the organic cortical substance be the mind; and if the affection of the entire brain, or common sensorium, be the animus; and if the faculty of feeling be in the sensory organs; and the faculty of acting, in the motory organs of the body; then a diligent and rational anatomical enquiry must shew the nature of the above intercourse; and must prove that the soul can communicate with the body; but through mediating organs; and indeed according to the natural and acquired state of such organs.

301. *From the foregoing considerations we may infer the nature of the intercourse between the soul and the body: for those things that are superior flow into those that are inferior, according to the order, and suitably to the mode, in which the substances are formed, and in which they communicate, by their connections, with each other.* We have already explained above (Part II., n. 283, 284) what the body is, and shewn that it is the ultimate determination of the soul, having divers corpuscles from the three kingdoms of the earth summoned to assist in its formation, so as to enable the spirituous fluid to attain consistency in the form of blood, and to enter the structure of the tissues, such as muscular flesh, cartilage, bone, &c. The body therefore is a substance by itself, because the blood is a substance distinct from the spirituous fluid; as also are all the other substances composed from the blood. The vessels also of the red blood are

distinct from the little vessels of the purer blood ; and the latter from the vessels, namely, the fibres, of the spirituous fluid : while notwithstanding, the blood is the ultimate determination of the said fluid, because this fluid reigns universally in the blood, and its fibres are continuous with the vessels of the blood, thereby causing the circle of life, which I described above. From this renewed description of the *body*, it may be seen that there is an intercourse between the soul and the body, as between the red blood and the spirituous fluid ; or what amounts to the same thing, as between the last organic forms produced by the blood, and the first organic forms produced by the spirituous fluid : and an intercourse by the mediation of the purer blood, or its vessels, or forms of vessels. For the fluids with their vessels, are determinant of all the forms in the organic body. (Part I., n. 594—607.)

Now if the body with all its organic forms, of which forms indeed it is the general complex, be the ultimate determination of the soul, produced in order that the soul may be enabled in a suitable manner to feel the ultimate modes of the world, and to produce ultimate forces or actions upon the earth ; it follows, that the intercourse between the soul and the body is nothing more than the translation of common modes to the singular modes of the soul ; and the translation of the singular forces of the soul to common forces : there being in this way a kind of progression of operations according to natural order, by a ladder divided into degrees. A clearer idea of this subject may be obtained at pleasure from other parts of our Work.

302. Meanwhile experience alone proves beyond a doubt, that modes or sensations, and motive forces or actions, flow exactly according as substances are formed, and communicate by their connections with each other. For when any organ of the body is injured ; for instance, the tongue, the ear, or the eye, its power of feeling at once vacillates to the exact extent of the mischief ; and when any nerve is injured or disturbed, the chain of communication perishes. Again, when the brain or common sensorium is the subject of the lesion, the faculty of feeling straightway suffers in the organs of the body, and the faculty of imagining and thinking, and the memory itself, in the brain. This is perfectly evident in wounds of the head, in

cases of mania, idiocy, apoplexy, epilepsy, catalepsy, catarrh, hydrocephalus, intoxication, and poisoning; in cases of headache, vertigo, dimness of sight, atrophy, deliquium, lipothymia, syncope, asphyxia; in nightmare, ecstasy, sleep; also in embryos and infants, and indeed in every one according to temperament, &c. In fact, whether the fluids, or the forms constructed of the fluids, be affected, a corresponding affection at once results in the sensations and motive forces; whence phthisis, paralysis, torpor, stupidity, loss of memory, privation of intellect, lethargy, and other maladies. Amid such a mass of evidence, and in such a broad glare of experience, to assert that the sensations and forces of the soul do not flow in exact accordance to the order and mode in which substances are formed, and communicate by their connections with each other; or what is the same thing, to doubt that the soul is a real essence and communicable substance, running without a break in the organic forms of the brain and of the body, as the most perfectly animal fluid, would be at once to impugn both experience and sound reason. Therefore let the nexus of substances teach us the particulars of influx. See Part I., n. 619—627.

303. *If the operation of the spirituous fluid be the soul.* To prevent the mind from falling into the common verbal controversies, it will be well to explain what is properly meant by the term, soul. The spirituous fluid itself is the eminently organic substance of its soul; just as the eye is the organ of sight; the ear, the organ of hearing; the tongue, the organ of taste; the brain, the organ of universal perception. Each of these organs, however, is the sensorium of the modes of its own degree and its own species. Now if the abovementioned fluid be a supereminent organ or sensorium, it seems that its faculty of operating is properly speaking the soul; just as the faculty of thinking is the mind; and the affection of the whole brain in common is the animus. But as the supreme entities in any series for the most part transcend the sphere of the mind, and of words also, so it is difficult to distinguish their adjuncts from their substances. Yet it is no matter whether we call the above fluid itself the spirit or soul, or whether we confine those terms to its faculty of representing the universe to itself, and of having in-

tuition of ends ; for the one cannot be conceived, because it is impossible, without the other. (Part II., n. 245, 246.)

304. *And if the operation of the soul in the organic cortical substance be the mind.* It is very evident from the anatomy of the brain, that the cortical substance is the first determination of the spirituous fluid ; and that each cortical substance is a sensorium in particular, just such as the brain is in general ; so that each may properly be called a cerebellulum. This substance is situated at the last term of the blood-vessels, and at the first term of the medullary fibres of the body ; consequently in a centre, to which all sensations ascend along the fibres, and all motive forces descend along the fibres. In a word, the brain is made up of as many similar forms and natures as it has discrete cortical parts. See the whole of the last Chapter, and particularly the position in n. 191. Now if we are looking in the brain for the organic substance in which the soul acts the most purely and intelligently, and proximately represents to itself the universe, and has intuition of ends, we shall find it to be no other than this cortical substance : to which, by means of the exquisitely organic substances of the fibres, the sensation of the body flows in from below ; shewing of course that it is the centre of operations, and indeed participates of both the soul and the body. In order to ascend from an inferior to a superior degree, it is necessary to pass to units according to the rules of order ; for in the unit lies the particular or singular faculty that exists as a universal or general faculty in the compound. The cortical substance is the unit of the whole brain : in this unit or substance then we ought to find that superior power of which we are in quest. Therefore in this, and not in any ulterior unit, because the cortical substance is the ultimate unit of the brain, we ought to find the soul's faculty of understanding, thinking, judging, and willing. Experience dictates the same thing ; for according to the whole state of this substance, or rather of its fibrils,—the state both natural and superinduced,—and according to its connection with its associate substances without it, the whole intellectual faculty is modified in singular and in general. The specific nature of this substance was described in the last Chapter. There are then as many little

sensoria, because as many cerebellula of similar form, and as many portions of mind, as there are cortical and cineritious substances in the cerebrum, cerebellum, and medulla oblongata and spinalis. The field of the mind's operations extends to every one of these substances ; and the distinctness depends upon the harmonic variety of all, and on the other circumstances mentioned in Part II., n. 193. For we proved above, that sensations do not mount to any particular region of the brain, but to every part of the cortical substance wherever distributed (*Ibid.*, n. 191, 192, &c.); although they are perceived in that part of the brain where the way of communication through the fibres is most fully opened. (*Ibid.*, n. 297.)

305. Now if the cortical substance be the place where the soul plays the mind, or thinks, and from which it determines its wills, let us see what the mind derives from the soul, and what from the body. All is corporeal that is borrowed from the three kingdoms of the earth for the purposes of composition and derivation,—all that the spirituous fluid carries with it in the blood. We proved in the last Chapter, (n. 117—147,) that the cortical substance resembles a corculum or little heart, and by a kind of perpetual animation, or systole and diastole, transmits the essences of the purer blood attracted into it, through an intermediate follicle or chamber, into the fibres and nerves ; and that its surface or woof is framed, with the utmost order, of perpetual fibrils containing spirituous fluid. This was shewn to be the case by experimental evidence. This purer blood, which glances through the little chamber of this corculum or cortex, partakes of the body exactly in so far as it partakes of corpuscles borrowed, as we said above, from the three kingdoms of the earth. Now it was shewn in Part I., in treating of the blood, that this purer or middle blood is actually the spirituous fluid, tempered by the most volatile etherco-saline particles. Hence in proportion as this blood that flows through the cortical substance abounds in these particles, in the same proportion does this substance, and consequently the mind, partake of the body. Thus the more unclean and gravitating the intermediate blood, the more corporeal in itself is the mind, and the more is the *vis operandi* of the soul infringed and dulled. This is plain enough in gross, sanguineous subjects, in states of intoxication,



in those who are ailing from diseased conditions of the blood, and in other cases, whose subjects live more in the body than in the soul.

The wonderful expedient by which in human brains it is provided, that the impurer blood shall not violate or defile the ingenious and consecrated machines of the cortical substances, will be explained in the Part on the Arteries, Veins and Sinuses of the Brain. For to the human brain is left the right and choice of excluding the impure blood, and particularly the red blood, and even of warding off this middle blood from these purest chambers, so long as the mind is viewing its reasons, and involving and evolving them; for all this time it moves its breath so tacitly, or stops the animations of the cortical substances, and almost constricts their chambers, consequently inhibits the transflux of this purer blood through these middle cavities; that is to say, every time it desires to be free from the sensations and forces of the body, and to be left to itself: and for this reason, indeed, at such time every sensory is deprived in some degree of its acumen. In regard to brutes however the case is different.

306. The following are the requisite conditions of a sound mind in a sound body. The spirituous fluid must be of the richest character, and involve the truest order of nature. The cortical substance must be of the most perfect form, open to none but genuine blood. Its fibrils or appendages must unanimously conspire with it; and communicate entirely with the organic forms of the body. The way of communication through the fibres of the cortical substance must be opened by habit and cultivation, duly and according to natural series. Each cortical substance must be so free in its connections with its associates, as to be capable of expansion and compression in particular and in general. The arteries of the red blood must be bounded off from the vessels of the purer blood, and the vessels of the purer blood from those of the purest; so that transflux may be prevented or granted just as occasion may require. The variety of all the cortical substances must be perfectly harmonic; and the general form and state of the brain must be correspondent with the particular form and state of the cortical substances. The blood itself must be healthy; not to mention several other

conditions, which must contribute to enable the mind to approach with any degree of nearness to the intuitions of its soul.

307. *And if the affection of the entire brain, or common sensorium, be the animus.* For if the cortical substance be the first determination of the soul, then the brain is its second determination, for the brain is a grouping of cortical substances. It is clear from examining the brain, that the cortical substances are so wisely arranged, as to correspond exactly to every external sensation. Thus they combine, as units, in glomes, to form a certain number or sum; and the little glomes, as new units, combine to form larger groups, that again unite into one grand mass, which is the brain. The several partitions are discriminated from each other by interstices, furrows, and winding channels; and are combined together by vessels and membranous prolongations; so as to be as it were numbers of units reduced to the form of a proportion: just as we should expect to find in the general sensorium, which is designed to receive every species of external sensation,—sight, hearing, taste and smell, distinctly. But this is a subject which will extend over several of our Parts, for without the anatomy of the brain and organs, it cannot come home even universally to the understanding. Meanwhile, since every cortical and cineritious substance is a unit, and as it were a part and portion in the matter and field of the mind's operation, we may conclude, if we sum up reasons in the analytic way, that the affection of the entire brain is the common or general operation of the mind; hence that imagination is a kind of general thought, and that cupidity is a kind of general will, which does not become singular and distinct until it ascends or penetrates into the sphere of the thoughts. But into this it can never ascend or penetrate by any simple progression from its maximum to its minimum, but only by a positive resolution of its minimum into a higher essence and nature. Consequently all such affection is purely animal; and we so far leave it behind us, as we are able to submit its singulars to the auspices and intuition of the higher mind and the soul.

308. *And if the faculty of feeling be in the sensory organs; and the faculty of acting, in the motory organs of the body; then a diligent and rational anatomical enquiry must shew the nature*

*of the above intercourse ; and must prove that the soul can communicate with the body ; but through mediating organs ; and indeed according to the natural and acquired state of such organs.* In order to investigate the intercourse of the soul with the body, and the reciprocal intercourse of the body with the soul, let us proceed to follow the path laid down by organic substances, that is to say, the clue of anatomy. We find that sight flows along the optic nerve to the thalami or crura of the medulla oblongata, and not only pervades their subtly cineritious and oculate substance, but passes thence through the base of the fornix all over the cortical circumference of the cerebrum ; for all the medullary substance of the cerebrum (derived from the cortex) that runs down to the chemical laboratory of the brain, passes through the base of the fornix, and upon the thalami of the optic nerves, and dips into the latter. The notes or modulamina of hearing strike the delicate fenestræ, sonorous membranes and scattered fibres of the vestibule and labyrinth of the internal ear, and are carried away by the soft and hard nerves of the seventh and fifth pairs to the annular protuberance, and thence to the top of the cortex, where the contremulation of the meninx and multi-foraminous cranium meets it from without. The smell, consisting of the least touches of the pituitary membrane,—touches not cognizable save by a common or general sense,—pours forth swift through the cribriform plate and mammillary processes towards the corpora striata, over the whole medulla of the centrum ovale, and so into the sphere of the cortex. The case is the same with the other sensations : the ultimate receiving-rooms of all are in the cortex, which is rendered conscious of all mutations that happen in compound series and substances.

But all these sensations, in so far as they are regarded simply as senses, appear to have nothing in common with the understanding. The soul represents them to itself, inasmuch as it is the order of its own nature, and thus knows what is harmonious, or agreeable to order, and what is inharmonious, or repugnant to order. This is the reason why brute animals have a more exquisite sense of taste, smell, and even sight, than man, who is furnished with understanding : in fact, the lowest class in society often discerns such discrepancies more

exquisitely than the highest; and perhaps the novitiate Pythagorean disciple, in his three year's silence, discerns them more distinctly than Pythagoras himself with his celestial harmonies. Wherefore those sensations are bare modifications of the fibres in the common sensorium or cortical substance, by means of which the soul feels exactly what is passing without; and in applying them to itself, and perceiving them, it does not need that a way of communication should be opened by the adaptation of the constituent parts of the fibre. These sensations, therefore, do not constitute the intercourse between the soul and the body: they are a mere translation from an organ obnoxious to the modes of the contiguous aura, to a circumference, and to whatever part of it they are wanted to extend; consequently, they do not ascend to a higher degree, but remain in their own degree, the same in which they were at their entrance.

309. If then sensations do not ascend and descend, but are only poured forth from their organs along the nerves into all the little cerebellula of the head, or into the cortical spherules, the question comes, what is there in sensations that is elevated through the degrees of the brain? The mere senses, as hearing and sight, considered in themselves, partake in no respect of understanding or reason, but are the natural helps and instruments which the intelligent soul makes use of to apply to itself and to represent to others the ideas of its mind and animus. Before this can be, sound must be articulated and discriminated into words, each of which signifies a general, special, or particular idea; and these again with their modals, verbals, nominals, relatives, copulatives, and other things of different character, must be distinctly conjoined and punctuated, according to all the rules of grammar, common place, logic and philosophy, before any compound idea or form can result, from which the soul can draw and elicit a sense or meaning. Thus the sound of the ear, or the image of the eye, is so ordered, as to fall under the intuition of the soul, and to ascend from degree to degree, as it were up the steps of a ladder. If we duly ponder and penetrate these facts, we shall see clearly, that the form induced on sounds and images by distinct articulations, is in reality different from sense considered in itself; and that it is as it were a sense in sense, not inherent in sense, but additional

to it, and which can exist either conjointly with it, or separately, and without it; or that material sense performs as it were the part of an instrument and vehicle. Now when this intuitive faculty of the human soul is carried to still higher degrees, the very form of words, from which the soul has drawn and sublimed a sense and essence, must be viewed as a simple idea, and again must be copulated with numerous other forms, as so many quasi-simple ideas, so as to result in a certain sublimer form, which ascends and penetrates still higher, and nearer to the intuition of the soul. From these compound forms, again regarded as simple, and associated with other similar forms, a still sublimer form is produced; and so on; until in fact forms of forms of words can no longer be furnished by any of the devices or periphrases of speech; for in this way ideas climb above the sphere of the mind, and approach to the representations and intuitions of the soul. This is the reason why the soul itself, beholding things at once most singularly and universally, cannot descend pure, or without the aid of a mind, into speech, or forms of words. Thus if any enunciation proper to the soul itself, were produced before the mind's understanding, not a single formula of such enunciation would be understood, because every one of them would climb above the terms of rational philosophy: and still less would a series of such formulæ be understood. Wherefore the speech of the soul is really angelic speech, and the mind cannot represent it to itself except by a kind of mathematical doctrine of universals, of which we have spoken above.

Now if any one enter into the operations of his mind by somewhat of sublimer thought, (which we may do inasmuch as we possess a soul that is above the mind,) he will not obscurely observe, that an inferior rational sight flows into every single word, and into every single form of words. For we represent to ourselves articulate sounds under an image not unlike that which enters by way of the eye: wherefore this conception of words is called imagination, and is in the degree next above hearing; as the visual image is above sounds, or the ether above the air. Again, by farther reflection we observe, that into these images, or objects of the imagination, which are the same as the objects of memory, there flows from a still higher

source a higher intellectual light, by which the things imagined or comprehended under a limited form, are perceived still more highly and abstractedly : this is the origin of thought, which is a faculty of the mind, so distinct from imagination, which is a faculty of the animus, that the two can exist either conjointly or separately. By the faculty of thought we approach still nearer to the supreme intuitions of the soul, although to its very general intuitions. In fact, neither this faculty nor thought can exist and subsist unless a certain light flows from the soul into the sphere of its thoughts, namely, into that of the mind : a subject of which we have spoken above.

Now if we consider how the intellectual light of the soul flows in, (for the light of the soul is twofold, as regarding both the mind and the animus, in which respect it is distinguished by degrees of universality,) it will be seen from the causes above explored, that this light travels by the same path as every sensation viewed in itself. For it inflows in one only manner, but according to the accommodate disposition of the parts constituting the fibres ; or according to the fibres themselves, and their degrees and forms : also according to the more perfect or imperfect state induced upon them by habit and nature. This is the reason why we are conscious of those things that we think and imagine. Thus then according to our proposition, the intercourse between the soul and body may be ascertained by a diligent and rational anatomical investigation combined with psychological experience.

310. If this spirituous fluid does not live its own life, and still less is wise with its own wisdom ; but with His who alone is life and wisdom, we shall in vain look in ourselves for a self-intelligent soul. To find this we must go beyond and above created nature ; nor even then shall we find it, for beyond the creation there is life and pure intelligence, not a common soul ; for the idea of a soul involves that of a natural subject accommodated at once to the beginning of motion and to the reception of life. This in fact is the reason that enquirers into the soul have not known where to bring it from, or where to assign it a place in the animate body. Some, for example, have said that it is a particle of the essence of God, not properly speaking created, nor derived from parents, but miraculously inspired by

God; although they confess that the essence of God cannot be a part of a created substance. Others have held that all souls were created by God at the beginning of the world, and were then successively intruded into bodies. Others have taught that particular souls for individual men were not taken from the bosom of matter, or made with the assistance of matter, but were infused by God into created matter. Others again, as Tertullian and the western presbyters of his time, maintained that the soul of the son was generated from the soul of the father, in the same manner as the body of the son from the body of the father. Aristotle and the Peripatetics declared that there is in matter a natural power of receiving a soul, although not of giving essence to a soul. Hence many theologians assert that in the production of man there are two actions involved; one, the action of God creating the soul; the other, the action of the parent uniting by seminal virtue, as an instrument, the soul created by God, with matter. All these opinions combine to form a perfect unity, when we gain a clear perception of life or wisdom as distinct from nature, and *vice versâ*; also when we acknowledge the omnipresence and universal influx of God in all created things according to the modified character and capacity of each. (Part II., Chap. III., Sec. V.; and n. 270, 271.)

311. Before we conclude this subject, we must consider the question, whether the soul is to be called *material* or *immaterial*. We have often said above, that in regard to substance the soul is a fluid, nay, a fluid most absolute; produced by the aura of the universe; enclosed in the fibres; the matter by which, from which and for which, the body exists; the supereminent organ. We have also said that the influxion of its operations is to be examined according to the nexus of organic substances, and according to the form determined by the fibres: also that its nature, or operations collectively, regard this fluid as their subject; and that these operations, in so far as they are natural, cannot be separated [from the fluid] except in thought; so that nothing here occurs but appears to be fairly comprehended under the term matter. But, pray, what is *matter*? If it be defined as extension endued with inertia, then the soul is not material; for inertia, the source of gravity, enters the posterior sphere simply by composition, and by the addition of a number of things



that through changes in the state of active entities have become inert and gravitating; for instance, all the mere elements of the earth, as salts, minerals, &c. The first aura of the world is not matter in this sense; for neither gravity nor levity can be predicated of it; but on the contrary, active force, the origin of gravity and levity in terrestrial bodies, which do not of themselves regard any common centre, unless there be an acting, causing, directing force. Hence neither gravity nor levity can be predicated of this fluid, made up as it is of this force or aura. When, according to the rules of the doctrine of order, I have shewn what matter is, what form is, what extension is, and what a fluid is, we shall confess that the controversy is about the signification of terms, or about the manner in which something that we are ignorant of, is to be denominated,—we shall confess that we are fighting with a shadow, without knowing what body it belongs to: however, this slight garment alone is prepared, before we have the measure, or have seen the form, of the body; and in order to make it fit, we figure to ourselves an idea of the body, which idea may be immaterial. But tell me whether the ideas of the animus are material, or not? Perhaps they are, inasmuch as images, and even the very eyes, are material. But as it is the office of the soul to feel, to see, and to imagine, equally as to understand and to think; yet the ideas of the latter faculties are called immaterial, because intellectual; perhaps because the substances that are their subjects are not comprehended by sense; and still material ideas not only agree but communicate with immaterial; are they then any ideas at all before they partake of the life of the soul? Apart from this, are they not modifications? If they are modifications, or analogous to modifications, then I do not understand in what way an immaterial modification is distinguished from a material modification, unless by degrees, in that the immaterial is higher, more universal, more perfect and more imperceptible. Is not every created thing in the world and nature a subject of extension? and may not everything, as extended, be called material? In fact the first substance itself in this sense is the *materia prima* of all other substances, and every controversy, even our present one, is a matter of dispute. But let us trifle no longer. According to

sound reason, whatever is substantial and flows from a substantial in the created universe of nature, is matter : therefore modification itself is matter, as it does not extend one iota beyond the limit of substance. (Part II., n. 293.) But as for the more noble essence or life of the soul, it is not raised to any that is more perfect, because it is one only essence ; but the soul is an organism formed by the spirituous fluid, in which respect greater and lesser exaltation may be predicated of it. This essence and life is not created, and therefore it is not proper to call it material ; so for the same reason we cannot call the soul material in respect to its reception of this life ; nor therefore the mind ; nor therefore the animus, nor the sight, the hearing, nor even the body itself so far as it lives. For all these live the life of their soul, and the soul lives the life of the spirit of God, who is not matter, but essence ; whose esse is life ; whose life is wisdom ; and whose wisdom consists in beholding and embracing the ends to be promoted by the determinations of matter and the forms of nature. Thus both materiality and immateriality are predicable of the soul ; and the materialist and immaterialist may each abide in his own opinion.

## X.

The spirituous fluid is thoroughly adapted and ready to take upon it infinite variety, and to undergo infinite changes of state : hence it is in the most perfect harmonie variety, both with respect to the parts in its system, and with respect to different systems relatively to each other. By means of this variety the soul is enabled to know everything whatever that happens without and within the body, and that comes in contact with the body ; and to apply its force to those things that occur within, and to give its consent to those things that occur without. Thus we may understand what free choice is : namely, that the mind has the power to elect whatever it desires in a thought directed to an end : hence to determine the body to act ; whether according to what the animus wishes, or whether the contrary :

but in those matters only in which the mind has been instructed by way of the organs, in which it views the honorable, the useful, or the decorous as an end. But in higher and divine things, the mind can will the means, but in respect to the end, it must permit itself to be acted upon by the soul, and the soul by the spirit of God. Meanwhile, this free power of doing, or leaving undone, is granted to human minds as a means to the ultimate end of creation, which is the glory of God.

312. *The spirituous fluid is thoroughly adapted and ready to take upon it infinite variety, and to undergo infinite changes of state.* The higher and more perfect entities of nature excel all others in this, that they are more susceptible of variety, hence more ready to undergo change of state. But here we must explain what we mean by change of state, and harmonic variety resulting therefrom; and lest our ideas should be lost in the indeterminate and abstract, let us attach them at once to an example. From a volume of air, and the modes of acting thereof, we know the nature of every part of it; for a part is the least volume of its atmosphere, and the nature of the atmosphere is plainly manifested in the action of many parts before the sensorium, which is rendered conscious of its mutations. The air, as we all know, readily allows of being either condensed in space, or expanded, with a difference almost incredible, according to the experiments of Boyle. Hence its modifiability, and aptitude for taking upon it all variety; or for constituting an atmosphere of whose parts not one is altogether alike or equal to another; but all are in perfect harmonic variety relatively to each other, which causes an equilibrium of the whole. Those parts that occupy the upper region of the atmosphere, are always more expanded and light than those that occupy the lower region; hence the two are ever unlike in their force of acting, and in the vigor and degree of their elasticity. In these respects the higher auras exceed the lower almost in the proportion of myriads of myriads to one; for in their susceptibility of variety, and in their change of state, their chief perfection consists: this produces perfection of forces and modifications, and enables them to serve as the causes of

infinite varieties in the posterior or consequent sphere. Hence it follows that the first aura, formed to the forces of nature in her most perfect state, involves the whole possibility of applying itself to every inconceivable minutia of variety, consequently of concurring with every assignable determination: so that on this account it deserves to be called essential force, essential elasticity, and primordial nature, although it descends from substances prior to itself. Or if we may speak according to the rules of elastic and purely natural forces, we should say that its elasticity is exactly equal to the pressing force, or that it reacts with an identical force to that by which it is pressed; that the sum of the forces before and after collision is the same; or that the quantity of the forces is maintained in every collision and act of pressure; that no impetus can be conceived in it, and no resistant, but only an agent: that no impression upon it is lost, but passes unimpaired into the whole atmosphere; shewing that there is a unanimous consent of all the parts, and that each part corresponds in its character to its whole universe; and that in the part as a least type lies all that had preëxisted in the world: not to mention other predicaments, of which I have spoken in my *Principia*, Part I., Chap. VI., where I have called this aura, the first element of the world. In order that the mutual harmonie variety of its parts may come under the imagination of thought, let us regard it as the atmosphere of the universe, or as the universe itself, and suppose in it as many perfectly active centres as there are stars or suns; the universe being thus divided into all these singular universes. Following the same path let us further suppose that there are the same number of spheres of activity and universal vortices, under which, and in which, the vortices of the planets or earths gyrate as inferior vortices. In every sphere of activity, or in every world, no one part of this aura is ever exactly similar or equal to any other; since there is a successive difference of forces corresponding to every part of the distance from the centre of activity; just in the same manner, although beyond imagination more perfectly and universally, as there is in the atmosphere of the air, according to regions, and according to the distances from the centre of gravity; for between the first aura and the air there is this difference, that the former involves active force

alone, while the latter besides has the adjunct of gravity. Hence the wonderful harmony of all things, and the equilibrium of the whole; and hence the fact that there are as many forces of nature in her most perfect state, as there are forms and parts constituting the universe. This mutation, which is the power of expansion and compression, is to be called their *accidental mutation*, or rather their *natural mutation*, as being the perfection of their nature.

313. From this supreme aura of the world let us pass to the spirituous fluid, which, as we have often indicated, is the richest progeny of the said aura. Effects prove very clearly, that all the above perfection is transferred into this fluid by its parent aura, for what in the animal kingdom can be conceived more fluid than it? what more modifiable? what more accommodate to assume every form? In fact, as a perpetual mother and nurse it enters every texture, the least as well as the greatest, and continues, irrigates, nourishes, actuates, modifies, forms and renovates it. (Part II., n. 221.) It feels whatever of mutability happens in any degree of its series, and pours forth every force impressed, all and entire, upon neighboring and distant parts; and seals the outermost sphere with the same presence and faculty as the nearest. (Part I. n. 100.) In virtue of this character, this fluid is the living force or natural life of its kingdom, and the representation of the grand universe in its own limited universe; hence by eminence it may be called the microcosm when the entire body is regarded as a macrocosm; or it may be said to be any one of the parts that perform any office in any part of the kingdom. Thus it is in a manner the supereminent lung, muscle, gland, organ, womb, &c., which denominations are ascribed to the cortical substance in an inferior degree. (Part II. n. 176, *seqq.*) I am at a loss to know on what principle or fact those persons rely, who love to predicate hardness of the spirituous fluid; when in fact it loses its busy life, and declines to inertia and death, in exact proportion as it loses its elasticity. For I know not what universal substance could do what has to be done, if in its leasts it were of itself inert, and at every imperceptible moment of its circulation lost some considerable amount of the forces it had received, and at every point were resisting. From the wonderful character of this fluid originates

every sensation and determination of the will into act ; also the amazing production of forms ; the perpetual animation of the system ; and the fact that the fluid can become so fixed as to assume the form of a little tunie (Part II., n. 296, 297) ; the harmonie variety of all the cortical substances of the medullary, nervous, and motive fibres ; of the blood ; of the other fluids ; of the viscera in the whole and in part, and of the effects therefrom resulting. (Part I., n. 97—99, 602—606.) Wherefore this accidental mutation of this fluid is its veriest perfection, and derogates in no respect from its form, and takes nothing from its essence and attributes. For instance, the lungs are not the less perfect because they respire ; nor the brain, because it animates ; nor the heart and arteries, because they beat. Essentials and attributes, whether within a large or a small space, like a circle with a greater or lesser circumference, nevertheless remain entire ; although modes, in respect to moments and degrees, are successively varied. Wherefore the most perfect and persistent constancy in form and essence ever accompanies this perfect mutability of the higher entities. Wolff corroborates this position. “The state of the soul,” says he, “is continually changing : the soul continually tends to change of state : all the changes of the soul take their rise from sensation :” &c. (*Psychologia Rationalis*, § 58, 56, 64.)

314. There is no worthier matter of enquiry within the field of rational psychology, than that presented by the question, whether besides the above accidental mutation there can exist also a *real* or *essential mutation* in the spirituous fluid : and if such real mutation exists, whether it comes in any way before the understanding ; for certainly it comes under the head of rational psychology as the main point from which all the rest follows. From a comparison of the spirituous fluid with the aura of the universe, that is to say, with the first aura of the world, it follows of necessity, that both are born to take upon them infinite variety, this being the spring of their natural perfection ; while nevertheless there is this difference, that those things that are impressed upon the spirituous fluid, inhere in it ; or that the parts in the fibres put on the state that principles procure for them, as is evident from our remembrance and understanding of things : but not so in the first aura, which is inani-

mate, and relapses at once into its natural state, after the assailant force has ceased. Such mutation in the spirituous fluid, which must be called a real or essential mutation, comes to be considered either in relation to its principle of motion, or to its reception of life. If any mutation happened with regard to its principle of motion, the soul might cease to be the order, truth, law, and representation of its universe: but that no such mutation takes place is confirmed by fact; for whatever be a man's character, still his children are born with the details of the human form; whereas if an essential mutation could be induced, the human race in the lapse of ages might degenerate into some monstrous shape different from the human. We learn also from a rational anatomical enquiry that this cannot be, for the spirituous fluid resides so high above other forms, and is concealed so deeply within its fibres, that it cannot be touched as regards its essential determinations by any extrinsic natural force, unless by a force of the most general kind derived from the perpetual disharmonies of the senses, especially of sight. But besides that this sense in itself does not penetrate beyond the sphere of the animus, and by no means reaches the mind (Part II., n. 308), much less the veriest singular sphere of the soul, no affection can result from it to the essential determinations of this fluid. And moreover it is most wisely provided by the Creator, that disharmonies shall be discussed by perpetual harmonies; (for the variety of all things is most beautiful, and particularly of the objects of sight;) also that the eye shall suffer from inharmious objects before the brain and its organism. Again, the most perfect and persistent constancy in form and essence ever accompanies the first entities of nature. (*Ibid.*, n. 313.) Hence it follows that no mutation, not even a general mutation, can be induced upon this fluid by this channel; on which subject the reader will see more in the sequel. Now if no essential mutation can come by way of the sight, much less can it come by way of the other senses, of hearing, taste and smell, which are still more general; least of all can it come from touch, or from the pain of body felt in diseases; feeling being the most general of all the senses. By an essential mutation of the soul, I mean a mutation of its essential determinations, or of its form, so far as it can be reduced from a more perfect to a more imperfect



form: just as if the fibres, humors and tunics of the eyes, or the membranes, tympana, and cochleæ of the ears, or the motive fibres of the heart, or the vascular or nervous lines of any other viscus, were reduced to a different and more or less ordinate situation and state, exceeding their natural state; as when circles are reduced to figures not circular. Such an essential mutation, therefore, cannot possibly happen to the spirituous fluid, in regard to its principle of motion. The apparent deviation of nature in monstrous fœtuses, arises from contingent causes extraneous to this fluid.

315. But it is a plain truth declared by daily experience, that mutations do happen to souls in regard to their reception of life. For we well know that we have the power to reflect, infringe, diminish, and intercept the rays of its wisdom; to oppose them with our own mists, to bring ourselves into darkness, and again to emerge into light; nay, to reject the better truths, and to embrace what is repugnant to wisdom, and to turn the mind from probabilities to either extreme; and thus from wisdom to pass to insanity, and from insanity to wisdom: there being therefore as many souls as men, because as many minds, rational and animal; or what amounts to the same thing, as many heads. But this mutation is not an essential mutation, like that described above; but still it is a real mutation higher than the essential, in the spirituous fluid itself, and it renders this fluid either better or worse fitted for receiving wisdom. Life itself is impassive, and inflows in one only manner according to the modified character and capacity of the subject (Part II., n. 261). This mutation therefore deserves to be called a *superior essential mutation*, the cause of which affects the fluid itself, since the fluid is the soul, capable of intelligence, and is the spirit. [*Ibid.*, n. 245.] In order to represent to ourselves the cause and reason of this mutation, we must descend from the spirituous fluid itself to its more general operations, or to the mind and the animus. We said above that the light of the soul flows into the sphere of the mind according to the state (acquired *a posteriori*) of the parts constituting the fibres; consequently according to their acquired disposition; in order that the perceptions of things may fall more nearly under the intuition of the soul, which flows in always

with one only force, light, or virtue. But this light is received according to the modification that the intermediate parts, or the parts constituting the fibres, induce; much in the same manner as the objects and subjects into which the solar light flows. Now let us ascend from this to the spirituous fluid, and by analogy conceive in it, as in a supereminent organ, the least and imperceptible lines or pores analogous to fibrillary lines, delineated and inscribed by the first aura of the world in immense abundance and with incredible perfection; and let us conceive that the essential determinations of this fluid, or that its form, which is the form of forms, results from these delicate delineations. Now as these analogous and supereminent fibrils, in regard to their constituent substances and entities, are accommodated or adapted to the reception of life, so the wisdom of life appears to flow in. To this point, by the help of analogy, we may raise our thoughts, and represent to ourselves a somewhat correspondent, but higher, in the soul: although it must be confessed, that without the aid of a mathematical doctrine of universals, and the most ample experience from the posterior sphere, we can never procure any other than the obscurest idea of the subject; an idea approaching nearer to the darkness of ignorance than to the light of knowledge. Still this subject is the noblest part of rational psychology. Indeed it is the principle from which, we have to deduce the reason why our ultimate human forms are never in all respects similar or equal, but perfectly distinct from each other: why every one wears his own countenance, and every one wears his own animus; the countenance being the effigy of the animus, the changes and passions of which, are conspicuously delineated on the face itself. If then the countenance, and the form of our actions, be a representation of the animus, and if the ulterior forms of actions when rationally inspected, be the representations of the mind, it follows from this, that the ultimate corporeal form derives its first origin from the soul and its superior essential mutation, of which we have already treated. Thus far on the ladder of psychology we may fairly mount, for we are still within created nature, and our inquiry is in reference to the formals and essentials of the spirituous fluid; but to climb further, or to the essence of life, would be to ascend beyond the soul, when be-

tween it and life there are boundaries which it is impossible for human faculties to transcend. (Part II., n. 266.)

316. But from this first thread let us weave, as far as we may, the web, and prosecute the argument, of our rational psychology. It is evident from actual laws based upon experience, that this state cannot be induced upon the spirituous fluid, except in a general, not in a singular manner; for the mind itself is but a very general operation of the soul, and is the centre to which the soul descends with its force and virtue, and to which things ascend under an intellectual form as objects, or principles imprinted upon the memory. Hence any such affection and mutation cannot, it seems, possibly be induced upon the soul except in a general manner. Otherwise, if the soul itself were the centre of influxes, as in a state of integrity, then a more singular, nay, a most singular mutation might be induced upon it. And the consequence would be, that every deliberate aberration from the truth, or every deliberate fault, would be indelible, as shewn above. (Part II., n. 299.) The general state readily admits of being repaired and reformed by singulars, but not the singular state by the general; for singulars constitute the general. For this reason it is most wisely provided that we should be instructed *a posteriori*, and rendered rational by successive stages. Hence it appears how dangerous it is with principles that are erroneous and hostile to the truth, to let ourselves loose in the height and depth of nature's prior sphere, and of the doctrine of universals or singulars: and how still more dangerous and wicked it is to disseminate such principles among the public. For the higher and the deeper we go the nearer we come to the essence and state of the soul. But those who let themselves be led by truths, may enter legitimately even into absolute singulars, and the higher they go, the rather and the more do they ascend from use; for uses serve for reducing those things to order that are derived from the imaginary and specious apparent truths of others, and which apparent truths are really falsities, and would disturb the way leading to absolute truths. But if we would insinuate ourselves farther into this noble subject, we must perforce discuss the subject of the will, of free choice, of the particular concurrence of the soul with the operations of the mind, and also the subject of conscience. And still we must be-

ware lest we seem to ourselves to be in the path of truth, when all the time we are wandering in error, if not wilfully, at least through ignorance. For at this point a sphere of thick darkness awaits the mind, and should this darkness be tempered by a few rays, still conjectures are associated with them, which appear as if they were bright with morning light. Thus we have explained the following part of our induction, namely, this: *Hence it is in the most perfect harmonic variety, both with respect to the parts in its system, and with respect to different systems relatively to each other. By means of this variety, the soul is enabled to know everything whatever that happens without and within the body, and that comes in contact with the body; and to apply its force to those things that occur within, and to give its consent to those things that occur without.*

317. *Thus we may understand what free choice is: namely, that the mind has the power to elect whatever it desires in a thought directed to an end: hence to determine the body to act; whether according to what the animus wishes, or whether the contrary.* But before we consider the subject of free choice, let us treat of the will itself. From the operation of the mind, (whose office it is to understand; to revolve what things it has understood according to the disposition of present things, in other words, to think; then to reduce its thoughts analytically to the form of an equation, that is, to judge; then to draw a line under its judgments, and sum them up, or in other words, to conclude) it follows, that the thing concluded is what is called the will; for to say, *it is concluded*, or *to will*, amounts to the same thing. It farther appears from this rational analysis, thus formed, that thoughts and judgments are successively involved in the conclusion, as in an equation; and from the conclusion, in which they exist simultaneously, are successively evolved by speech, or by actions. Hence the will is the closing act of the thoughts.

318. But the nature of the will may be better understood by comparing it with conatus or effort. It is manifest from physiological laws that motion is perpetual effort or endeavor; and that in effort lie all the essentials of motion. Take the following examples. The expanded lungs perpetually endeavor to expire or contract; the ribs, to relapse to the position of rest; the fibre

and blood-vessel, to contract; the cartilages and the stretched membranes, to return to their previous state; the muscle, to collapse; the obstructed brain, to animate; compressed auras, to expand; a spring, to recoil; in short, almost everything endeavors to change its state, resistance being all that prevents and restrains it: so that when the resistance is removed, effort passes into open motion, and this, to the exact degree to which the resistance is removed. Thus the same causes are the determinants or essentials of motion as of effort; consequently motion is perpetual effort. I am not now speaking of that motion of bodies that proceeds from external force; for to keep in motion is more natural than to remain at rest. But to return to the will: this involves in it as many essentials as there are points that have entered from the thought into the judgment, or as the mind has allowed, by the liberty of judging, to enter into the conclusion. This is the reason why action is perpetual will; and why all the essentials of action lie in the will; and why action is estimated according to the will.

319. But let us still pursue the subject of the will, as the best means to illustrate the nature of free choice. A single will or a single conclusion is formed of as many wills or conclusions as there are means, that is, intermediate ends leading to that which is regarded as the ultimate end: and not one of these wills comes forth openly into action unless resistance be removed, and then only in the degree in which it is removed. Thus the mind regards impossibility and degrees of impossibility, as a subject exercising effort or endeavor regards resistance and its degrees; whence in every step of determination, the mind pauses to reflect upon place, time, opportunity, the state of things, its own power, the retractive forces of the animus, and many matters that constitute arguments of possibility; and thus in a manner every time concludes, or forms wills, in order that all things may be carried on in the natural order to the ultimate end; and the more intelligent the mind is, in order that all things may proceed as of themselves and their own accord. This constitutes foresight and prudence. And the mind acts thus with the greater earnestness in proportion to the ardor with which it desires and loves the end; the love of the end being as a kindling heat to intellectual light. Now if will

be like conatus or effort, and may therefore in some measure be called rational effort, it follows, that it passes into action upon the simple removal or lessening of impossibilities, such passage being called its determination. (Part II., n. 159—161.)

320. What then is the free choice or liberty that is attributed to the will? From the very definition of the will it is perfectly clear to every one, that the liberty of willing is as great as the liberty of thinking and judging, and that the extent of judging is as great as the faculty and measure of understanding: shewing that the will proceeds *pari passu* with the understanding. In order to enable any one to admit essentials from the sphere of the thoughts into the conclusion, he must of course know and understand what to admit, and what he can bring in. Thus the more intelligent the man, the more free his will. And hence there is no freedom of will in inanimate things; a certain analogon of free will in brute animals; a shadow of it in maniacs and idiots; a small share in the lowest grades of mankind: in all a larger measure, according to their degree of intelligence: in Adam, a faculty of the kind absolutely perfect.

321. As the will proceeds *pari passu* with the understanding, and as it is the part of an intelligent being to regard ends, and to govern nature in accordance with ends (Part II., n. 236, 237), so it follows, that the will is busied only in choosing ends, and in disposing the progression of means: consequently in preferring the better and rejecting the worse, or in modifying and applying them to serve as means. Thus the essential and principal part of liberty consists in being able to choose the good, and to omit the evil; but not in being able to do whatever is agreeable and pleasant, even though repugnant or not conducive as a mean to a more excellent end.

322. Now as liberty is the companion and spouse of the intellect, it follows, that the one as well as the other may be exalted and perfected in the human race: and in fact all possible means and aids are provided to ensure the perfection of both. Thus our very soul itself, which flows from above into the rational mind, is essential science and natural intelligence (Part II., n. 276, 277), depending immediately upon the spirit of life,

and instructed by the lips of Infinite Wisdom. (*Ibid.*, n. 241, 242, 245, 257, *seqq.*) Then below the soul there are the senses, which are so many masters to instruct us in the nature of the world; and to teach us what is done at their own doors, and what in the remotest regions. And that we may know all things that all men know, speech is given us: also the memory of the past; and perpetual experience: wonders too familiar, and too closely environing us, to allow us to wonder at them. "Custom," says Seneca, "removes from our minds the sense of the greatness of what is constantly taking place; for we are so formed, that daily occurrences pass notice, however worthy of our admiration."<sup>x</sup> Add to the above-mentioned means the circle of the sciences, as improved by the finest talents of mankind; and the knowledge of things that transcend the intellectual sphere given by actual divine revelation, which, as the learned teach us, is the spring from which the knowledge of heavenly things and the most essential laws of the purely moral code have gone forth throughout the world. Nay, in our very souls is implanted the thirst of knowing and exploring the most hidden and the highest things; and an ardent desire of discerning ulterior ends in means, and of divining the future from the present and the past. In the same way we also have a love of ourselves, which increases with the rise of our faculties. Thus we value hearing more than smell; sight more than hearing; understanding more than sight: consequently this very love ascends by its own degrees from the body to the soul, whose happiness we cannot but prefer or desire before all the happiness of any lower life. And that nothing may be wanting to perfect the understanding, and to exercise it upon the objects of the memory, and upon the consideration of things, it is also given to man to separate the mind from the medley crowd of the affections of the animus; so that nothing may disturb its analyses or mar its quiet; and thus we enjoy that golden liberty which consists in the right to expatiate in thought over universal nature, and to seek and embrace the truth, wherever it lies hidden. (Part II., n. 42, 164, 215, 299.) "The powers of the body are injured," says Grotius, "by a too great excellence in the object; for example, the sense of sight by the light of the sun; but the more excellent



the objects with which the mind is conversant, such as universals, and figures abstracted from matter, the more perfect it becomes. (*Op. Cit.*, lib. i., § xxiii.) And those things that draw the mind away from the body, are indeed the more excellent actions of the mind." (*Ibid.*, annot. 3.) We are also enabled to determine into act whatever the mind desires, not only almost without consulting, but even in opposition to, the animus; for the body is under the necessity of doing, and the animus of wishing, what the mind desires, as is perfectly well known in civil life; it being the office of the body to form looks and actions, to be disposed, and to do what the higher lives desire. (Part II., n. 280.) We have advanced so far at the present day, that we have skill enough to exalt the sense of sight far above its natural acumen; it now remains for us to do the same for the rational sight, and this, by means of a science of sciences. It is clear then that we are amply furnished with helps for perfecting the understanding, and amply endowed with powers conducive to wisdom. But the real obstacles to progress come now to be considered.

323. In order to the existence of a power of choosing the better side, there is not only required a knowledge of the worse, but also a reacting force, to enable the mind to turn itself either to the one or the other. Hence the mind is placed in the veriest centre and concourse between the superior acting and the inferior reacting forces: the soul acting upon it from above, and the spirit of life acting upon the soul; and the animus upon it from below, and the body, upon the animus: shewing that the mind holds the fulcrum of the balance, and weighs things on both sides with even scales. Below are the cupidities of the animus, the blandishments of the senses, the pleasures of the body, and the infinitely various amusements of human societies; forming so many allurements and impediments to prevent the mind from employing itself rightly in the intuition of ends, and the election of the greater good, and from acting freely from a ground of choice. Besides these things there are a vast variety of loves emanating from every man's selfhood; also cares, domestic, economic, and public, which come to us with the force of necessities, [and which are real impediments to the mind]; for to seek our bread with anxious solicitude, and to withdraw

the mind from the body, are in a manner two opposites; the one is to will to live within the world; while the other is to will to live without it. And the heaviest weight that is thrown into the scale on this side, is, that the delights of the body and of the animus come clearly within the sphere of our sensations, and reach the consciousness of the mind, but not so the weights that ought to be added to the opposite scale: for those things that occupy the higher place, are incomprehensible, and apparently continuous, to the sensory of lower things. (Part. I., n. 623.) And the reason of this may be seen from what has gone before: for we cannot at all feel, or be conscious of, those things that are transacted *within* the fibres and vessels; while whatever exists *in* the fibres themselves, even in their purest texture, does fall within the sphere of our sense, the fibre and membrane being therefore commonly said to feel. Consequently we know nothing at all of the modification of the spirituous fluid, the proper modification of the soul, but only of its common modification in the mind, when the little fibrillary stamina are conjointly modified by their appropriate causes. Now hence it follows, that we are more capable of understanding what is true than of willing it, and that the liberty of acting, or the wife, is very easily divorced from the understanding, or the husband. And this separation in the marriage-bed of the mind is often more complete in the intelligent than in the simple-minded, for the former persuade themselves by various intellectual reasons to take the part of the lower senses, and speciously cloak the merest vices under the garb of virtues. But let us rightly consider the cause of this equilibration, and what it is that turns the scale. Nothing is acceptable or grateful that does not proceed from free choice: what is done from necessity has no merit. In order for us to be judged from our will, the motives that operate from below must necessarily appear stronger than those that operate from above. Victory is estimated according to the number and valor of the enemy; and on our part, according to the effort we make, and our power, as measured by our degree of intelligence. Wherefore everything is removed from us that might compel us to will; such as the exhibition of miracles, the visible presence of angels and the dead: for blessed are they who see not and yet believe. [John xx., 29.]

There is then an internal man, and an external; and the two fight against each other: and from the two as a compound source, essentials may be brought into the will, that is, into the conclusion of the judgment, or the closing operation of the thoughts. But although our wills are the conclusions of judgment, yet, nevertheless, by the help of free choice, we have the power to judge them over again, or to ruminate our thoughts, before they are determined into act; and even after actual determination, to direct, and as it were amend them, to prevent them from wandering too far beyond the circle of means tending to the better end.

But in truth none of the things above mentioned are of themselves inimical or hostile to us. The delights of the world, and the pleasures of the animus, are harmless in themselves, and serve as the fuel and incentives of bodily life, and as means and helps to the promotion of ends. This we may see very plainly by considering them one by one. For nature, regarded in itself, is dead, and only serves life as an instrumental cause: being altogether subject to the will of the intelligent mind, which uses it to promote ends by effects. (Part II., n. 234.) And indeed a more exquisite spice and sweetness lies in these things when they are only made use of as means and helps. Those persons therefore appear to be somewhat beside themselves, who aim, not to moderate, but altogether to exterminate the pleasures of the senses and the delights of the world, as if they were so many deadly and pernicious poisons. For they would deprive bodily life of its appropriate excitements; the progression of ends, of their means; the order of nature, of its course; and themselves, of the proper palm that is the reward of victory: nay, they would deprive free will, which is the human delight, and the right use of which is human wisdom, of all relation to merit; for it depends upon free will that we regard these things not as ultimate but as intermediate ends; since it is an eternal law that everything is judged by its end. But born slaves lose the very sense of liberty; and the lower state is believed to be the universal, the all, and the eminent state, when the higher is either unknown, or the power of rule is not conceded to it.

324. I say that cupidities and pleasures are harmless in themselves, and that in the first instance, or originally, there

is no evil in them. Those of them that exist in the body, are so many vehicles of means to a given end, and spring from a pure fountain in the soul. But they are as streams that gather mud as they run, and every ditch in which they tarry becomes a new source of impurity. Nay more, the desires and loves of ends excite the intellectual light in the mind; and the loves of corporeal uses excite the vital light in the animus; as is plain from the illumination of the thoughts, and the kindling of the imaginations. This is in some measure comparable to the light of vision which in the eyes of some animals is kindled up in the dark by the activity of appetite. But let us speak from instances. Taste and flavor is not only an index of the quality of foods and drinks, but acts also as a stimulus to repair the forces of the body that must otherwise fail: consequently it is a delight making easier and more pleasant the process of formation and renovation in every living subject; and thus it flows down from the soul as a pure love of preserving by means of nutrition its own ultimate form in the body, and of prolonging the years of life for its own sake and for its associates. The desire for sexual connection descends from an innocent and burning desire of the soul to multiply the individuals of its kind in order that the earth may be peopled; and in the human soul for a still more universal end; and the more this universal end reigns in the desires, the purer is its derivation. So parental love exists as a means to the education and parental care of the offspring. Anger exists from zeal for defending the truth, for protecting oneself, resisting injuries, and for preserving the order of one's own nature, and of the nature of the whole. Ambition exists in order that in these respects each man may excel, may rise to a proper height in knowledge and mind, and affect the higher rather than the lower sphere; &c. And the same may be said with respect to other desires and affections, whose seed lies deep in the soul. And what is particularly worthy of remark, in proportion to the universality of any natural end, these incentives increase in delights and hence in desires. But as they flow downward from their pure fountain, the more rapid is frequently their current, and the more defiled and polluted are they by accessories; so that at length we scarcely know whether they be streams from

that fountain, or not. In fact, in order to recognize them in the higher degree, we sometimes have to climb above them to a degree higher still; and so by its means to explore the intermediate. It follows then that it is left to the choice of the mind to regard these heats of life either as vehicles of means, or as ends; for every mean is also an intermediate end; but as it is regarded, so we are regarded. Thus the mind has the power of controlling the impetuosity of these torrents, lest they should flood the kingdom with a dominant reign of general licentiousness.

325. But if it be the soul that thinks, that judges, that concludes, and determines the conclusion or will into act; and if the soul is the all as it were in its mind, as well as in its body, it may perhaps be thought that free choice should be ascribed to it, and not to the mind as a faculty different from it. If however we attend to the operations of the soul within the fibres, and to its operations without the fibres; and to its operations, singular, general, and more general; and relatively to the influx of things by way of the senses; and also to the soul's state of representing the universe, and to its state of regarding ends, or receiving wisdom of life; that is to say, to its natural and moral state, (of all which we have spoken above,)—then the consequence of a distinct perception of these several topics, will be a distinct solution of every doubt: and a proof that the superior essential mutation of the soul flows from the single source of the free choice of the mind. (Part II., n. 315.) Hence the moral distinction of souls and the natural distinction of systems one from the other, proceeding not from any error or lapse of the mind, still less of the animus and the body; but from deeper causes, principally from its consenting and condescending to form wills out of the principles impressed upon the mind *a posteriori*: also from its not suffering itself to be impressed with, and its not admitting, principles, from which truer judgments and conclusions may be formed: independently of many other reasons of the deepest kind: such, for instance, as the following: that as the soul of the parent is derived to the offspring, so also is the penalty of transgression so far as relates to the body, but not so far as relates to the soul; for every one lives and dies amenable to God for his own conduct alone. So many

examples confirm this truth, that I know not one to the contrary to be found in the history of any lineage, although brought down to the latest date. Yet we ourselves rarely experience the truth of it within the brief round of our own lives and reflection, partly by reason of our indistinct perception of the revolution of things. But these and the like subjects do not properly belong to the gyre of this Part of our Work.

326. *But in those matters only in which the mind has been instructed by way of the organs, in which it views the honorable, the useful, or the decorous as an end.* We have hitherto been considering the fact, that the power of choosing moral good and evil resides in the same mind as the reasoning faculty and judgment; and as the principles that can be made subjects of discussion and collision, when the love of an end kindles up a contest on either side. And as there are no innate ideas or imprinted laws in the human mind (Part II., n. 293—295, 300), so the contest is carried on only by those that have assumed the character of principles in the mind. Thus men naturally incline and descend to take the side of those that are felt to be something by the whole animus and body, or of which we are clearly conscious, and which most come home to us. In regard to other things, although we do not absolutely doubt them, yet we have to grasp them by a sort of faith, as being more remote from us; we being in a manner ignorant whether they concern us, or not. It is therefore natural to seize as ends of our intuitions and actions such things as most nearly affect us; hence such as have relation either to the useful, the honorable, or the becoming. For in the equilibration mentioned above, the lower things preponderate, because they come clearly home to consciousness by means of sensation. Those things that relate to *the useful*, are all the endowments of our life, which constitute either its essence or its adjuncts; for the useful in itself, is useful for something, or to something; for which reason alone it is called useful. These endowments, as they are proximate and most present, easily win the palm from all other things. The highest degree, and the lowest at the same time, consists in regarding the useful not as a means but as an end; this is avarice, which consists, not in the use, but in the bare contemplation of possibilities; and out of the

abundance of goods, measures uses by potency, and not by act; wherefore this end is justly regarded as sordid, and by the honest or honorable man as the very vilest of ends; nay, is despised in others even by the miser himself. It is natural to regard another on the same principle as that other regards himself. Thus if any one regards the honorable as only a means or instrument for arriving at *his* end, or the useful; and if another regards the useful as only a means or instrument for arriving at *his* end, or the honorable; these two persons, each estimating the other from the end, can never agree in a third end, but will contend with each other from the respective principles which guide their election of good and evil. And in fact one and the same person is not unfrequently at variance with himself in his own mind, as having principles imprinted upon it in one part for the useful, in another for the honorable; which divergent principles issue in fight and conflict, and ultimately in a secret compromise, by which each agrees to serve the other reciprocally as a means. *The honorable* also involves its own ground of existence, as being in a manner the complex of those things by virtue or on account of which it is styled honorable. Thus its essentials are the various virtues, such as the cultivation of friendship, the preferring good name to life, the desire to achieve immortality of fame; to serve the public; to sacrifice ourselves for our country; to acknowledge and embrace the truth; in a word, to be a citizen of citizens and an upright and honest man, and to enjoy free will according to the degree of one's understanding, under no compulsion from civil or forensic law. Such were the heroes of old: such were many of the illustrious leaders of the Roman people. "What think you," says Cicero, "impelled C. Mucius Scævola to slay Porsenna, without having himself the least prospect of escape? What power supported Horatius Coeles to stand against all the enemy's host on the bridge alone? . . . What end was aimed at by those two bulwarks of the Punie war, Cneius and Publius Scipio, when they thought to have excluded the Carthaginian hosts solely by the barrier of their own single persons? What was the aim of Africanus Major and Africanus Minor? Of Cato, likewise, who arose in the interval between these heroes?" &c. (Part I., n. 232.) But pure honesty or honor apart from all regard to utility to



onesself as an end, is something almost superhuman: at least we contemplate the reward that proceeds from virtue; knowing that desert always lies in virtue, as punishment always lies in vice. "He that has defined all good by the honorable, is happy within himself," says Seneca. (*Epist.* lxxiv.) Yet still the honorable cannot extend beyond principles, or beyond the rational induction proceeding from principles impressed upon the mind by way of the senses. And for this reason we often take up and embrace as right and honorable, things that in themselves are the reverse; of which the mistaken morality of various nations is a sufficient proof. However, it is not to be denied, that the virtue of the soul flows into this moral man with a fuller and distincter vein; in short, that the virtue flows from a more genuine soul, as a subject more perfectly accommodated at once to the beginning of motion and to the reception of life. So that of such men we may predicate a sounder reason, according to the requisites stated above (Part II., n. 306), and also more of life, because more of wisdom. The seeds of honesty or probity are derived *either* from parents (*Ibid.*, n. 295), who by the practice of virtues derived from acquired principles, have been the means of giving birth to a good inclination in their children: for the soul it is that determines and provides that the way leading to herself shall be opened successively according to her own nature, which in fact she has derived from her parent. (*Ibid.*, n. 298.) *Or else* the seeds of honesty are formed in the subject itself out of true principles originating in a variety of ways, and thus breathed upon in their deepest depths by the light of life and of wisdom. But as regards *the becoming*, it always is for the sake of something, for it is the essential form of the useful and honorable, being not at all in itself an end; since when assumed as an end it is pure vanity,—the very insanity that for the most part sticks to pride. All things must take some form, that is to say, some decorum or becoming expression of their own, in order that their existence may be recognized, and their due place and rank admitted: so it is with actions, manners, gestures, speech, &c. This decorum or formal expression is not confined to any certain laws, but springs from, and depends upon, the authority of custom; so that often what is decorous to one person is indecorous to another. And it is

not inaptly termed mode (or fashion), for modes vary while essence and attributes remain the same. Yet the constantly or consistently decorous is identical with the right or honorable. Meanwhile, in the lapse of ages, we seem to fall from the constantly or consistently decorous, or the honorable, to the inconstantly decorous, or to the forms of things; that is to say, from the internal to the external, and from the centre to the surface; and this, to such an extent, that the very essential of humanity is reckoned to consist in the power to mimic virtues by forms, and to make mere utility pass under the guise of honor and honesty; and so artfully is this accomplished that nothing of it transpires in the means until the end is actually achieved. Meanwhile the honorable itself is desirous to put itself forward under the form of the decorous (Part II., n. 286). The mind's office then is, to choose the decorous or becoming, as the vehicle for carrying on the means to the end that it has in view.

327. It will be said, perhaps, that the will is not perpetually constituted of essentials derived at all from the useful, honorable, or becoming; or from principles referable to any one of them: that it does, and leaves undone many things from fear of punishment, misfortune, enmity, anger, revenge, inclination, love, habit. But these are things that either carry the mind away captive, or determine the will upwards by another force than that of love. With respect to the fear of punishment, or misfortune, we are constrained by it to enjoy our liberty as becomes us, or to abuse it as becomes us not. As to anger and revenge, these passions determine us from the higher to the lower sphere, or from liberty to slavery. Similar remarks apply to inclination and love, by which we are frequently consigned to chains, and the mind itself sees its own will put in fetters, and sometimes smiles with bitterness the while, but without having the power to shake off the yoke. With respect to habit, it is no will into which any essential enters anew as a result of judgment, being only an acquired instinct imitating a natural one. But it is beyond the capacity of the human intellect to explore the essence of the will with all its causes and adjuncts, so far at least as concerns the principles determinant of reason, which may be taken from some most remote and internal cause, of which we are altogether ignorant; and this,

not only in others, but even in ourselves. It is indeed possible to prescribe certain general rules, but to reduce the singulars to order, would require us to go through all human minds, with their innumerable mutations; which are as numerous as individuals, and in some persons must be counted by hours and moments. We may observe, however, that to leave anything undone through fear, inability, necessity, or any powerfully dominant circumstance, is to will to do, and not to be able: consequently in these cases the will itself is regarded as the action, for the action is committed as soon as the reagents are removed; &c.

328. Let us now briefly consider, whether liberty can, or cannot, be predicated of the will.\* Liberty is a power, or the very posse added to the very esse; and the will is in a manner the determinative of action: besides which, the power of choosing resides in the judgment, and reasons flow into the judgment from the thought, and from the judgment pass into the will, that is to say, into the conclusion; as we observed above: according to which it appears, that liberty cannot be attributed to the will regarded as a conclusion. Yet as we can reflect upon even the conclusion, and submit the reasons constituting it to a renewed consideration, and recall and reëxamine or ruminate them, so in this respect the will seems to have something like liberty, and to be considered as a præ-judicial decision, that is liable to be again brought up by appeal before a revising tribunal, there to receive true judgment.

329. *But in higher and divine things, the mind can will the means, but in respect to the end, it must permit itself to be acted upon by the soul, and the soul by the spirit of God.* These higher things are what concern the soul, and the highest are what relate to God. Among the higher we may specify the knowledge that after the death of the body, felicity of felicities awaits the soul that is pure; felicity eternal, because in God and immediately from God; felicity incomprehensible and ineffable. Among the highest things we should reckon the belief, that God is the Creator of the universe, omnipotent, all-provident, omniscient; who is to be worshipped,

\* It appears that Swedenborg makes a distinction between the free choice of the mind and the liberty of the will.—(Tr.)

to be adored, to be loved; that the very means leading to him are to be adored as Himself; that He is life eternal; the end of ends; the ruler of things, all and singular, yea, most singular; besides an infinity of other truths that do not come of themselves into the intellectual mind. It is plain from our account of the soul, the will, and free choice, to what extent the mind can freely rise to these things, or choose them in preference to lower things, that is to say, naturally weigh them in the balance, and so remit from the intellect into the will those things that tend as means to this end. Although high and divine things are incomprehensible, and do not come home to our mental consciousness at all by the path of sensation, yet still they do come to our knowledge by the instructions of our teachers, and by sciences; and in some measure also by our power of reflecting upon arguments, and the things flowing in therefrom, and perpetually from the universe *a posteriori*; but principally from the Holy Scriptures. By these means the mind may know and understand the existence of these high things, and so far as concerns us, their nature and quality; and therefore the fact that they are to be earnestly sought after. Afterwards from the intellect they may fall into the thought; from the thought into the judgment; and then into the conclusion or will, consequently into action; for action is perpetual will, as will is perpetual determination into act.

330. But although we are able to will these things, it does not follow that we will freely. The freedom of willing depends upon the love of the end, which results in desire. From the equilibration (Part II., n. 322, 323) established in the mind as a centre, between the influx of the higher forces and the lower agents, we observe that the lower forces are so much stronger than the higher, that the weight in one scale naturally bears down that in the other, and that the love of self, and its adjuncts, sensibly excited by the delights that every moment ascend into the sphere of the mind, alluringly solicits the mind to turn in this direction. In fact, there are always incentives at hand, to persuade it to descend, and to dissuade it from rising above itself to something that is incomprehensible, that hides its delights in secret places, and remits them away from the present to the future. Therefore it is not that knowledge

and acknowledgment escape the understanding of our minds ; but it is that the desire resulting from love is not present when ever the mind begins to exert its choice : although here above all a surpassing love should be present, to put out the flames of other loves. We ourselves have no power to light up this sacred fire ; and scarcely to desire it with more than a wish of itself not active [but passive] ; hence we cannot by any power of election proper to ourselves, carry those things that regard the higher ends as essentials, from the judgment, into the conclusion or will. It is the part of the mind, or of the intelligent being, to regard ends, and to will them in so far as it loves them.

331. But let us proceed still further. The mind does not doubt that it is in the power of Him who is the absolute esse and posse, to infuse this love or essence of faith into human minds. He himself is the end ; he governs all things below as mere subjects ; and rules the universe with all its singulars, in things and particulars the most singular, with infinitely more power, wisdom, and providence, than any soul whatever rules its own body. Therefore as He is the veriest posse, it cannot be doubted that he is willing as he is able. It would be contrary to wisdom, and to his essence, not to will what pertains to himself, or to the end whose intermediates leading to that one end alone, the created universe contains. Granting this, it follows that there is a universal law, on our obedience to which depends our being able at last to desire that, which at first we tacitly and coldly wish. This law, of his ordaining, appears to be, that our willing should excite his willing, and that our posse should excite his. If he willed without restriction, of course he would be able without restriction. In such a law then the highest wisdom must lie hid, for whatever is in God, and whatever law God acts by, is God. Or this mystery is the law, that we cannot be regarded, except from some will of our own directed to an end ; for it is a standing truth, that whatever is necessary, is associated in the mind with the impossibility of doing otherwise, and is not in itself pleasing or acceptable ; and that every contingent is regarded from the cause which makes it contingent. If then we strive to the utmost of our power to will and to be able, it follows as a matter of course, that a higher power then breathes upon us, and raises

our efforts to powers not human; and thereby brings us back into a state emulous of that liberty which we have lost. "Nothing," says Lactantius, "is so much a matter of the will, as religion; if the mind of the worshipper be turned away, religion is gone, or annihilated." (*Divinarum Institutionum*, lib. v., cap. xx.) And Grotius says: "There is no real worship of God but that which proceeds from a willing mind." (*Op. Cit.*, lib. vi., § vii.)

332. But from our statement of the balance of the mind (Part II., n. 322, 323), it is quite clear, that one of the scales has for the most part heavier weights thrown into it than the other, the contents of which indeed are not weights at all, but mere forces. In order then to turn the balance in favor of the latter scale, the weights of the other must needs be so disposed as to yield, or obey, the forces of the first: or else they must be removed: that is to say, the mind, which holds the top of the balance, must try to separate itself, or withdraw, from the animus, and as far as possible abandon itself for the time being to the regard of higher things. It has been occasionally shewn above, that the potency and power to do this are granted to human minds; in short, that the mind can in a measure stand guard on the outside of, and away from, the animus and the external senses, or can keep watch and wake while the body sleeps. Of course then, by this means, the mind is left to the disposal of the soul, and suffers itself to be acted upon by the soul, which then flows in with fuller light, and is received by the mind in an almost purely intellectual sphere. And by consequence the soul itself is left to the disposal, and under the auspices, of the Spirit of wisdom, who cannot but be rendered conscious of [its] intuitions, because its thought is at this time directed to him, and terminates in him; besides which he is conscious of all things, and weighs all, even the very minutest particulars, and knows how they are weighed by us. Nay, in order that the balance may incline to his side, he most mercifully provides for the possibility of an approach to himself, and for the reflection of his divine light upon the human race, by a Mediator, who being in our human nature united to God, has exactly fulfilled the essentials of the divine law in every tittle.

333. Lastly we have to remark, that it is all one whether we say that we are regarded [or judged of] by our faith, by our will, or by our actions. For faith is the soul of this will, and the love of the end is the life of both. Faith without will is faith without love, that is to say, mere knowledge and acknowledgment; and in fact, is faith without life, or dead faith. What essential can be insinuated by a mind thus directed, into the conclusion, or into the will, that the love of the end, or faith rightly understood, does not involve? And what can be insinuated into action that the will does not involve? To separate the one from the other, would amount to separating the end from the means, the soul from the body, and life from the soul; or to saying—I acknowledge, I desire, but I do not will; or, I will, but I do not act. Thus we may know from the action itself, supposing it to be sincere, whether there be faith or not, and if there be, what the faith is. But indeed faith itself is not meritorious if the mind has absolute proof of its object in the visible and intelligible sphere. Whatever is comprehended by positive demonstration, puts aside the essence of faith. In short, faith is in a manner opposed to perception; the former entering the mind *a priori*, the latter *a posteriori*.

334. *Meanwhile, this free power of doing, or leaving undone, is granted to human minds as a means to the ultimate end of creation, which is the glory of God.* We have sufficiently proved already, that this free power is the marriage portion of the human understanding, and that by its means the understanding can turn to any side, or in any direction, where it either sees that happiness is to be gained, or suspects that it can be heightened. Indeed when we first escape from slavery to liberty, we clearly feel that liberty is the essence of human delight, and at once hail it as a golden gift. By mere liberty we are distinguished from the brutes, as by our use of liberty we are distinguished from our fellow-mortals. By liberty we are raised to a higher state, even almost to the state of integrity before the fall. By the aid of liberty we may elevate the mind towards the higher sphere; yea, and exalt our life itself, until it becomes beatific and eternal. So that indeed it may be said, that the right to claim heaven is ours, although to claim it by prayer; for as we are respected according to our power and will, so, by



God's grace, *that* is regarded as merit which in itself is not merit, and in this way the promised reward becomes its inheritance.

335. And if we extend our reflections to the essence of free choice, and to the end for which free choice is given, we may infer intellectually, that all moral distinction of souls, and all natural distinction of bodies, takes its rise from this source. For whence the diversity of minds, except from the free power of thought? Whence the diversity of morals, except from the free execution of the will? And whence the diversity of countenances, except from the bodying forth and imprint of the affections of the animus,—the imprint derived from the state of the mind. Shewing that the variety of subjects in all human society proceeds from the same source. This is the ground why governments can be formed, and laws prescribed, these being demanded simply to direct our free choice, and to bend it in favor of the public and private weal. Indeed I think I shall not be in error, if I declare, as a matter of rational induction, (for so I am free to declare it,) that as in civil society the members must be distinguished from each other by certain individual characteristics of mind, animus and body, before any form of government can exist, so also in the universal or heavenly society of souls, (respecting which see the last paragraph of the present Part, n. 366,) there must be a moral difference or distinction between the members, arising from the superior essential mutation mentioned above (*Ibid.*, n. 314), and therefore from the exercise of free choice; or in fact from the same source as the distinction of members in a state: and that from this moral distinction of souls, that supreme form of government, and the perfection of the whole, results. Hence this free power is granted to human minds as a means to the ultimate end of creation, which is the glory of God. This view is confirmed by the fathers of the Christian church; but I will here content myself with citing the words of Bellarmine. "Free choice," says he, "is the free power of choosing one in preference to another of those things that conduce to an end; or of accepting or rejecting one and the same thing at pleasure. This power is attributed to our intelligent nature to the great glory of God." (*De Gratiâ et Libero Arbitrio*, lib. iii., cap. iii.)

Having once begun this chain of inference, we may pursue it to this further link, that without moral distinction, and consequently without free choice, there could be no real distinction between souls; in short, the soul of each man could not lead its own life, or enjoy its own happiness: for on the ground of permanent general integrity, absolute similarity or equality would follow, not only in this life but in the life to come (Part II., n. 299); in which case there would be an inevitable union of many, or of all souls into one general soul. Which consideration shews that this free power is the universal mean by which subjects or systems are specifically distinguished from each other; in order perhaps that a harmonic variety of souls, as the perfection of the whole, may be the result. We shall feel that we verily and indeed enjoy this free power of thinking and reflecting, if we will but well attend to the marvellous workings of divine providence; which plainly shew that numerous circumstances happen in human society, entirely relevant to, and flowing from, this moral distinction of souls, as their ultimate cause and origin. I allude to those universal rules or laws of nations which nature herself dictates; by which, for instance, we instinctively revolt from marriages between brothers and sisters; also to the fact that marriages are said to be made [*præstabilita*] in heaven; and to an infinity of other circumstances, in which the finger of providence is plainly seen, distinguishing individual from individual.

336. But as we have it in our power to abuse this most excellent gift, by rejecting the good, and choosing the evil; so we also abuse it in this, that we throw the blame of our choice upon the Creator himself, and what is still worse, upon His providence. Unless it were an eternal law of the highest wisdom, that what is done of necessity and compulsion is not regarded as proceeding from any cause in the agent, and that every contingent is regarded from the cause upon which it is contingent, to the end in us that what has no merit in itself should be converted into something like merit, and that thus we should be rewarded for something not ours, as though it were our own,—what should hinder the Omnipotent from forcing us if he pleased? Surely he might have driven us to his altar with lightnings and thunders, bent our stubborn knees, and prostrated us in worship.

He might have distributed angels and departed spirits, under human forms, through all the societies of the earth; or every instant have addressed us by word of mouth, and by fearful terrors, as the Jews of old upon Mount Sinai. In short, he might have crushed our wills by perpetual miracles. But under this necessity, could any action be regarded as our own? Nay, should we not rather boil with deeper wickedness? Did ever the obedience of a beaten slave seem to merit reward? We all confess that virtue compelled is no virtue at all. On this ground it would seem that God has deigned to permit so many apparently repugnant and contrary circumstances, and even to admit among his miracles the very jugglings of the Egyptian magicians; in order that something might still be left to the minds of men, that might savor of the liberty of discerning truth from falsehood; and in order that real miracles themselves might afford an opportunity for the exercise of somewhat of faith. Thus the heavier the weight and the greater the wrong that inclines the balance of the mind, the brighter its reward shall be, if it gains the victory: as indeed the Holy Scriptures teach us. Nay, even if power fail us, it is enough if we really will to possess it, for then we stand in relation with it, and the power we have, is exalted by the essential power of God, to whom all things are possible.

337. Oh! how does the mind degrade itself, when dimly illumined by a few scanty rays of life, it thinks from blind nature, and contemplates the order of nature as not order! (Part II., n. 237.) If the intelligent mind governs nature suitably to its ends, how much more suitably to the ultimate end, or to the end of ends, must the infinitely wise God govern the universe and all things in the universe. It is a necessary consequence of a necessary Being, that all things whatever that have been, that are, and that will be, follow in a constant order as means to the perfection of the whole; however it may appear to be otherwise, from the fact that things are not rightly viewed according to their circumstances, and that [we think that] at every moment God attempts by some new impulse to rule the universal world, just as we ourselves, to rule our own little world. But God sees and embraces all series of means and ends in the universe from the first to the last, simulta-

neously, in the present, from the highest point of view, in himself, most distinctly. We, on the other hand, see and embrace only some, and indeed few, series of means and ends, in fact, the last immensely distant from the first, successively before simultaneously; from the past in order to be in the present; from below, from contingent causes, and withal most obscurely. For this reason a vast number of things appear to our most limited minds to be repugnant [to the laws of a divine providence]. But I believe and trust that even we, despite our present feeling of their contrariety, will yet be led to confess, if not in this life, yet in the life to come, that nothing could possibly be more just, that nothing could be more wise.

## XI.

But not so in brute animals; for their purest fluid receives its form from the ether of the second order, not in a higher degree than, but in the same degree as, their organism, which corresponds to that of our mind: and in consequence of this circumstance, they are born to communication between the soul and the body, or to all the conditions of their life; and are carried, suitably to the order of nature, into ends that they themselves are ignorant of.

338. *But not so in brute animals; for their purest fluid receives its form from the ether of the second order.* Respecting the auras of the world, and the manner in which they rise in perfection according to degrees, see Part II., n. 272, 273. And respecting the perfection of sensations by comparison with the modifications of the auras, see *Ibid.*, n. 289—291. From the analogy of causes, the likeness of effects, and the order of things, it follows, that the fluid of beasts is not in reality different in origin from the human fluid, but comes from a lower aura: therefore, for the sake of distinction, we call the fluid of animals, their purest fluid; but that of man, the spirituous fluid. Yet the truth is, that either of them may fairly be termed a soul, as a common denomination; for the fluid of

brutes even, making allowance for the difference of degrees, is the order, law, rule, truth, and science of their nature; although indefinitely falling short of the perfection of the human soul. Moreover it is a subject accommodated at once to the beginning of motion and to the reception of life. (Part II., n. 241—250, 272, 278, 283, 290.) For as the sun of the world flows in one only manner, and without essential union, into the subjects and objects of its universe, so also does the sun of life and of wisdom. (Part II., n. 257—259.) But as the sun of the world flows into subjects and objects according to the modified character and capacity of each, so also does the sun of life and of wisdom. (*Ibid.*, n. 261—264.) Furthermore, by the omnipresence and universal influx of this life into created matters, all things flow constantly in a provident order from an end, through ends, to an end. (*Ibid.*, n. 267, 268.) For it is not life, (which itself is single, or one only thing,) that is exalted in perfection; but it is the organism that is so exalted, although in respect of the organism, greater and lesser perfection may be predicated of life also. (*Ibid.*, n. 311, &c.)

339. We have said that the purest fluid of animals, in short, that their soul, derives its origin from the second aura: and that this is the case, is evident from an examination of their instincts, or of those natural effects that flow from the soul as their principle: clearly, for instance, from this, that in numerous cases animals have shewn the most exact and complete capacity to turn to the different quarters of the world, and to return to their homes over miles of ground, through paths that they had never before smelt or attempted; and in like manner to betake themselves to their pastures, stables, hives, streams, houses. We allude to dogs, horses, bees, ants, crabs, &c., all of which may be compared to living magnets, since the magnet has in it a similar directive force to these animals. That this force owes its origin to the second ether, was shewn in my *Principia*, Part I., Chap. IX., and in the present Work, Part II., n. 272. With man this force cannot be connate, because the direction of the first aura is universal, as the direction of the created universe. I need not mention other proofs in the several instincts, which flow derivatively from the same kind of animate direction.

340. Meanwhile the comparative anatomy of the brains of animals clearly demonstrates, that their purest vital fluid or eminent blood is of a lower order or less noble rank than the human fluid. We shall speak to the point of anatomy in various Parts of our Work, from which at present we will only select the following proof by anticipation. The pituitary gland of animals, which receives this [purest] fluid from the brains, and transmits it through the basilar sinuses into the jugular veins, and so to the heart,—this gland, I say, in brute animals cannot fail to be fashioned with reference to the character of the fluid that is brought to it from various sources. Now in animals a very broad passage leads into this gland through the beak of the infundibulum, of so much greater calibre than the corresponding passage in human brains, as plainly to present the appearance of a hollow tube, and easily to allow the injection of a colored liquid. In the human brain, on the contrary, the passage is so narrow, that neither is it visible to the eye, nor can any elementary fluid be made to permeate it: except that the mere beak of the infundibulum performs the office of a sieve to an essence of the subtlest kind. But perhaps this may not be considered sufficient proof of our view, because the genuine use both of this gland, and of the infundibulum, and ventricles, is not yet recognized: and as long as the use is a moot point, any induction from use furnishes no sort of proof. The arguments then from the brains, and from anatomy generally, must be brought together in other Parts of our Work. Meanwhile, from those brains that I have examined, I have convinced myself, that there is as great a difference between the animal fluid and the human spirituous fluid, as there is between a lower and a higher degree, or according to the rule of order, as there is between a cube and its root; or between the sonorous forms of the ear, and the visual ideas of the eye; and how immense and almost unassignable this difference is, see Part II., n. 290. But the actual effects displayed by particular animals offer the clearest evidence on the subject: these effects being so many derivations from the nature of their first fluid, and all originating in their causes therefrom. See Part I., Chap. III.; Part II., Chap. II. Hence it follows, that the purest fluid of animals, according to our induction, is—

341. *Not in a higher degree than, but in the same degree as, their organism, which corresponds to that of our mind; or to the modifications of the aura of the second order. (Part II., n. 289.)* However it does not follow from this that animals possess a rational mind. Before an intellectual mind can exist, a light must flow into the sphere of the mind from a higher power or soul; but without this light there can be no thought, and *a fortiori* no judgment, and no conclusion or will of which liberty can be predicated; as I think we have already more than sufficiently shewn. This is still better seen by a comparison of vital effects; and this, too, that all the apparent perfections of animals are but so many proofs and signs of their imperfection as compared with the state of our human life.

342. *And in consequence of this circumstance, they are born to communication between the soul and the body, or to all the conditions of their life; and are carried, suitably to the order of nature, into ends that they themselves are ignorant of.* Thus of themselves and their own nature they know and seek out those particular aliments that are suitable to them, and actually use vast skill in discovering them whenever and wherever they happen to be concealed, and on the other hand, they reject, separate, and loath things that are not suitable to them. They lay up provisions for the winter season; such at least is the case with bees, ants, birds, and various little animals. In many ways they correct anything amiss in their natural functions, yea, even by recourse to herbs and different kinds of waters. With admirable art and ingenuity they build their nests, lining them with feathers, and making their walls with layers of clay, skilfully intermingled with twigs. They are acquainted with modes and ways, too subtle for the most penetrating sight to follow, of copulating or propagating their species. They know how to lay their eggs; how to hatch their young; to nurture them with affection until the new brain is competent to supplant their parental care; they know when to discard them; how to distinguish their foes, to elude or baffle them, to provoke them to battle, vanquish them, and defend themselves and their offspring; they know how to form a mimic commonwealth, and how to express the common affections of their animus, by the heightenings and modulations of a single sound. But these are the general



endowments of animals; the particular endowments of each species are almost innumerable. In fact, from their soul, as being the order and truth of sublunary nature, they seem by their very birth to enter on the possession of this world's sciences,—natural chemistry, mechanics, medicine, in a word, universal physics; although they cannot reduce a single one of these into a systematic form; this being reserved for humanity. These are plain and sufficiently demonstrative proofs, that from the first to the last of life all the ideas representative and intuitive of ends, are involved and connate in the soul. (Part II., n. 293—299.) These ideas at once display themselves in brute animals: but they cannot do this in man, because the mind has to be instructed *a posteriori*, so that it may not govern its actions by instinct, but morally, from a rational ground; and that there may be a will, as a standard by which the man is estimated.

343. But before we rise to examine causes, it will be well to compare the brain of animals with that of man: for a diligent anatomical enquiry conjoined with experimental psychology, must shew the nature of the intercourse and communication [between the soul and the body], and of the effects resulting therefrom. (Part II., n. 308—310.) Those things that are superior flow into those that are inferior, according to the order, and suitably to the mode, in which substances are formed, and in which they communicate, by their connections, with each other. (*Ibid.*, n. 301—304.) The brains of different species of brutes differ respectively according to the nature of their souls; and not only in bulk, but in figure and disposition of parts, and especially in the direction and dispensation of the fluids, as they pass from the outer sphere to their cortical substances; and this, entirely in accordance with the nature of their purest fluid, which is the cause of all the consequent fluids, since it is the formative force and substance, that draws the thread from the first living point, and continues it afterwards to the last point of life. (Part II., n. 229, 230; Part I., n. 253, *seqq.*) And it has determined and provided, that the way leading to it should be opened in this order. (*Ibid.*, n. 298.) In the most general respects, the brains of animals of all kinds are so like human brains, that unless we view the difference of the two by a rational intuition, we may easily be led by the apparent simi-

litude to presume an absolute similitude in first causes, and to think that the form is the sole ground of distinction. Thus in both cases we have a cerebellum distinct from the cerebrum; a medulla oblongata and medulla spinalis; almost similar investing membranes or meninges; and almost similar folds and septa connected with the meninges, and forming partitions and separations: in both cases again we find a corpus callosum, fornix, septum lucidum, ventricles, choroid plexuses, corpora striata, thalami nervorum opticorum, lesser protuberances, nates, testes, pineal gland, infundibulum, pituitary gland, rete mirabile, receptacula cavernosa, tuber annulare, corpora olivaria and pyramidalia: then again similar subdivisions of the brain into congeries, large and small, bounded by winding channels, furrows and chinks; and convoluted into serpentine gyres: also similar cortical and medullary substances: all of which are penetrated, united, and irrigated by similar arteries, namely, the carotids and vertebrales. There are sinuses, too, superior as well as inferior, placed in nearly the same situation in both animals and man: and in the brains of both, every part enjoys its own animation; not to mention still more numerous similarities that present themselves in the members. In animals, the organs of the external senses are for the most part more excellent than in man; to the end that animals, which possess no reasoning power to infer the whole cause of their instincts, and to apply it to themselves and their own nature, may enlarge their capacity of sensation to the utmost, and supply their wants from present objects. From a careful comparison, however, it is very clear, that everything in the human brain, which is the common sensory of all, is wonderfully disposed with a view to enable man, otherwise than brute animals, to live a rational life under the auspices of a higher sense, or of the intellect in the sense; that is, of a soul raised to a sublimer faculty; and to be directed to his ends by internal and not external motives, as we shall explain in the succeeding Parts of this Work.

344. But the great similitude between man and animals in regard to the brain, the organs of the senses, the viscera of the body, and even the respective actions of each, proves absolutely nothing. It only shews what we do in common with brute animals; for instance, from the ground of the animus and the

several operations of the animus, which consist in the various appetites for those things that pertain to life; and in the various changes we undergo when we cannot obtain them, as indignation, anger, consternation, envy, and the like; these being the passions and affections of the animus. But in order to know in what we are distinguished from the common herd of the creation, we must climb to the very origin and prime cause of all, which is to be found far beyond the eye, and will never be seen so long as we persist in fixing our regard upon the most external and the lowest sphere alone. In fact we must ascend from the visible forms of animals to their purest fluid; that is to say, to the soul that is their universal formative substance. Now we shewed above that the animal soul is as different from the human, as air is different from ether, or hearing from sight; in a word, as a lower degree from a higher, or a whole number from the units of its unit. But in order again to represent this difference, let us compare hearing with sight. The former scarcely extends its sphere of perception farther than a few yards, before it begins to grow indistinct and dull; the latter extends its sphere, almost without degrees and moments, beyond the vortex to the sun and stars. And we are convinced by a careful examination and comparison of the operations of both, that even such is the difference in point of perfection between the souls of brutes and the human soul.

Suppose now that the purest fluid of brutes is produced from the vortical or sublunar ether, and our human spirituous fluid from the celestial aura, or the primal aura of the universe; it follows, that animals cannot fail to be born at once to communication with their soul, or to all the conditions of their life; in other words, that in animals the way of communication from the external senses, through the fibres, to the soul, cannot fail to be open from the moment of birth. The reason is, that those things that are insinuated by way of the senses or *a posteriori*, correspond in their degree with the natural power of the very souls of animals; so that what touches the fibres extrinsically, is of one and the same order and purity with what modifies them intrinsically: whence it follows, that the little tunic of the fibre is at once accommodated. What is intermediate is bound to act in compliance with the forces of either agent, or of two

agreeing in nature. Not so if the agent on one side be above the nature and measure of that on the other. Then of course the intermediate must be previously disposed by peculiar causes, or by the continual influx of external sensations, to obey the higher forces, as in man. Indeed, we may infer from physiological laws, that the little tunic of a fibre, (which as we have proved above, is compacted or made up of the matter of its fluid) (Part II., n. 296, 297), cannot be compacted and conglutinated by a lower and more imperfect fluid, in the same manner as the little tunic of a fibre is compacted and conglutinated by a higher and more perfect fluid. For the natural perfection of both consists in the fitness and proneness to take on infinite changes, or in expansion and compression, which we have called accidental mutation (*Ibid.*, n. 312, 313); in assuming which, if the higher animal fluid excel the lower in the same proportion as the perfection of the ether excels that of the air, or as the higher degree excels the lower; then the tunic of the higher fluid may be entirely bent upon furnishing almost all the means of complete communication; but not so, the little tunic of the fibre of the lower fluid. And this appears to be the reason why human infancy, childhood, and youth, are so much more protracted than the corresponding periods in the lives of irrational animals: shewing that our apparent imperfection is in reality a proof of our perfection. In any case it is certainly plain that the way of communication is closed in the perfect animals, but opened at once in the more imperfect, presenting a broad avenue of approach from their senses to their very soul, which latter, by virtue of this circumstance, is enabled straightway to concur with all those modes, and marked particulars in modes, that can possibly flow in *a posteriori*. And this soul, being the order and truth of its nature, and the science too, perceives at the first glance and warning, what is in agreement with order, and what is in disagreement; and welcomes agreeing and harmonic objects, as friends, with smiles and nods of recognition, but discountenances and dispels as enemies, all disagreeable and inharmonic objects. Thus in animals there is a perpetual concurrence of the sensations with the perceptions of the soul; and the living operations or actions that result therefrom, are mere instincts. Indeed, when the soul is put in action, it flows

down not more wonderfully into the motive forces of the muscles, or the forms of actions, than into the actions themselves, when [as in the case of animals] it has produced them from the beginning; as both the one and the other result from the operation of the soul within the fibres. (Part II., n. 293.) Is it not then clear enough, that in the order of nature, all and singular things constantly flow as intermediate ends to an ultimate end; that the created universe is the instrumental cause for promoting these ends: and that there is an influx of a life of the most sublime intelligence, disposing and directing all things. (Part II., n. 236, 237, 267, 268.) Grotius speaks as follows of brute animals: "That they do not," says he, "possess the power of discovery, or of judging between different things, appears from the fact, that they always act in one and the same manner: wherefore it follows that these actions proceed from an extrinsic reason, either directing them, or impressing its efficacy upon them. And this reason is no other than God." (Part II., n. 259.)

345. On these premises let us see what effects must proceed from the foregoing circumstances considered as a cause; in short, what actions must spring from the above-mentioned concurrence of the soul with the body. The result, then, is, that such animate beings can have no intellectual mind; they cannot think, judge, conclude or rationally will, at all; in other words, they cannot act from foresight or prudence; they cannot regard ends freely or exercise choice; they cannot express themselves in articulate sounds, or words; they cannot get a higher sense or understanding out of the forms of words: and they cannot bring forth actions as perpetual wills formed out of the materials of thought. It is as impossible to instruct their faculties in these and the like respects, as to infuse life into a stone, to turn water into ether, or to rise to the sun on the waxen wings of Dædalus. Still as animals possess a soul, whose organism answers to that of the human mind, and as they are ignorant of the operations of that soul within the fibres, just as we are ignorant of the operations of our soul within its fibres, so they possess some analogon of a mind, or of reason and will. Yet only in such wise, that the actual determinations of their forces, we mean, their actions, put on this analogous appearance, when they are regarded by the human mind: and indeed these actions not unfre-

quently seem better ordered [than ours], inasmuch as they take effect in correspondence with the order of nature.

346. But if they have no mind, or no centre of operations, higher and lower, and yet their soul is accommodated to the beginning of motion and to the reception of life, they must possess an animus, to serve as the centre of their operations, and into which force and light flow in from the soul *a priori*, and from the body and the bodily senses, *a posteriori*. Hence they must have a perception of the things that flow in from the senses; and also an imagination, with its allied cupidities. (Part II., n. 279.) Now particular experience here conduces us to the same result. For animals, in common with ourselves, possess the affections of anger, envy, fear, hatred, friendship, &c.; also appetites of various kinds; in a word, all the peculiar attributes of the animus, which indeed furnish them with the incentives and fires of life. Therefore it would be wrong to liken animals to automatons or inanimate machines. The subordination of their faculties should, as we think, be regarded as a continuous proportion of three successive terms or ratios, of which the first is to the second as the second is to the third; there being, in this way, a constant relation of the last to the first through the middle term: and thereby a perpetual correspondence of the passions and actions of the body, with the soul, through the animus, which latter participates in both. On the other hand, the subordination of the faculties in man, is rather to be considered as a proportion consisting of four terms or ratios, not standing in continuous or constant progression, but the first being to the second as the third to the fourth, and which proportion, to make it continuous, and thoroughly agreeable to order, requires that, by anxious and laborious effort, the second term shall be to the third as the third to the fourth, and in the same ratio as the first to the second: in short, that the animus shall respect the mind as the mind the soul, and that the body shall be referable to the animus; so that the continuity between the animus and the mind is not interrupted. This is the natural progression or ascending series; but we are also formed for a descending progression, from the soul towards the body; to the end that our several faculties may depend in continuous subordination upon the soul, and the soul, upon the

spirit of God. By such progression we may ascend constantly, degree after degree, from the lowest world to the highest, or from the more imperfect sphere of nature to the more perfect; and when the intellectual mind regards ends in effects, then we ascend according to nature's order from the very ground of the creation to the Creator himself as the end of ends. Ascent and descent of this kind is possible in man alone: in other animals the circle is shorter, and completed within the boundaries of nature. In man the circle extends to the mind, and there another circle begins, and runs up towards the higher sphere, thence to return to the circumference of the lower circle, and like that of animals, to descend.

347. It is well to be remarked, that all the wills and actions of animals, we mean, all the instincts, are excited simply by external motives or moving causes,—by those things that strike their senses, or that affect their blood in a general manner. The changes and conditions of the air and ether, recurring with the four seasons, send heat into their fluids, which burn and boil accordingly; and with the fluids, as determinants, a corresponding change is wrought in the organic forms of the body and the brain. In this way the principle of motion is at once excited, and animals are carried, agreeably to nature's order, into rational-seeming effects involving ends. Hence their loves, and hence the periods those loves obey. Hence the wonders they display in building their nests, incubating their eggs, and hatching their young. Hence their amazing parental care. Hence their public consultations as to the manner of providing for themselves and their progeny in the coming winter; and a number of other effects, which proceed from a soul like theirs, accommodated to the reception of life according to its own peculiar character; whenever it is excited [by appropriate circumstances]. Experience attests the truth of these remarks. For we know that the same effects are produced on animals by the warmth or heat of a room as by the heat of the sun, and when the season is neither spring nor summer. We may therefore say that the soul of animals resides in their blood, because it is always actuated by a cause extrinsic to itself. Not so the soul of man. He indeed is likewise moved, yet is not governed, by external causes. The affections of the external world pass



*a posteriori* in some measure into the sphere of intelligence ; yet in man they are determined into act by a foregone will arising from an appropriate principle and cause. Thus we men are stirred to action by a fire kindled, alike in winter and in summer, in the very sphere of the mind. As the philosopher says : “ Whatever a secondary cause can do, a prior cause can also do in a higher and more noble manner. The first cause assists the second in its operations ; and secondary causes are illuminated by the light of the first.”<sup>x</sup> Oh ! then, how obscured—how deeply buried in the grave of the body are the minds of those, who judge of themselves by the brutes, and of their own souls by the souls of brutes, reasoning from likeness of actions, likeness of senses, and likeness of brain, so far as the eye alone discloses the brain ; and do not see beyond the likeness, the immense distance and difference of the two : fit subjects, indeed, for ridicule, did they not rather deserve our pity.

## XII.

348. On these premises it may be demonstrated to intellectual belief, that the human spirituous fluid is absolutely safe from harm by aught that befalls in the sublunary region : and that it is indestructible, and remains immortal, although not immortal *per se*, after the death of the body. That when emancipated from the bonds and trammels of earthly things, it will still assume the exact form of the human body, and live a life pure beyond imagination. Furthermore, that not the smallest deed is done designedly in the life of the body, and not the least word uttered by consent of the will, but shall then appear in the bright light of an inherent wisdom, before the tribunal of its conscience. Lastly, that there is a society of souls in the heavens, and that the city of God upon earth is the seminary of this society, in which, and by which, the end of ends is regarded.

349. *On these premises it may be demonstrated to intellectual belief, that the human spirituous fluid is absolutely safe*

from harm by aught that befalls in the sublunary region: and that it is indestructible, and remains immortal, although not immortal per se, after the death of the body. We are persuaded by a dictate of the soul itself, as it were by a certain whisper within us, that some part of us shall survive when the body dies. Thus we often aspire from a kind of instinct to immortality of fame; we encounter death for our country, nay, for objects higher than our country, and for the highest object of all. I am not now speaking of low but of elevated souls. To all mankind the soul appears as an essence of sublime extraction, independent of the body, and belonging to a higher state, and which penetrates by intuition even to the life that is intrinsically immortal. This is a truth attested by the history of nations, and in the writings of philosophers. See Part II., n. 249, 250, &c. "The body of the sleeper," says Cicero, "lies as the corpse; but his soul lives in undiminished vigor: and much more will it live after death, when it shall have entirely forsaken the body." (*De Divinatione*, lib. i., § xxx.) And according to the philosopher, the mind alone is divine, immortal and eternal. (Part II., n. 250.) But to seek for arguments *a posteriori*, by which to prove a truth of this kind, imprinted on the very soul *ex se*, or *a priori*, is a task the more difficult, since the mind itself, conscious of what its possessor has done, and of what he intends to do, would gladly find reasons to believe, that all which constitutes man is destined utterly to perish. But we shewed above, that the soul is a real essence, reigning universally and singularly in the body, and capable of operating by essential determinations and forms in the ultimate sphere of the world; and that death is the destruction of those forms, and enables the soul to be released from the trammels of earthly things. Meanwhile, to prevent us from falling headlong from doubt, (to which, as we have just said, the mind is so prone,) into actual denial, certain theologians, following the philosophers, have chosen to regard the soul as in fact intrinsically immortal, so as to surmount the possibility of its destruction by the action of any created thing: which they have done in preference to deducing the proofs of its immortality simply from the conservative influx of God. Yet the soul cannot truly be said to be of itself immortal, because it is created by the only immortal Being,—by Him who is

eternal life. To create anything that should be immortal of itself, would be to make *that* which the Creator is. Whereas what God does, is to make *that* which is immortal through Him.

350. It is evident from an *a posteriori* examination of the human spirituous fluid or soul, that that substance cannot be destroyed by any created thing; and this is confirmed by the doctrine of order and series, which empowers us to enter thoroughly into the subject; and teaches that prior things can exist and subsist without posterior, but not *vice versá*. (Part I., n. 617.) Thus the first aura may exist without the second, the second aura without the ether, and the ether without the air. The highly volatile sulphurous and saline substance may exist without the fixed salt, and the latter without the compound crystallized salt. The higher sensation may exist without the lower, and in the same way the purest fluid without the middle blood, and this, without the red blood. In a word, the simple may exist without the compound, the part without the general, the prior without the posterior, the cause without the effect, but not *vice versá*; for the compound, the general, the universal, the effect, consists of its simples, parts, singulars and causes. Moreover the higher entities of nature are intrinsically more perfect than the lower, and enjoy a more persistent constancy to their essence and form. (Part II., n. 313.) Now as the spirituous fluid is the first, simplest, highest, inmost, remotest, and most perfect substance of its body, and in the third degree above the red blood (*Ibid.*, n. 222); as it is determined in the most perfect manner, and without a medium, by the aura of the universe, or the primal aura (*Ibid.*, n. 227, 228), and partakes in no respect of terrestrial matter (*Ibid.*, n. 311); as it is entirely above the world, and the nature of posterior things, and above the soul of brutes, as the unassignable is above the assignable (*Ibid.*, n. 290, 344); as it is the one only substance in its body that lives; and as all the posterior and compound substances live its life according to their degree of composition, and to their form, which makes them such as we find them to be (*Ibid.*, n. 243, 244): as surely as these positions are true, so surely does it follow, that a fluid with such endowments is absolutely safe from harm by aught that can befall in the sublunary region. No part of the air can affect or

touch the vast volume of its individualities, save in the most general manner: nor any part of the ether; nor of the aura of the third degree with all its forces. But if the auras of the world are powerless to harm it, much more so are the material entities of the earth, which, compared with the atmospheric fluids, are gross, heavy and inert; I allude to all volatile, sulphurous, saline, oily, and aqueous substances, whether they float in their peculiar atmosphere, or gyrate in their peculiar fire. Clouds and streams of such entities circulate in every animate body, without even disturbing the current of life, much less stopping it; for it is as distant from them as unity from multiplied myriads of myriads of myriads. (*Ibid.*, n. 290.) Nothing can cause in it any essential mutation, except a deliberate act of descent on its own part, or a consent to things repugnant to natural truth, and especially to divine truth (*Ibid.*, n. 314, 315), and even in this case it can only undergo the superior essential mutation, which has reference to its reception of wisdom. [*Ibid.*, n. 315.] If it cannot suffer dissolution from any external cause, evidently it cannot from its internal cause, which is ever operating to conserve it, and which gives life, not takes it away. Hence we have no more right to doubt its conservation than to doubt the omnipresence of this life, nor the omnipresence more than the omnipotence, omniscience, and universal providence. These in fact are so conjoined, that the one is the other, and God is his own attribute; for whatever is in God, is God. (*Ibid.*, n. 253.) The plain consequence is, that when the hour of death arrives, and the body falls, the lower forms only die, and this, in order that all substances borrowed from the three kingdoms of the earth may drop away. (*Ibid.*, n. 283, 284, 301.) Suppose then that the planet shall perish, and the circumambient atmospheres shall perish too,—still the soul is unharmed. Suppose even that the like fate overtakes the universe, with its universes, stars and sun, yet still the soul is not annihilated; because it is the one only essence accommodated to the reception of wisdom, for the sake of which the universe was created: and the end must subsist though the means perish; for posse and esse, to be and to be able, are one and the same with God. We are however led to think for a variety of reasons, that this fluid cannot be absolutely released from its connection with the earthly things with

which it is entangled externally, (for example, in the blood and the other fluids, and in the soft and solid materials proper to the body,) except by the searching action of an extremely pure fire. The fact then that this fluid remains indestructible after the body dies, or that no created thing can deprive it of its form, or therefore of its life; and that still less can it be destroyed by its internal cause, which in truth is the most essential means of its conservation;—this fact, we say, comes home to intellectual perception, as the ground of an intellectually philosophical belief.

351. *That when, emancipated from the bonds and trammels of earthly things, it will still assume the exact form of the human body.* We have often shewn already, and as, I presume, explained clearly enough on the ground of anatomical experience, that nothing lives in the whole body except the spirituous fluid in the fibres, in other words, nothing except the fibre that contains the spirituous fluid; therefore that the real body itself is the complex of the forms of the soul, or in fact, is the universal soul. (Part II., n. 122, 123, 168—170, 205, 241—248, 283, 284, 301, &c. Part I., n. 37, 40, 41, 91, 97, 150, 261—271, 370, 503, 556, 559, 634, 636, &c.) If these forms, or the body, must necessarily die, in order to procure the separation of earthly bonds; and if nevertheless that which principally lives, is destined to continue for ever, indestructible and inextinguishable by any causes that can arise, the question is, what the form will be in that second birth or resurrection, after the dissolution of all the present forms, intermediate and ultimate. It follows from the tenor, or to speak more plainly, from the necessity of the same reasons, that the soul can return into none other than its very own, that is to say, the human form; this being its proper form, or that into which it is necessarily determined when it is left to itself: as for instance, in the egg and the womb, where the several parts of the body are formed successively, and one fibre is added to another and one little member to another. Unless indeed the series of such determinations existed in the soul, the latter could never conspire so constantly, from the first thread to the completed fabric, to its own general form. That the soul itself adopts its own general form, or is carried into that form naturally and spontaneously,

and that the matter of the ovum does not induce it, this is very evident from the successive growth of parts, and from the perpetual metamorphosis or transmutation of specific viscera from a comparatively simple to a compound and varied form. This is exemplified in the brain, the spinal marrow, the heart, the lungs, and other organs of the body; as we shewed in the First Part of the present Work. And that this is the general form that corresponds exactly to the nature or operations of the soul, is again proved by the fact, that after the soul has been once inaugurated into it, thenceforward it protects it as itself; and if any part should fail, or by any mishap its order in the body be disturbed, the soul at once endeavors with her whole forces to repair the evil; as we learn from her marvellous economy and perpetual conservation of the private in the public weal. The soul moreover feels at once, and deeply sorrows, when any disharmony touches and injures her own supremely harmonic state; and in a manner herself suffers whenever her form suffers. This arises from no other ground than the fact, that nothing exists in the body or general form, but regards something correspondent in every single part. (Part II., n. 275.) These lower forms may be dissolved and demolished, since the soul is not left to itself, but enclosed in, and at the same time tied to, the fibres, and cannot act out of them (Part II., n. 293, 296, 297); and moreover is entangled or trammelled in the fetters of terrestrial elements, and therefore depends upon all their changes of state. But the moment it is freed from its bonds, it again asserts its rights, and obeys its own laws of action. It follows from the proofs already brought forward, that whenever this happens, it must return into its own veriest or common form: yet this, in such wise, that it is then no longer the body, but the soul under the form of the body; the spirit without the red blood, or the flesh and hard bone produced from the blood: the soul transmuted from a lower to a higher life. And it can never again attract elements from the three kingdoms of the world, or enter anew into a fleshly covering, such as it had hitherto carried about it; for the natural passages constructed of terrestrial materials, for the purpose of successively insinuating and adapting elements of the kind, and which might serve these elements as vehicles, now exist no longer. The

necessity and the appetite to open them have died together. Nor can the soul again migrate back into life by means of an ovum; according to the dreams of the old philosophers; for the volume of the animal fluid is great, and cannot possibly begin [a new existence] *e minimo*. Therefore the soul is under the permanent necessity of living in its own state, and in no other.

352. But the mind, ardently desirous to find in death the deepest tranquillity, oblivion of miseries, and everlasting sleep, will needs indulge itself in presuming a privation of all the attributes that are allied to form, and thus found to have a real existence. Nay, to leave no stone of doubt unturned, it will inevitably suggest the idea, that the spirituous fluid, not in itself continuous, but consisting of myriads of distinct individual parts, would seem rather to go to wreck and dissipation in the universe, than again to tend to reunion; for it may be asked, what force is there to drive one individual part to seek and find another, however intimately the two were once united in the body. Yet the truth is, that such a surmise or presumption can arise only from mere ignorance of the perfection of nature's substances in her prior and highest sphere. And I think it will be seen that the contrary is the fact, if we compare the properties of the universal aura with those of the fluid now under consideration. With respect to this aura, according to the account we have given of it, (Part II., n. 272, 312; Part I., n. 604; and my *Principia*, Part I., Chap. VI.) it is formed on the model of the forces of nature in her most perfect state, and comprises all possibility of applying itself to every inconceivable minutia of variety, and of concurring with every assignable determination; and thereby merits the name of essential force, essential elasticity, and primitive nature, which involves neither impetus, gravity or levity, or resistance, but only agent and patient, hence nothing but agreement among its parts. If there be nothing resistant in it, of course this fluid can be determined wherever the soul attracts it. And besides its similar natural perfection, (Part II., n. 312, 313,) it has this further endowment, that it is perfectly alive in all its singulars or individual parts, and that its intuitions and representations are coextensive with the created universe; as we indicated above, and shall prove in the sequel. Thus perpetual vital rays extend-



ing to the ends of the universe, must reciprocally discover the places and presence of similar lives (supposing for a moment, what we do not grant, that the lives were separate), and become associated with them by the same relationship and love as in the body. Nor can they be held asunder by space, for space does not oppose them. If by the guidance of the doctrine of order we penetrate to the real perfection of primitive nature, we shall indeed be persuaded, that as it must be considered almost apart from moments in time, so it must also be considered almost apart from degrees in motion and space; or that time and space, distance and obstacle, are only to be predicated of it analogically or transcendently. I have thought it better to have recourse to demonstrations grounded in nature, to prove that the individual parts of the spirituous fluid are necessarily associated with each other; and for this reason, because it gives me an opportunity of shewing, that nature is so ordered as to serve life as an instrumental cause, subject to the will of an intelligent being, who uses it to promote ends by effects. (Part II., n. 234, *seqq.*) But I acknowledge, since we have made so little progress in the doctrine of order, that the above-mentioned perfections are predicates too like conjectures or propositions derived from an occult quality; although when we ascend from perfection to perfection by the ladder of degrees, they result as consequences from positive laws. But it is not the fault of the teacher but of the percipient, if things are not comprehended as they are in themselves. Meanwhile, I have felt bound to declare this natural cause, lest for the reason before given when speaking of the immortality of the soul, the proofs of the point should be deduced entirely from the copulative influx of God. [*Ibid.*, n. 349.]

353. But let us raise our reflections above created nature, namely, to power, knowledge, providence, and omnipresence, divine and infinite; which being universal in singulars, and most singular in the universe, cannot but associate all things together at the same time that it distinguishes all things. For that infinite perfection of action, with which no natural perfection is comparable, cannot surely allow aught that pertains to the proper essence of any individual, to be indistinct and separate. If such a faculty of consociation may be seen and

recognized to be naturally possible, by the mediation of the aura of the universe, how much more shall it be possible supernaturally, by the thorough and intimate action of the spirit of life? Especially when it is considered, that there is a moral difference or distinction between different souls, or human forms and essences respectively, according to which each man leads his own life, and enjoys his own happiness,—a distinction arising from the gift of free choice, as the universal mean by which souls are specifically distinguished from each other; in order perhaps that a harmonic variety of souls, as the perfection of the whole, or a most perfect universal form of a society, may be the result. (Part II., n. 299, 335.)

354. That there is to be such a consociation of the living individualities of this spirituous fluid assumed as the soul, we may perceive even in this life as by a shadow, from the love that belongs to our animal and rational minds. These however are feeble and dim rays to illustrate the reflection, although they will afford us the occasion of thinking more loftily and distinctly. Love in animate beings corresponds to likeness and harmonic agreement in inanimate things: it is therefore defined as conjunction of dispositions, arising from real or apparent likeness of operations. Daily experience shews us what it is with parents, in whom it certainly owes its rise to the fact, that the soul of the offspring is derived from the soul of the parent. (Part II., n. 295.) And this the soul knows right well, although the mind does not; yet even the latter becomes acquainted with it by the effect of ardent love; and by the desire that the parent feels, of still living in the closest possible conjunction with the offspring,—a desire often so strong, as to cause indignation or anger that the offspring cannot be united with, and even absolutely reënter, the parent; who tries to effect this object by the closest embraces, squeezes and kisses. We may infer from this love of parents towards their children, that every individual part of this purest fluid vehemently aspires to mutual conjunction with all its fellows; and we have already proved above that its wishes are granted. But the best demonstration of the fact will be supplied by the mathematical doctrine of universals, when it institutes its calculus about the nature of love, and applies it to other marvellous sympathies.

355. And we find the fact attested even in the grosser and

lowest world. For by virtue of a corresponding perfection in the ether of the third order, and of the likeness between its parts, inanimate things are resuscitated from their ashes, nay, even by artificial means: I allude to plants, flowers, arborescent forms, which are born again exactly in their own image, as it were by a kind of love in the substances constituting the compound. Even these things will not allow themselves to be sundered, or carried off into the atmosphere with the flux of the universe. How then should beings most perfectly alive, and which are conjoined not by mere similitude but by intimate love—beings that in all their perfections immensely exceed these lower things?

356. Had I not found myself supported by the authority of the most Christian fathers, I should not have dared to pronounce the opinion that the spirituous fluid is the [soul] that will live after the death of the body. But these fathers held it for certain that we shall hereafter be angelic essences. Thus Apuleius, Origen, Ambrose, Basil, Justin Martyr, Psellus,\* and Lactantius, believed that angels are natural bodies. Augustin indeed pronounced doubtfully, that he thought it would be rash in him to decide whether spirits are not clothed in bodies *composed of air*, (as though he would say, not of our gross or atmospheric air, but of a purer aura, as we, of the spirituous fluid assumed as the soul.) But Dionysius the Areopagite, Philo Judæus, Athanasius, Chrysostom, and Thomas Aquinas with the school-men, maintained that angels are without bodies. Gregory and Damascen took a middle course, and held that angels relatively to God seem to be corporeal, but relatively to man, incorporeal. But all in modern times agree, that we shall be purified bodies, or spirits without bones and flesh; into the composition of which, and of the red blood, as we have shewn in various places, terrene matters enter, that are ultimately to be put aside.

357. *And live a life pure beyond imagination.* Then, that is to say, the soul will live its own life, namely, in its own intelligence, in the representation of the universe, in the intuition of ends, in the beginning of determinations; a life inexpressible by words; incommunicable in its degree to the body;

\* Apuleius and Psellus were not fathers of the Christian church.—(Tr.)

the inmost life of itself; a life left to itself; subject to no lower lord,—neither to the imagination, nor its allied cupidities; a life most distinct, unanimous, constant, immutable; above the nature of the sublunary world; beyond time; almost apart from degrees and moments, except that myriads of its moments and degrees will equal but one of ours, and yet myriads of ours will not appear to it as one appears to us: a life only terminable in its representations and intuitions, by the created universe. The ear, though it lies in a carved recess in the petrous bone of the temples, nevertheless can drink in sounds from no mean distance. The eye, although but a little ball, shut up in its orbit, penetrates nevertheless to the sun and stars, and by the assistance of art pierces into the substances of nature's purer sphere. The mind goes even beyond the stars. What then is the range of the soul, which is above the mind, a representation of the universe, order, truth, above the rules which govern effects, in the very aura of the universe. Nay, but in respect to its operations, it does not terminate with nature, but is capable of regarding ends beyond nature, and therefore of rising to the Creator. Why should I say more? If the mind would represent to itself the perfections of this exalted life, it must rise above itself, and out of the region of the abstract take ineffable forms of things, and then so far as it keeps persistent there, and lifted above the animus, thought carries it away, I know not whither.

358. *Furthermore, that not the smallest deed is done designedly in the life of the body, and not the least word uttered by consent of the will, but shall then appear in the bright light of an inherent wisdom, before the tribunal of its conscience.* In order to arrive at the subject of this tribunal, we must first consider what will be the nature of the memory after death, and also what the conscience is. With respect to the memory, see above (Part II., n. 297), where we have shewn that it is neither a picture of objects or images painted upon a *tabula rasa*, or blank surface, nor a copy imprinted in the way in which the primary object appears, but that it is only an adaptation or accommodation of the parts constituting the most delicate fibres, by a species of expansion, to the properties of the spirituous fluid; or a restoration of them to a state more nearly approaching the in-

tuitive state of the soul, which is science, and upon which, as a principle, the principles of natural and moral things are imprinted. And thus things not only fall under its intuition, but also clearly reach our consciousness by following the course of the fibres. In order that the soul may converse intellectually with the materials of perception or memory, the fibrillary substances must be put together on the model of its intuitive and representative nature, and over these substances it must run, and reduce agreeing simples analytically to a compound form, and then to a practical result, from which will emanate. But this adaptation or accommodation of the fibres *a posteriori*, is not only a general one of images or sensible things, but also a singular one of the same, as well as of higher or intellectual things, which are only derived from the form of diction or of words, abstractedly from images. The fibres, however, are affected generally before they are affected singularly. This is the order of our nature, consequent upon the necessity under which we lie, of being informed *a posteriori*.

359. We may be confirmed by reflection upon common experience, that the memory is in itself most happy, and never suffers any loss of an object that has once been imprinted upon it. Thus we know that things often return which we had thought were entirely obliterated, or long buried in profound oblivion; nay, images themselves come back with all their minutest detail; for example, in sleep, when dreams present us with the effigies of persons we had formerly seen, or with the representation of houses, fields, and other objects, with all their lines, marks, and minutest differences; and, moreover, with so great verisimilitude, that the ablest painter, if he gazed upon the same objects for days together, could never delineate them so exactly: a proof, that no part of what we see is quite obliterated, but rather is covered over with more general ideas, and lies hidden the while under their activity. The same is the case with actions and expressions, which find their way into the memory with even greater distinctness, because by a slow process, and being perceived intellectually, induce upon the substances of the fibrils at once a singular and a general state. This shews that nothing whatever is insinuated *a posteriori*, but produces some change, general, singular, or most singular, in

the state of the parts. The reason why everything is not reproduced, and why some things should be apparently erased, depends upon a different ground; indeed, upon the same cause as the loss of memory in lesions or obstructions of the brain; or at least upon a similar cause: but more particularly upon any continued inordinate excitement, through the senses, of general cupidities and ideas. Whenever the mind is free from these, and devotes itself to the regard of causes in an orderly manner, and increases at the same time its fire by desire or zeal of any kind, and either deprives the senses of their penetrating sharpness and microscopic intensity, or lulls them entirely, as in sleep,—then long buried things return without confusion from their profound abiding-places, and bring along with them the several helps that belong to the present analytic state. Of this we may convince ourselves by innumerable facts, which it would be tedious to detail. By consequence, not the smallest word or action is obliterated, however it may seem to have perished.

360. Whether we reason from causes or effects, (and the best way is to reason from both at once,) we are abundantly convinced, that all the particulars of this life fall under the intuition of the soul after its release from the body. No desire for surrounding things then occupies and carries away the animus. Nothing that enters by the senses excites or disturbs the calculations of the mind, or buries them in the body. Nothing ascends into the intellectual sphere, by means of the blood, from the lowest or non-intellectual spheres. The mind is disengaged from all the objects that had formerly roused and assailed it. The faculties that were once most active are now as utterly and permanently passive as the body in its deepest sleep. In a word, the soul now descends with full light and total intuition into the hall of the mind, empty and fearless of all disquietudes, and the mind into the corresponding courts of the animus and the body; and at once views all things and reflects upon all things. And if the constitution of the soul approach more perfectly to the moral state, it then smiles at the things contemplated beneath it, rightly discerning of itself whatever they contain that is congruous to the truth, and whatever that is repugnant; and it openly sees and judges of its past insanities, much as one who regains his right mind after a fit of delirium,

or who calmly contemplates emmets or worms contending with each other for the ownership of a little dust. Such would seem to be the memory of the past which the soul enjoys after the dissolution of the body.

361. But the question of *conscience* remains to be considered. It is very common to appeal to conscience in the light of a witness, or judge; to rejoice in the possession of a good conscience; to suffer with the pains of a bad one; to place the highest human happiness in the former; the greatest unhappiness in the latter: to value the morality of a man precisely in proportion as he himself values his conscience: to esteem conscience as the queen of our actions, and the nearest bond and deepest law of social life, without which the members of society would hurry to perdition, unbridled, lawless, irrational, careless alike of all rule and right, human and divine.

362. As there are no innate ideas or imprinted laws in the human mind (Part II., n. 294, 300, 326), so conscience is generated from those things, and those alone, that have assumed the character of principles or governing laws in the mind; and which, by the agency of free choice, are capable of being carried, after the scrutiny of reason, into the judgment, and so into the will; the flames of battle being lighted up the while on either side by the love of some purposed end. After the conflict is over, conscience is found to be either killed, or wounded, or victorious. If *killed*, it is a sign that the mind has given itself up to be governed by the lower forces, and has shaken off all sense, regard and fear of those things that occupy the higher place; and that its moral state is degraded to a natural state. If conscience be *wounded*, it is then either tormented with a present idea of punishment, or driven hither and thither through contrary states; at one moment abandoning hope, at another rising, and renewing the contest. Or else it seeks for an asylum, whither to retreat in quest of some general solace, and flies to the doctrine of predestination, to a dead faith which it supposes to be living; to an absolute mediatorial power; to universal grace bestowed without any efforts to deserve it. Or sometimes it attacks and impugns the truth, although the conscience that will do this, is well nigh dead of its wound. On the other hand, if conscience be *victorious*, then it is filled with



intimate and transporting joys, and renews the warfare without intermission against the scattered forces of the enemy, until the end and final triumph crown the scene ; &c.

363. Now if no action or word, however insignificant, will perish ; and if the soul, as order, and as intelligence, will nicely perceive in the veriest singulars, what itself contains that agrees with the truth, and what that is repugnant thereto, then, in the bright light and most present glory of a wisdom, by which it is exalted to the highest degree of intelligence of which it is capable, it cannot fail, of itself, and by virtue of its own moral state, out of the depths of its conscience, (as sometimes we find even in the present life,) to call itself to account, and to pronounce its own sentence. In the same way as when (if we may use the comparison) the natural state of the eye is injured, the pain is exquisite in proportion to the intensity of the light ; and more so still under the glare of lightning ; though all the time the light itself is blameless and excellent.

364. *Lastly, that there is a society of souls in the heavens, and that the city of God upon earth is the seminary of this society, in which, and by which, the end of ends is regarded.* From all we have hitherto said of the economy of the animal kingdom, and of the human soul, we clearly perceive, that everything in the created universe exists and subsists for the sake of an end ; in short, as a part of the circle of things ; in which circle, it at once respects its own centre, and the common centre of all. (Part II., n. 287). What is the world with its forces and forms, and the earth with its kingdoms, but a complex of means to a universal end ? To what purpose are the auras, with their modifications, unless to minister corresponding sensations in the animal kingdoms ? In themselves, they are but mediate or instrumental causes, and dead things, but as soon as they enter the animal kingdoms, they begin to live. For what purpose are sensations given, but to produce intellectual ideas in human minds ? In themselves they are but mediate or instrumental causes, and aspirations to intellectual ideas, but as soon as they enter the higher sphere of human minds, they begin to live more sublimely, or to understand. For what purpose, again, are intellectual ideas, unless to subserve the supreme life, or wisdom. In themselves, they are but mediate or instrumental causes, and aspirations to the

ideas of wisdom, but not until they enter the supreme sphere do they begin to be wise. Thus one thing is the instrumental cause and mean of another; modification, namely, of sensation; sensation, of intelligence; and intelligence, of wisdom; and by wisdom all are made into something, because by wisdom they exist for the sake of something; and they are made into essences by Him who is essential being and wisdom. Therefore the universe is nothing else than a complex of means to a universal end.

365. If then everything in the universe respects some end as the ground of its existence; and if ends and means ascend from nature to life, from life to intelligence, and from intelligence to wisdom, it follows, that the universe is created for the ultimate subjects of creation, in short, for men as the abodes of intelligence; and therefore assuredly for their souls; for human souls do not exist as means to the organic forms of human bodies, but *vice versa* (Part II., n. 229, 230); nor indeed even the souls of brutes, which are meant to minister to those of men. The act of creation is represented every moment in our own minds. First we view and embrace some end abstractedly from means: then we form and create means, and thereby the end is advanced and finally obtained by physical effects as instrumental causes. Thus the end that was the first, and which is the all in the progressing means, becomes the last. Much more is this true in Him who is essential wisdom. Is there not then an ascent from the created universe, through human intelligences or souls, to Him, as the last end, who was the first, through *that* which was the all in the means? And do not those souls themselves exist for an end beyond nature,—an end that they penetrate into by intuition, and which is no other than the existence of a society of souls, in which the end of creation may be regarded by God, and by which God may be regarded as the end of ends.

366. If there be a society of souls, must not the city of God on the universal earth be the seminary of it? The most universal law of its citizens is, that *they love their neighbor as themselves, and God more than themselves*. All other things are means, and are good in proportion as they lead directly to this end. Now as everything in the universe is created as a mean

to this end, it follows, that the application of the means, and a true regard of the end in the means, are the sole constituents of a citizen. The Holy Scripture is the code of rules for obtaining the end by the means. These rules are not so dark or obscure as the philosophy of the mind and the love of self and of the world would make them; nor so deep and hidden, but that any sincere soul, which permits the Spirit of God to govern it, may draw them from this pure fountain, pure enough for the use and service of the members of the city of God all over the world, without violating any form of ecclesiastical government. It is foretold, that the kingdom of God shall come; that at last the guests shall be assembled to the marriage supper; that the wolf shall lie down with the lamb, the leopard with the kid, the lion with the ox; that the young child shall play with the asp; that the mountain of God shall rise above all other mountains, and that the Gentile and the stranger shall come to it, to pay their worship.

But see the *Second Epistle of Paul to Timothy*, chap. iii., ver. 1—10; and the *Acts of the Apostles*, chap. xvii., ver. 18—34.

THE END.



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## BIBLIOGRAPHICAL NOTICES OF AUTHORS

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### THE ECONOMY OF THE ANIMAL KINGDOM.

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THE remarks prefixed to the corresponding "Notices" in the "Animal Kingdom," Vol. II., p. 599, may be repeated here. Where an author is mentioned in those "Notices," his name alone is given in the present account, with a reference to the "Animal Kingdom;" or such of his works as come under our plan, and are cited in the "Economy" and not in the "Animal Kingdom," are specified.

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ARISTOTLE, "the chief philosopher of the Gentiles," (Swedenborg, *Econ. A. K.*, Vol. II., p. 240,) born at Stagira, B.C. 384, died at Chalcis, B.C. 322. The edition of Aristotle made use of in the present translation, is that of Du Val, 4 vols., folio, Paris, 1654. The annexed bibliographical account is borrowed from the article "Aristotle" (by F. A. Trendelenburg, translated by George Long,) in the "Biographical Dictionary of the Society for the Diffusion of Useful Knowledge."

"The following are the most important editions of all the works of Aristotle :

"The Editio Princeps, which has the value of a MS., is the Aldine, called Aldina Major, printed at Venice, by Aldus Manutius, 1495—1498, 5 vols. fol. It is well printed, and was scarce even in the time of Erasmus. Certain small variations show that this edition was printed twice (Dr. Postolaka, in the *Zeitschrift Wiener Jahrbücher*, 1831, 2nd Heft). The edition of Basle contains the emendations of Simon Grynæus, and the preface of Erasmus; Basle, 1531, fol. The second Basle edition belongs to the year 1539; and the third, on which both Conrad Gesner and Grynæus were employed, to 1550. The Aldina Minor was edited by J. B. Camotius, whence it is also called Camotiana, Venice, 1551—53, 6 vols. Svo.

"The Frankfort edition by F. Sylburg has some critical notes and indexes; it is well printed, and justly valued; Frankfort, 1584—1587, 11 vols. 4to. The edition of Isaac Casaubon, besides some various readings and emendations printed on the margin, contains the Latin translation by several hands; Lyons, 1590, fol., Geneva, 1605, fol. The edition of Du Val contains the Latin version; Paris, 1619 and 1629, 2 vols. fol.; 1639, 4 vols. fol. Du Val was physician and councillor to

Louis XIII. of France. He has added a view of the Peripatetic philosophy, and of the writings of Aristotle. The edition of Buhle contains valuable literary notices in the first volume; but it was never finished. Only five volumes 8vo. appeared; Deux Ponts, 1791—1800.

“The most important edition for the text of Aristotle is that of Immanuel Bekker or of the Berlin Academy, Berlin, 1831—1836, 4 vols. 4to. The first two volumes contain the text, which is established on the collation of numerous manuscripts, but no use has been made of those older readings which may be derived from the Greek commentators on Aristotle. The third volume contains the Latin translations of the works of Aristotle. The fourth volume is entitled ‘Scholia in Aristotelem. Collegit Christianus Augustus Brandis, edidit Academia Regia Borussica, 1836, 4to:’ it contains excerpts from the commentaries on Aristotle, chiefly Greek, printed and unprinted, and is very useful for the understanding of the text. A fifth part, which is to be a continuation of the Scholia, is still expected.

“. . . Further information on the editions of Aristotle, and of his several works, may be found in Buhle’s edition, vol. i., p. 210, &c.; Hoffman’s *Lexicon Bibliographicum*; and Aristotle, *De Anima*, by Trendelenburg, Jena, 1833, Preface, p. 17, &c.”

For particulars respecting the life and philosophy of Aristotle, the reader is referred to the abovementioned authority, or to the article “Aristotle” in Smith’s “Dictionary of Greek and Roman Biography and Mythology.”

BAGLIVI, GEORGE, an Italian physician, born in 1668, according to Haller at Ragusa, according to Nicholas Comnenus, at Lecce, a town of Otranto, in the kingdom of Naples, died at Rome in 1706, or 1707. I. His “Dissertatio de Experimentis per infusoriam in vivis Animalibus,” was published with his work, “De Praxi Medicâ,” 8vo., Rome, 1696; 8vo., Lyons, 1699; in English, 4to., 1703; 8vo., 1723. II. “Specimen quatuor Librorum de Fibrâ Motrice et Morbosâ,” 4to., Perousa, 1700; 4to., Paris, 1700; 12mo, Rome, 1702; 8vo., Utrecht, 1703; 8vo., London, 1703; 8vo., Basle, 1703; Altorf, 1703. III. “Dissertationes varii Argumenti,” 8vo., Leyden, 1707; 8vo., 1710. The complete works of Baglivi were also published: viz., “Opera Omnia Medico-practica et Anatomica,” 4to., Lyons, 1704, 1710, 1715, 1745; Paris, 1711; Antwerp, 1715; Basle, 1737; Leyden, 1744; Venice, 1738, 1754; and by Pinel, with notes, corrections, and a preface, 2 vols. 8vo., 1788. Baglivi is esteemed the father of modern “solidism,” which in general attributes the primary morbid affections of the body to the solids rather than to the fluids. It appears, however, that he did not intend to banish the humoral pathology (fluidism) from medicine, but to counterbalance it, and prevent its undue application. Some of the positions on which his solidism is grounded appear to be questionable as axioms of physics. Thus he says: “Solido major, quam fluido, vis inest, et resistentia.” (*De Fibr. Motr.*, lib. i., cap. vii.) And again: “Evidenter patet corpus solidum continuum, partibus duris et resistentibus compositum esse magis aptum conservandi propagandique motum sibi impressum, quam moles fluida clausa intra canales, et composita minimis contiguis, mollibus,” &c. (*Ibid.*, cap. ix.) These statements are hardly countenanced by the tenor of modern art and science. In general the works of Baglivi display great powers of observation and grasp of mind. He discarded the hypotheses prevalent in his age, and betook himself to the writings of Hippocrates, “the Romulus of physicians, who speaks in the language of nature, and not of man.” (*De Praxi Medicâ.*, lib. i., cap. i., mon. iv.) He was also a diligent student and close follower

of Lord Bacon, whose style of writing he imitated with great exactness in his works. And he coincided with Bacon in adopting the aphoristic manner of delivering the sciences (as Hippocrates had also done), in preference to the methodical. (*Ibid.*, lib. i., cap. ix.) His observations on the dura mater as a moving power in the brain and the body, and the experiments which he instituted to bear out his views, occasionally brought him near the verge of that grand peculiarity of Swedenborg's theory, the alternate animation of the brain.

BARTHOLIN, THOMAS. (*Animal Kingdom*, Vol. II., p. 599.)

BELLINI, LAURENCE, an Italian physician and anatomist, born at Florence in 1643; died at the same place in 1704. "Opuscula Aliquot ad Archibald. Pitcairn, de Motu Cordis," 4to., Pistoya, 1695; 4to., Leyden, 1696, 1714, 1737.

BIDLOO, GODFREY. (*Animal Kingdom*, Vol. II., p. 600.)

BOERHAAVE, HERMANN. (*Animal Kingdom*, Vol. II., p. 600.) "Aphorismi de Cognoscendis et Curandis Morbis, in usum Doctrinæ Domesticæ," 12mo, Leyden, 1709, 1715, 1728, 1734, 1742; 12mo, Paris, 1720, 1726, 1728, 1747; 12mo, Louvain, 1751; in English, by J. Delacoste, M.D., 8vo., London, 1715.

CALDESI, J. BAPTISTA, a native of Arezzo in Tuscany. His book on the Turtle and Tortoise, "Osservazioni anatomiche intorno alle Tartarughe marittime, d'Acqua dolce, et Terrestri;" 4to., Florence, 1687, is described by Haller as an excellent work, entirely based upon facts: and the same authority says, that it would not be easy to name another animal, of the anatomy of which we possess an equally good account.

COLUMBUS, REALDUS, an Italian anatomist of the 16th century, born at Cremona in the Duchy of Milan, died about 1577. His work, "De Re Anatomicâ libri xv.," was published at Venice, fol., 1559; 8vo., Paris, 1562, 1572; 8vo., Frankfort, 1590, 1593, 1599 (the two latter editions enriched with anatomical observations by J. Posthius); also 8vo., Leyden, 1667. Realdus Columbus was a pupil of Vesalius, and according to Haller was among the first who described the alternate dilatation and constriction of the brain; but which he says are coincident with the motions of the heart.

EUSTACHIUS, BARTHOLOMÆUS. (*Animal Kingdom*, Vol. II., p. 601.)

FANTONI, JOHN. (*Animal Kingdom*, Vol. II., p. 602.) His Epistle to Pacchioni, which is so often quoted by Swedenborg in the present work, is printed in the various editions of Pacchioni's "Opera:" in the Translation we have made use of Ed. 4, Romæ, 1741. See *Pacchioni*.

GROTIUS, HUGO, or HUGO DE GROOT, one of the most celebrated of Dutch writers, born at Delft in Holland in 1583, died at Rostock in Mecklenburg in 1645. His work, "De Veritate Religionis Christianæ," was published at Leyden, 8vo., 1627 and 1629: with the Author's Notes, 8vo., Paris, 1640; 12mo., Leyden, 1640; Paris, 1650; with an Arabic version by Pocock, 8vo., Oxford, 1660; 12mo., 1678; 12mo., Amsterdam, 1662, 1669; 8vo., *Ibid.*, Elzevir, 1674; also 8vo., 1709; 2 vols. 8vo., Jena, 1726. This work has been translated into nearly all the European languages, as well as into Arabic and Persian: and many times into English, in which it has gone through numerous editions.

GULIELMINUS, DOMINICUS (GUGLIELMINI DOMINICO). An Italian writer on mathematics and medicine, born at Bologna in 1655, died at Padua in 1710. "De Sanguinis Naturâ et Constitutione exercitatio physico-medica," 8vo., Venice, 1701; 8vo., Utrecht, 1704: also in the author's "Opera Omnia," 2 vols. 4to., Geneva,

1719 and 1740, edited by Morgagni, who appended to his edition an account of the author's life.

HARVEY, WILLIAM, an English physician, and the discoverer of the circulation of the blood, born at Folkstone, in Kent, in 1578, died in 1658. I. "Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus," 4to., Frankfort, 1628; 4to., Leyden, 1639 and 1647; 12mo., Padua, 1643; fol., Amsterdam, 1645; 4to., Leyden, 1647; 12mo., Rotterdam, 1648, 1661 and 1671; fol., Geneva, 1685; 12mo., Glasgow, 1751, and in Manget's "Bibliotheca Anatomica." In English, 8vo., London, 1653. II. "Exercitationes de Generatione Animalium," &c., 4to., London, 1651; 12mo., Amsterdam, 1651 and 1662; 12mo., Padua, 1666; 12mo., the Hague, 1680; and in Manget's "Bibliotheca Anatomica." In English, 8vo., London, 1653. III. "Opera Omnia," 2 vols., 4to., Leyden, 1737: best edition, by the London College of Physicians, with Life of the Author in Latin, by Dr. Lawrence, 2 vols., 4to., London, 1766. In speaking of Harvey, Haller observes, that "out of that very England, in which hitherto anatomy had scarcely an existence, a new light of the art arose, whose name is only second in medicine to that of Hippocrates."

HEISTER, LAURENCE. (*Animal Kingdom*, Vol. II., p. 602.)

LANCISI, JOANNES MARIA. (*Animal Kingdom*, Vol. II., p. 603.) His "Epistola de Gangliis Nervorum" was published with Morgagni's "Adversaria Anatomica V." According to Haller, Lancisi maintains that the ganglia serve as cerebella to the voluntary motions.

LEEUWENHOEK, ANTONY VON. (*Animal Kingdom*, Vol. II., p. 603.)

LITRE, ALEXIS, a French anatomist, born at Cordes in 1658, died in 1725. Litre is the author of no separate work, although he was a laborious cultivator of the sciences, and his whole life was absorbed in their pursuit. His papers were published at intervals in the "Hist. de l'Acad. Roy. des Sciences de Paris," from 1691, but principally from 1700 to 1720. Those on the foetus and the foetal circulation are contained in the above Transactions for the years 1700, 1701, 1709.

LOWER, RICHARD, an English physician and anatomist, born in Cornwall in the early part of the 17th century, died in 1690 or 1691. His "Tractatus de Corde, item de Motu et Colore Sanguinis, et chyli in eum transitu," was published in London, 8vo., 1669, and again in 1680; 8vo., Amsterdam and Leyden, 1708, 1722, 1728, 1740, 1749; and in Manget's "Bibliotheca Anatomica." This is the author's chief work.

MALPIGHI, MARCELLUS. (*Animal Kingdom*, Vol. II., p. 604.) "Appendix De Ovo Incubato," Bologna, 1672; London, —; and in the author's "Opera Omnia." Haller states that the descriptions in this tract are somewhat more accurate than those in its predecessor, "De Formatione pulli in ovo," &c. (See a note in the *Economy of the Animal Kingdom*, Vol. I., p. 209.)

MANGET, JOHN JAMES. (*Animal Kingdom*, Vol. II., p. 604.) Manget's "Theatrum Anatomicum" and "Bibliotheca Anatomica" assume an importance for the translators of Swedenborg's physiological works and manuscripts, from the fact that the latter has often borrowed his citations of the anatomists from these compilations, and not from the original sources. And this accounts for certain interpolations, omissions, &c., with which Swedenborg appeared to be chargeable. It is to be observed that Manget's works are not remarkable for correctness.

MERY, JOHN, a French surgeon and anatomist, born at Vatan in 1645, died in

1722. "Nouveau Systeme de la Circulation du sang par le trou ovale dans le fetus humain, avec les responses aux objections de MM. Duverney, Sauvage, Verheyen, Sylvestre, et Bussiere." 12mo., Paris, 1700.

MORGAGNI, JOHN BAPTISTA. (*Animal Kingdom*, Vol. II., p. 604.)

MUNNICKS, JOHN, a Dutch physician and anatomist, born at Utrecht in 1652, died in 1711. "De Re Anatomicâ liber," 8vo., Utrecht, 1697; in Dutch, Amsterdam, 1740. This is a short but well-written work, and contains many original observations.

NEEDHAM, WALTER, an English physician, died in 1691. "Disquisitio Anatomica de Formato Foetu," 8vo., London, 1667; 12mo., Amsterdam, 1668; and in Manget's "Bibliotheca Anatomica."

NUCK, ANTONY. (*Animal Kingdom*, Vol. II., p. 605.) "Observationes et Experimenta Chirurgica," 8vo., Leyden, 1692, 1696, 1714, 1733; 8vo., Jena, 1698; with his "Sialographia" and "Adenographia," 12mo., Lyons, 1722; and in his "Opera Omnia," 2 vols., Leyden, 1733.

PACCHIONI, ANTONY, an Italian physician, born at Reggio, in the Duchy of Modena, in 1664, died at Rome in 1726. His works consist of a number of short dissertations, principally upon the anatomy and physiology of the dura mater. These were collected and published; viz., "Opera," ed. 4, 4to., Rome, 1741.

REVERHORST, MAURICE VAN. (*Animal Kingdom*, Vol. II., p. 605.)

RIDLEY, HENRY, an English anatomist. I. "The Anatomy of the Brain, containing its mechanism and physiology," 8vo., London, 1695; in Latin, by M. E. Etmuller, and (1705) in the "Eph. Nat. Cur.," dec. iii., app.; and in Manget's "Bibliotheca Anatomica;" also at Leyden, 8vo., 1725, under the title, "Anatomia Cerebri complectens ejus mechanismum et physiologiam." II. There is a paper of Ridley's in the "Philosophical Transactions," n. 287, detailing a case of vivisection, in which the systolic motion of the brain was observed to be continued and even increased after the division of the dura mater.

RUYSCH, FREDERIC, (*Animal Kingdom*, Vol. II., p. 605.)

STENO, NICHOLAS, a celebrated Danish anatomist, born at Copenhagen in 1638, died at Swerin, in the Duchy of Mecklenburg, in 1686. Haller speaks very favorably of Steno's paper in T. Bartholin's "Acta Hafniensia," detailing his experiments in living animals upon the motion of the heart, and styles the experiments, "Optima et utilissima." This paper was reprinted in Manget's "Bibliotheca Anatomica." Steno was pupil to Bartholin and great-uncle to Winslow. In 1669 he embraced the catholic religion, and towards the close of his life became an ecclesiastic and missionary, and was made a bishop by the Pope.

SWAMMERDAM, JOHN. (*Animal Kingdom*, Vol. II., p. 606.)

VALLISNERI, ANTONIO. "Considerazioni ed Esperienze intorno al creduto cervello di Bue impietrito, vivente ancor l'animale, presentato dal' Sig. Verney all' Accademia Real di Parigi," Padua, 1710.

VALSALVA, ANTONY MARIA, an Italian physician and anatomist, born at Imola, in Romagna, in 1666, died at Bologna in 1723. His work, "De Aure Humanâ," was published at Bologna, 4to., 1704; 4to., Utrecht, 1707; and Ed. 4, "A. M. Valsalvæ Opera, hoc est, de Aure Humanâ et Dissertationes Anatomicæ, cum additionibus J. B. Morgagni," 4to., Venice, 1740; 4to., Utrecht, 1707, 1717; Geneva, 1716. Haller describes Valsalva as an unwearied and laborious enquirer.

VERHEYEN, PHILIP. (*Animal Kingdom*, Vol. II., p. 606.)

VIEUSSENS, RAYMOND. (*Ibid.*, p. 607.)

WEPFER, JOHN JAMES, a Swiss physician, born at Schaffhausen in 1620, died in 1695. I. "Observationes Anatomicæ ex cadaveribus eorum quos sustulit apoplexia, cum exercitatione de ejus loco adfecto," 8vo., Schaffhausen, 1658, 1675 (the latter edition enlarged by new cases); 8vo., Amsterdam, 1681, 1724 (the latter edition again enriched with eleven new cases); 8vo., Leyden, 1734; Venice, 1759. II. "Historia Anatomica de puellâ sine Cerebro nata," 8vo., Schaffhausen, 1665; and in "Eph. Nat. Cur.," dec. i., an. 3., obs. 129; reprinted also in Manget's "Theatrum Anatomicum." According to Haller, Wepfer stands in the first rank as an enquirer in the whole circle of the medical sciences. And Eloy says, that he was not of the number of those anatomists who have no other power than their eyes; but that he possessed the skill to fathom the causes of things, and to elicit truths from phenomena.

WILLIS, THOMAS. (*Animal Kingdom*, Vol. II., p. 607.)

WINSLOW, JACQUES BENIGNE. (*Ibid.*, p. 608.)

WOLFF, WOLF, or WOLFIUS, CHRISTIAN, a German philosopher, born at Breslau in Silesia in 1679, died at Halle in Saxony in 1754. I. "Philosophia prima, sive Ontologia, methodo scientificâ pertractata, quâ omnis cognitionis humanæ principia continentur." Ed. 2, 4to., Frankfort and Leipsic, 1736. II. "Cosmologia generalis, methodo scientificâ pertractata, quâ ad solidam, inprimis Dei atque naturæ, cognitionem via sternitur," 4to., Frankfort and Leipsic, 1731, Ed. 2, 1737. III. "Psychologia Rationalis; quâ ea, quæ de Animâ Humanâ in dubiâ experientiæ fide innotescunt, per essentiam et naturam animæ explicantur," 4to., Frankfort, 1734 and 1740. Swedenborg became acquainted with the "Ontology" and "Cosmology" of Wolff after writing his "Principia," in the last paragraph of which he says, that he had formed and written his theory two years before he saw those works; but that they greatly confirmed him in it; and he admits important obligations to them in the revision of his Treatise; adding that whoever will take the pains to compare his work with those of Wolff, will see that his special principles, in their application to the world and the series of which it consists, are almost exactly coincident with the metaphysical and general axioms of Wolff. And again he says in one of his posthumous works: "July 10, 1733, . . . I have seen the 'General Cosmology' of Wolff, who aims to establish the nature of the elements on metaphysical principles alone; this work rests upon very sound foundations." (*Itinerarium: sectio prima*, p. 21, 8vo., Tübingen, 1840.) And in a Manuscript preserved in the Royal Academy of Sciences of Stockholm, we find the following, which appears to be a draught of the paragraph before alluded to, but containing additional particulars:

"Comparison of the 'Ontology' and 'General Cosmology' of Christian Wolff, with my 'Principia.'"

"I wish to institute a comparison between my 'Principia' and the rules of metaphysics, with a view of enabling me in some measure to judge of the foundations upon which my philosophy and theory repose; and whether their parts are geometrically and metaphysically true, or the contrary. There is no better source for this test, than the 'Cosmology' of the learned Christian Wolff, who may justly be styled a true philosopher, since he has drawn out the principles of a true philosophy with unwearied care, scrutiny and elaboration, and teaches them metaphysically and in the most regular order, and at the same time scientifically and by experiment. Let us see then whether there be consent between us, or any dissent. In rational



philosophy Wolff treats admirably of the mode of philosophizing. 'The liberty of philosophizing,' says he, 'should be allowed to those who philosophize in a philosophical manner; and from this concession, no danger need be apprehended either for religion, virtue, or the state.' Again he says: 'Without liberty in philosophy, progress in knowledge is impossible.' And further: 'A place must be granted in philosophy to philosophical hypotheses, inasmuch as they prepare the way for discovering the real truth.' And again: 'If any one philosophize in a philosophical manner, he has no need to refute opposite opinions.'"

The Biographers of Swedenborg state that he corresponded with Christian Wolff. It is certain that much of the terminology of Wolff is to be found in the "Economy" and "Animal Kingdom;" and perhaps an investigation of Wolff's books would in some cases conduct us to approximate definitions of Swedenborg's terms.



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ASCENT AND DESCENT OF FORMS. As the forms of the modulations or sounds of the air in the ear are to the forms of the modifications or images of the ether in the eye, or in the animus, so are the latter to the forms of the superior modifications in the mind, which are termed rational and intellectual ideas, in so far as they are illuminated by the light of the soul, II., 269—271. And so again are the forms of the mind to similar supreme forms, inexpressible by words, in the soul, which forms constitute intuitive ideas of ends, in so far as they are illuminated by the light of the First Cause, II., 271.

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ATTRIBUTE: see *God, Substance*.

AURICLE: see *Coronary Vessels, Heart, &c.*

AURA. There is an aura purer than the common air, which contains the most volatile substances of nature, as the air contains the grosser, 44. See *Blood*. Without the auras no animal could subsist either in whole or in part, 49; II., 193. See *Air, Ether, Sense*. The parts of the auras are most perfect forms, determined according to the gravity and acting force of their magnitude; expansile, compressible, contiguous; modifiable; allowing the smallest loss of impressed forces; exactly representing the images of impressions received in one extreme, at the other; pressing equally in all directions according to their force or gravity, from the centre to the circumferences, and *vice versâ*, 50, 68, 284; II., 17, 215, 302. As are the parts of the auras, so are the volumes, 51; II., 302. The auras are the realized forces of nature, 51; II., 180, 250. See *Atmosphere*. The auras of the world are four, viz., air, ether, and two others still more simple, 52; II., 6, 250. The aura, properly so called, is prior to the ether, and the ether to the air, 52; II., 250. See *Fire*. In the higher auras myriads of myriads of moments produce scarcely one in the ultimate forms of visible nature, 129; II., 302, 351. Their undulations increase in perfection and indefiniteness, 131; II., 302. See *Mutation, Series*. The earth could not exist without the auras, II., 6. As they descend in order, they decrease in simplicity, purity, universality and perfection, *ibid.* He that doubts their exist-

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AUTHOR, the, has thrown in sparingly the results of his own experience, but deems it best to make use chiefly of the facts supplied by others, 7; II., 207. He found himself paying too much attention to his own, to the neglect of the sterling observations of others, and therefore laid aside his scalpel, 8; II., 207. See *Plan*. He is by no means anxious to disown his ignorance, 253. He is resolved to be contrary to no one, but to fix his attention on data and facts, and to follow the cause supported by experience and reason, 449. He is not sure that he has always followed the truth, II., 55. He is resolved, cost what it may, to ascertain what the soul is, 207, 211. There are two classes to whom his works may not be acceptable; 1. those who will not seek the truth beyond visible phenomena; to whom he asserts that the truth is to be sought far beyond the range of the eye: 2. those who drown their ideas in the occult at the outset; to whom he declares that there is no such thing in nature as an occult quality, II., 210. He does not persuade any one to his opinion; nor undertake his works for honor or emolument, *ibid.* It is the end of all his endeavors, that truth should hold the supreme place in his mind, II., 243.

AVARICE is the root and mother of vices, II., 53. See *Correspondences*. It regards the useful, not as a means, but as an end, II., 318.

AXILLARY MOTION. If a substance twist and untwist in a spiral, an axillary circumvolution will follow, 280. See *Animation, Motion, Spiral*. And in more perfect substances, a central gyration, *ibid.*

BILE: see *Liver*. The bile, though excrementitious, is made use of before it is thrown out, 318. See *Meconium, Secretion*. The causes of its discharge are both external and internal, 322.

BIRTH. The crying and sneezing of the infant at birth are helps to change the coincidence of motions between the brain and heart, to a coincidence between the brain and lungs, II., 110.

BLOOD. It is the common fountain and general principle of the animal kingdom, 1. The doctrine of the blood, though the first to be propounded, is the last that can be completed, 1, 2, 3, 4, 168, 196, 426, 574. The fortunes and condition of animal life depend upon the nature, constitution, determination, continuity, and quantity of the blood, 1, 47; II., 150, 182. These five relations, multiplied together,

furnish the different conditions under which the blood may exist, 48. It is the complex of all things in the world, and the storehouse and seminary of all in the body, 1, 2, 46, 246 ; II., 150. It imbibes the treasures of the atmosphere, 2, 43, 44. All things in the world exist for the sake of it, 2, 45. Whatever exists in the body, preëxists in the blood, 2, 46, 246. It is all in all in the body, and contains the ground and means of each man's distinctive life, 2, 48, 49. The science of it involves all the sciences that deal with the substances of the world and the forces of nature, 3, 5, 6, 49. See *Animal Spirit*. The red blood is divisible into a purer and pellucid blood, and this, into a most attenuate fluid, 37, 61, 62, 167, 290 ; II., 142, 143, 150, 213. Whatever it possesses, it contains within, and derives solely from intrinsic forces and substances, 38 ; II., 213. Fluidity, flexibility, volatility and vitality are occult qualities inherent in it, *ibid.* It is a vital and most spirituous fluid in immediate connexion with the soul, 39. The red blood contains numerous salts in different proportions, *ibid.*, 290. It is a compound liquid, 40 ; II., 213. It is the vicegerent of the soul in the animal kingdom, *ibid.*, 246 ; II., 182. It enables the soul to descend into the body, *ibid.* It is the *soul of the body*, or the corporeal soul, *ibid.*, 245 ; II., 182, 199. It is surrounded with serum, *ibid.* See *Serum*. Unless the blood were replenished with the threefold order of substances contained in the serum, it could never be fitted for the uses of the animal economy, 45. Whatever is to form a solid tissue is first converted into blood, 46. Three passages lead into the venous blood ; one, from the common stomach ; one, from the compound stomach of the lungs ; the third, from the skin, *ibid.* Three passages lead out of the arterial blood into the system, *viz.*, glands, vesicles and pores, 47. The blood selects its subsidies cautiously and providently from the domains of the world, 47. See *Medicine*. Every animal lives the life of its blood, 48. Any change in the constitution of the blood produces a corresponding change in the system, 48. The continuity of the blood is the spring of unanimity in the body, 48. The science of the blood presupposes an exploration of the auras of the world, 49. Its modifications are in conformity with those of the auras, 50 ; II., 212. Its particles are contained in form by an interfluent aura, 50. When it loses its finer aura, it begins to die, 50. Animal life imparts a peculiar heat to the blood, 55. See *Heat*. The genuine heat of the blood is greatest in youth, but decreases in old age, 57. The heat is kept up by the constant division and combination of the parts, and by the continual exertion of the blood by the brains, *ibid.*, 63. The heart and brain vivify its heat, *ibid.* The blood assumes varieties of color under different conditions, 58. See *Animus, Brutes, Color*. The red and heavy blood comes by means of salts tempering, copulating, determining, and perfecting it, 62, 63. It undergoes division by degrees into its original principles during its progress through corresponding vessels, *ibid.*, 167, 138, *seqq.* ; II., 213. The three degrees of composition in the blood must be perceived distinctly, since the blood is distinctly compounded, and distinctly divided, into each, *ibid.*, 123, 167, 187 ; II., 16, 141, 144, 150, 213. The red blood is the great great-grandson of the spirituous fluid, 63 ; II., 213. When the blood is resolved, it does not die, but continues its life in its purest substances, which enter the fibres, *ibid.*, 167 ; II., 16, 144, 145, 213. See *Salt*. The middle blood is the effect of the spirituous fluid, and the efficient of the red blood, 64. The red blood-globule consists generally of six plano-oval spherules, fitted into the six hollow sides of a particle of fixed salt, whence its spherical figure, *ibid.*, 65 ; II., 144, 150. Its parts are in intimate union and orderly arrangement, 65. The blood is different in every species of animal, and differs with temperaments, states and ages, 65. It may



be either legitimate or spurious, 67. The volume of it within the vessels is either pure, mixed homogeneous, or mixed heterogeneous, 70, 122, 123. The crassamentum is the mean between the volume of the fluid and the mass of the solid, 70. It is the fourth composition of the blood, 71. The fibrous part of the blood arises, when any portions combine into one larger portion on account of the insertion of saline triangles, 72. The gelatinous crust is the sluggish serum that escapes in small quantities from the crassamentum, and condenses on the surface, *ibid.* The matters obtained by distillation from the blood, did not previously exist in it, but are generated, as such, by the action of fire, 72, 73. See *Chemistry*. The particle of common salt is the basis and fulcrum of the blood-globule. 73, 76. There is no simpler or more perfect substance in nature than the blood-globule, 76. It comprises mere principles, elements and simples, and virtually and potentially involves everything in the world that is producible from principles, elements and simples, *ibid.* See *Unit*. It is different in every viscus, 105, 187. See *Circulation*. It is vivified by the nervous fibres at every point of its progression, 116. There is nothing that the blood, in its limited universe, does not connect, irrigate, nourish, renovate, form, actuate and vivify, 117, 351; II., 12. The red and compound blood contains, in simultaneous order, each entity of the simpler substances, 118; II., 212, 213. The circulation of the middle blood is promoted by the lungs, 131, 254, 268, 338, 343; II., 183. See *Undulation*. The undulation of the blood commences with the wave sent from the heart, is propagated through the arteries to the smallest twigs with facility, and terminates in conatus, 137. From conatus it gives out the same effect as if the first motion were actually present, *ibid.* The undulation of the blood ceases where the artery ends and the vein begins, 138. See *Fear*. The blood is soft and flexible in health; hard and renitent during sickness, 167. It is perpetually undergoing birth, death, and rebirth, 168. See *Absorption, Courage, Death, Secretion*. More blood is contained in the least vessels collectively than in the trunks, 197. The quantity of blood in the body cannot be assigned, because the red blood is ever undergoing formation and destruction, 198. The quantity of blood in the body is in reality the quantity of fluid in relation to the solid, 195. The purer blood is prior to the red blood in the heart and every other viscus, 345. See *Cause*. The fluidity of the blood is not owing to its water or serum, but to the spirituous fluid, 543; II., 212. All the genuine blood-globules, when resolved, distinctly enter the medullary and nervous substances of the brain and body, II., 150, 182.

**BODY**: see *Blood*. It desires the treasures of the world, in order that man may be a microcosm, 45. See *Brain*. In the animal body, nature makes almost as large a demand upon our faith as miracles themselves, 188, 233, 238, 239. She passes through every state, and her path lies through all things, 188, 233; II., 204. See *Artery, Order*. Throughout the body there is the form of a kingdom, republic and state, 229. Three sisters manage the threads of the body, viz., the cerebrum, cerebellum, and medulla spinalis, 231. See *Embryo, Formation*. It is an image of the representations of the soul, 240, 241, 242; II., 202, 265, 266, 345. See *Foramen Ovale*. After birth the brain and the body begin to act as distinct and peculiar causes, the muscular fibre being excited against the blood, and *vice versâ*, 417. The body is the mere appendix of the brains, woven by them for the performance of the uses of the lower degrees, 452; II., 27, 212. The proximate cause of the action of the viscera proceeds from the body, 554. See *Death*. The whole system is woven of fibres and blood-vessels, II., 196, 345. The office of the body is, to feel, to form looks and actions, to be disposed, and to do what the higher

lives determine, will, and desire, II., 263. Its pleasures correspond to the cupidities of the animus, *ibid.* The body, so far as it lives, is actually the soul, II., 265, 266, 345. See *Soul*. It is the ultimate organic form of the soul, *ibid.*; II., 287, 345. The elements borrowed from the earth's three kingdoms, to enable the soul to descend to the earth by essential determinations, constitute what is merely corporeal in an animal, II., 266, 287, 291, 345. It is both what the egoists and what the dualists describe it, *ibid.* The mere determinations of the soul are what is called the body, *ibid.*, II., 287, 345. The body is a substance by itself, because the blood is a substance distinct from the spirituous fluid, II., 287. The body is the universal soul, II., 345.

**BRAIN** : see *Vessel*. The cortical substance of the brains consists of internodia between the little blood-vessels and the fibres, and proves the existence of similar internodia in the body, 112, 118, 181. See *Gland*. The arteries and veins of the brain communicate in a particular manner with those of the body, 179, 263. The internal carotid and vertebral arteries are the arterics of the brain; all the others belong to the body, *ibid.* See *Carotid Artery, Fibre*. The motions of the arteries of the brain depend on a different origin from those of the arteries of the body, 183, 260, 424; II., 68. Scarcely any vessels but arteries ramify over the circumference of the brain, 193, 425; II., 158. The brains are different in different animals, 241; II., 43. Their motion constitutes animation, and the action of the spirituous fluid depends upon it, 254; II., 66. See *Animation*. Experience and reason alike attest the motion of the brain, 255; II., 59, *seqq.* A true knowledge of the brain and nerves is impossible, unless their motions be admitted, *ibid.*; II., 44. Every part and particle in them proves that they are formed in, and for, motion, *ibid.*, 257, 279, 424. Set the brain in motion, and the use, effect, and end of all its members will be manifest to the senses, 256, 258, 279, 328, 339; II., 144. The ventricles of the brain allow of its contraction and expansion, 257. The vessels of the brain have no muscular tunic, and without its animation would have no action, *ibid.*, 325, 424; II., 65. The motions of the brain and heart may, or may not, be synchronous, 261; II., 65. The brain expands by self-animation, but is driven to contract by extrinsic causes, *ibid.* Animatory expansion is its proper motion, but its constriction is a species of exanimation, 262. See *Gaping, Laughter, Nose, Respiration, Sneezing*. The heart has no power over the arteries of the brain, 263, 306, 325; II., 64, 65, 153. See *Fontanelle*. The motion of the brain is according to its divisions, viz., general, special, and particular, 268; II., 44. Before the heart's motion begins, the brain aims to give the blood a proper circulation, 272, 304, 306, 317; II., 64. Unless the brains were actually discriminated into parts, their animation would be indeterminate, and there would be no life, 286, 490; II., 16. Before birth the brains perform nearly the same office for the blood, as the lungs after birth, 317. Nothing is formed in the body except under the auspices of the brains, *ibid.* They have the prerogative of drawing up and demanding the proper quantity and quality of blood, *ibid.*, 324, 327, 328, 329, 333, 425; II., 73, 110, 153. After birth they no longer admit all the blood of the heart or body, but exercise an elective power, 324, 333; II., 73, 110, 153. When busied in thought they banish the material blood from the shrine of their inner organs, 325; II., 110. See *Vertebral Artery*. All the arteries, veins and sinuses of the brain are placed in the stream of its motions, 326, 424. They open when the brain collapses, and contract when the brain expands, 327, 328, 424, 425. See *Attraction, Embryo*. The brains attract all the better blood, 347; II., 139, 140. See *Foramen Ovale*. The action of the heart is from within to without, but the action of the brain from without to within; shewing that the brain

concentrates all the forces of the body upon itself, while the heart, on the contrary, pours them all from itself, 425 : II., 158. See *Cause*. The cortical masses can animate separately from each other, 490. The brain, by its power of animating particularly, does not act immediately upon the fibre of the muscle, but upon the fibre of the medullæ, and thus mediately, 492. The brain has two offices ; 1. to will what it knows, and know what it wills (II., 65) : 2. to transmit into the blood the spirituous fluid elaborated in its cortical spherules, II., 43. It has chemical organs, as well as sensitive and intellectual organs, II., 44. It breathes from its surfaces to its planes, from its planes to its axes, and from its axes to its centres, *ibid.* It has two axes, a transverse and a longitudinal, II., 45. It has two centres, viz., the pineal gland, and the base of the fornix ; which centres correspond to its two general offices ; the base of the fornix being its centre of rest ; the pineal gland, its centre of motion, *ibid.* The most minute parts of the brain are similarly circumstanced, II., 46. See *Cortical Substance*. The brain is not under the control of the heart, save when it purposes to lead a corporeal life, governed by mere instinct, II., 64. The origin of its motion is voluntary, the brain itself being the author of it, II., 65. The animation of the brain propelling the spirituous fluid, is seconded in the body by the respiration of the lungs attracting it ; the lungs playing the same part in general, as the brains universally in particular, II., 66, 86. All the affections induce similar states on the lungs and the brains, II., 67. Even in animals the pulse of the heart stops at the threshold of the brain, II., 74. When the brains perform systole, their blood-vessels perform diastole, and *vice versâ*, II., 75. The brain is the mover of its own arteries, veins and sinuses, and the dispenser of its own blood, II., 75, 110. The venous blood does not quit the cranium without leave from the brain, II., 76. The ramification of the pulmonary pipes over the brain and spinal marrow in insects, proves the concordance of motion between the brains and lungs, II., 83—86. The blood of the brain is eminently divisible into its degrees, II., 139, 141, 142. In the brain and spinal marrow there is absolute community of all imported goods and fluids, II., 165. Truly human brains have the power of keeping the blood outside, at the doors of the cortical substance, II., 179. The brain pours upon the pure essence extracted from the blood a new essence conceived and excluded in the finest wombs of the cortical substance, *ibid.* It is the model and effigy of all compositions and derivations, and especially of all the glands, II., 190.

**BRONCHIAL ARTERIES.** They supply the lungs with red blood before birth, 345. Their blood, together with the colorless blood sent through the pulmonary arteries (see *Circulation, Lungs*), adapts and lays down the passages that the red blood is to traverse after birth, 347.

**BRUTES** are led by instinct to rational-seeming ends according to the states of the blood, 61, 360 ; II., 178, 196, 340. They incessantly desire what their blood craves ; being as much controlled by their body as by their brains, 182 ; II., 196, 340. They are incapable of acting against their nature and organization ; not so man, 200, 360 ; II., 339. See *Brain, Formative Substance*. They have no reason and no will, but live under the guidance of instincts, 244, 360 ; II., 251, 338. See *Instinct*. Every animal has its own soul, 244 ; II., 334. Their cortical substances are coördinated in a peculiar manner, otherwise than in man, II., 178, 334. Their blood is with difficulty prevented from rushing into their brains, and suffusing the cortical substance, at the slightest instinct and intimation, *ibid.* They derive their nature from the auras, and live under the government of the world, II., 196, 251, 330, 340. Their purest fluids owe their origin to the second aura, II., 251, 330.

They possess imagination, II., 261, 339. See *Thought*. Their purest fluid may be termed their soul, as being the order, law, rule, truth, and science of their nature, II., 331. They are as living magnets, for the magnet also owes its forces to the second ether, *ibid.* Their purest fluid is of a lower order than the human fluid; the difference being as between a cube and its root, II., 332, 336. It is not in a higher degree than, but in the same degree as, their organism, which answers to that of our mind, II., 333. Their apparent perfections are proofs of their imperfection, *ibid.* They are born to communication between the soul and the body, or to all the conditions of their life, *ibid.* In mere generals their brains are like those of man, so that without a rational view we might be led to infer absolute likeness in first causes, II., 335, 341. Such likeness shews only what we do in common with brutes, II., 335, 336, 341. There is in them a complete concurrence of the soul with the body; II., 336—338. They possess some analogon of a mind, or of reason and will, II., 338. And an animus, as a centre of operations, with perception, imagination, and its allied cupidities, II., 339. Their faculties stand in a continuous proportion of three successive ratios, of which the first is to the second as the second to the third; while in man the proportion consists of four ratios, of which the first is to the second as the third to the fourth, *ibid.* All their instincts are excited by external motives, II., 340.

CAROTID ARTERY. The carotid, in man, is not a trunk, but a branch of the aorta, 180, 328; II., 109. It drops its muscular coat as it enters the skull, *ibid.*, 325; II., 70, 109. After this it has not the character of a continued heart, and does not promote the circulation, *ibid.*, 325; II., 68, 70. It forms several gyres on entering the brain, 180, 182, 325; II., 68, 70, 109. It submits itself entirely to the intercostal nerve and dura mater, 181; II., 70, 71, 109. When it reaches the cerebrum, it anastomoses with itself, and produces a perfect communion of blood throughout its branches, 181. It goes to every spherule of the cortex, circumvesting it, and constructing it of the innermost and universal membrane of the arteries of the body, *ibid.* See *Artery*. It swells out into a kind of belly in the cavernous receptacles, II., 71, 109. This belly is a reservoir from which the brain can take out the blood as it wants it, II., 72.

CAUSE: see *Experience*. The faculty of exploring causes is peculiar, and the brain must be initiated into it from the beginning, 8. See *Faculties*. Where it is naturally good, it may be impaired in various ways, 11. The desires of the animus and the pleasures of the body, when not submitted to the mind, render the persistent investigation of causes, impossible, 11. The thirst for glory and the love of self are the chief hindrances to the rational faculty, and cause it to become retrograde instead of progressive, 11, 12. The mind can never find causes, but in the subordination of things, and the coördination of things subordinate, 51. See *Degree, Order*. The cause survives when the effect perishes, 51. The continent and the content are one common cause of determination, 105, 138, 139, 512. Efficient causes are multiplied in every part of the system, 177, 199, 262, 360, 461, 473. The multitude of causes in the highest sphere is ineffable and unassignable, 178. Causes repair the deficiency and waste that occur in causates, 178, 231, 232. Causes, speaking generally, are internal and external, 178, 179, 196. The cause must exist before the causate, 226, 518. See *Animation, Formative Substance, Substance*. In the formation of the body, the spirituous fluid is the first cause, the purer blood the second, and the red blood the third, 246, 247, 286, 290, 347. Every cause proceeding from the brains is internal; every cause proceeding from the heart or blood is comparatively external,

426. To understand causes we must commence from the simple, arriving thereat analytically from compounds, 450. See *Animal Spirit, Motion of the Heart*. Before the effect exists, the cause is in the effort to act, 518. Causes are in an ascending and descending order, proximate and remote, 535. There are causes proximate and remote between things of the same degree, though properly speaking, this is but a continuity of the same cause, 535. See *Aura*. To speak from a cause is to speak to innumerable effects; whereas to speak from an effect is to speak to but few causes, II., 94, 206. Judgment implies that we can abstract causes, and causes of causes, from effects, II., 205. We are apt not to separate the principal cause from the instrumental, II., 232. The desire of apprehending causation, or the *why* of things, is the characteristic of life in the intellect, II., 261.

**CEREBELLUM:** see *Brain, Glands*. The cerebellum conducts the natural operations or instincts of the body, 243; II., 176. It acts all at once, and is an organism of the second degree, *ibid.*, 493. See *Cortical Substance, Intercostal Nerve, Par Vagum*. The cerebellum propels its blood towards the jugular veins by its own proper force, 545. See *Motion of the Heart*. It has the general administration of the body, but the cerebrum watches only over its own system, 546. It provides the heart with spirituous fluid and nervous juice; being all in all in the heart, 547. It is a unique and grand mass of cineritious substance, 553. The cerebellum expands and constricts all at once; but the cerebrum can expand and constrict specifically and individually, or in parts, II., 167. The common animation of the cerebellum is voluntary when that of the cerebrum is voluntary, II., 176. It animates synchronously with the respiration of the lungs, II., 177.

**CEREBRAL NERVES.** The fifth pair of cerebral nerves is analogous, in the head, to the great sympathetic or intercostal nerve in the body, 462.

**CEREBRUM:** see *Brain*. The cerebrum governs the voluntary operations; acts dividedly; and is an organism of the third degree, 243, 493; II., 176. The formative substance adjoins the cerebellum to the cerebrum, *ibid.* The cerebrum and cerebellum are the successors of the parents, or the new parents of the conceived offspring, 253. The cerebrum propels its blood towards the jugular veins by its own proper force, 539. See *Sleep*. And the cerebellum, 545. See *Motion of the Heart*. The cerebrum can inspire any fibres, or fascicles of fibres, that it pleases, II., 169. This particular and special action exists under the general voluntary action, II., 174. By a distinct perception of the coördination of the cortical substances, we understand how the will is determined into act by the cerebrum, and how by the cerebellum, *ibid.*

**CERVICAL NERVES.** The first four pairs of them form a reciprocal proportion consisting of two ratios or four terms; and the action of the second and third being equal to that of the first and fourth, an equation or equilibrium of actions is produced, 349.

**CHEMISTRY.** The chemistry of nature can produce anything out of anything, 55. See *Blood*. The substances elicited from organic bodies by chemistry, did not exist under those forms previously, 73. It is not possible, by the present chemistry, to obtain in a separate form the spirit of the blood, 74.

**CHYLE.** The new chyle mounting along the thoracic duct meets the spirit descending from the brains, in the jugular vein, 422.

**CIRCLE.** Nature is a circle, II., 268. See *Nature*.

**CIRCULATION:** see *Heart*. There is a circulation more universal than that of the blood through the arteries and veins; namely, from the fibres into the vessels,

and from the vessels into the fibres, 37, 268, 303, 347, 351, 451; II., 181. See *Animal Spirit, Blood*. At every gyre of the circulation the blood is opened into its principles, 76, 142. The circulation is subtriplimate, 113. The least universal circulation is that of the red blood; the more universal, that of the purer blood; the most universal, that of the spirituous fluid, *ibid.*, 268, 303, 347, 351. There is unanimous harmony, and yet perfect distinctness, between the circulations, *ibid.* The universal circulation is without beginning or end, 117, 351. There are barriers to prevent the blood of one degree from passing undivided into the vessels of a higher degree, 117. The circulation of the red blood is performed by a successively propagated undulation, the moments of which are imperceptible, and produce the pulse, 127, 267. The wave of blood, once impelled by the heart, is afterwards moved forward by the whole arterial system, 139, 147. The circulation proceeds from the heart at an accelerated velocity through the lesser and least vessels, *ibid.*, 147. The blood is surrounded by a sluggish serum in the large vessels, but purifies itself therefrom in its course, 142, 147. The blood is constantly aspiring to its purer sphere, *viz.*, the field of least vessels, where it is left to itself, and to its own nature, *ibid.*, 147, 194, 195. At every point in the circulation a fresh pressure is superadded to the blood, so that it passes on in something like the ratio of falling bodies, 143, 147. In the second order of vessels the current is far more rapid and spontaneous; in those of the first order, *viz.*, the fibres, its velocity is indefinite and immense, *ibid.* In its course to the purer sphere, the blood can never be said to descend, but always to ascend, 147. Without general pressure there could be no circulation; and *vice versâ*, 148, 184, 185, 191. See *Artery, Death*. The general equilibrium of pressure, and the circulation, are exact correspondents, 148, 191, 416. The general equilibrium of pressure is the basis of the animal economy, 149, 154, 191. The undulatory circulation ceases with the arteries; a common or general circulation begins with the veins, 162. The liveliest and most spirituous blood occupies the axis of the vessels; the more sluggish and angular portions are rejected to the circumferences, 165, 186. The circulation is natural and perfect in proportion as the blood is purified from serum when passing from the arteries into the veins, 169, 187. See *Secretion*. When the artery contracts in length and breadth, the outer tunic of the vein is drawn upon, and affords a free access and open channel to the blood, 185. See *Egg*. The circulation of the red blood runs through three marked periods, 304. The **FIRST**, when the primitive heart propels the blood received, through certain vessels upward towards the brains, and the brains express it downwards into the umbilical vessels, 304, 305. At this period the brains, and not the heart, are the principal cause of the circulation, 306, 309. The expansion and constriction of the arterial trunk of the head arise probably from the animation of the first living point, *ibid.*, 309. During the **SECOND** period the aorta extends down to the abdomen; the brains having taken the heart into fellowship to form the rest of the body, 306. The blood is now carried by the inferior vena cava, through the cardiac vesicles, to the brains; and from the brains, by the superior vena cava, through the cardiac vesicles and descending aorta, to the abdomen; and so again through the inferior vena cava, 307. At this time the auricle pulsates with two motions; first when the blood enters it from the superior cava, and again when it enters it from the inferior cava, 308. And the ventricle with two, first when the blood is driven through the descending aorta, and secondly, when it is driven into the ascending aorta, *ibid.* While the arterial trunk of the head protrudes the blood once, the heart does the same twice, 309. The circle the blood thus describes is double and reflex, but continuous; and while it lasts, two motions must exist suc-



cessively in the auricles, and two in the ventricles, 310, 502. The mode and determination of the circulation before birth, in the united or conical heart, is similar to the above, *ibid.* The blood carried from the brains through the superior cava to the right ventricle, is sent through the ductus arteriosus into the descending aorta, and so to the lower region; thence through the inferior cava, and foramen ovale into the left ventricle, and so towards the brains, *ibid.* The blood flows from the superior cava into the right ventricle before it flows through the inferior cava and foramen ovale into the left, 311. At this time all the blood of the superior cava flows into the right ventricle; and all the blood of the inferior flows through the foramen ovale into the left, 312, 313. The whole of the former blood goes to the brains and upper parts, 313. The blood of the two cavæ is not mixed, 316. The heart distinctly determines the stream in both cases, by help of the foramen ovale and ductus arteriosus, 316. The differences in the circulation are differences in form, not in kind, 324. The THIRD period of circulation is that which supervenes at birth or exclusion, 324. At this time there are no longer two successive motions in the auricles or ventricles, *ibid.* See *Ductus Arteriosus, Foramen Ovale.* The circulation of the purer blood depends on the motion of both the brains and lungs, 338. It is everywhere prior to that of the red blood, 345. Before birth it is a simple circle, from the brains to the right heart, thence to the lungs, thence to the left heart, and thence again to the brains; a circle like that which the red blood first describes, 347. There is a circle of perpetual formation, *viz.*, of the red blood from the purer blood, and of the purer blood from the spirituous fluid, 351. See *Circulation of the Heart, Coronary Vessels, Proper Vessels of the Heart.* The causes of the general equilibrium of pressure are either internal or external, 416. See *Fibre, Ganglia.* Every point of every artery and fibre propels its fluid, just as if the beginning were there, and the heart or brain most absolutely present, 497. See *Motion of the Heart.* The circulation of the red blood is a late discovery compared to that of the spirituous fluid, II., 181. The circulation of the latter could not exist without a motive force, in a word, without the animation of the cortex, II., 182. The spirituous fluid does not return to the brain through any venous [nervous] fibres, *ibid.* The first and last terms of the circulations are voluntary, but the middle term natural, II., 182.

CIRCULATION OF THE HEART. See *Circulation, Coronary Vessels, Heart, Proper Vessels of the Heart.* There is a gyre in which the blood visits the right auricle and ventricle twice, before it passes through the lungs, 412. This is performed through the refundent vessels of the right auricle, and the retorquent vessels, *ibid.* Also a gyre in which the blood runs directly into the aorta, without passing through the lungs, through the transferent vessels of the right ventricle and auricle, *ibid.* And a gyre in which the blood passes twice through the lungs, and twice enters the left auricle and ventricle; which is brought about by the retroferent vessels, *ibid.* A gyre in which the blood from the lungs does not go to the left ventricle, but directly from the left auricle to the aorta through the anticipant vessels, 413. And a gyre in which the blood is carried from the left ventricle into the aorta by the coronary channel, *viz.*, through the retorquents of the left ventricle, *ibid.* If the vessels that discharge the blood into the aorta communicated with those that carry it into the right auricle, the motion of the heart and the circulation of the blood would not long continue; but the same effect would follow as if the septum between the ventricles were perforated, 417. The heart would not be what it is, *viz.*, an organ for compounding the blood out of various liquids, were it not for the transference and circulation of the blood through its own proper arteries and veins, 422. See *Motion.* The



heart is the first to taste of the blood-cup, before passing it to the other organs, 423. Its fibres are supplied with the purest essence of all, *ibid.* The blood that passes through the refundent vessels may perform its circle four times before it allows itself to be conveyed to the lungs, 423.

CITY OF GOD upon earth: the universal law of its citizens is, that they love their neighbor as themselves, and God more than themselves, II., 356.

COLOR is the determinate proportion between light and shade in objects too minute to be seen distinctly, 59. Nothing produces its varieties more distinctly than saline corpuscles, 60, 136. When the proportion of light is small, the color is green or azure; when greater, yellow, 60. The complete transition from black to white takes place when all the volatile saline particles are translucent, and like irregular pieces of glass, reflect the rays inordinately, *ibid.* Colors arise principally from the salts of the second degree, *ibid.* Those of the first degree do not produce color, but insinuate its principles, and give strength and brilliancy to colored objects, 61. See *Blood*.

COMPARISON illustrates, yet does not teach the nature of that with which the comparison is instituted, II., 240. See *God*.

COMPOUND. See *Leasts*. Everything is particular and limited in proportion as it is compound, 122. The effect that is obtained immediately in simples, is obtained mediately in compounds, II., 90.

CONATUS is the end and beginning of all motion, 135, 278, 281, 285. See *Motion*. Resistance converts motion into conatus, 135, 280, 281, 283. On unresisting bodies, conatus produces the same effect as if the first motion were present, *ibid.*, 281, 283. It is the internal principle of animation, which ceases when conatus ceases, 281. It begins to die where substances are no longer capable of gyration, *ibid.*, 283. Animation is often confounded with conatus, which however may persist without a real expansion, 283.

CONNEXION. There is a connexion, communion, and mutual relation of all things in nature, 6; II., 10. And in the body, 48.

CONSCIENCE: see *Immortality*. Conscience is generated from those things, and those alone, that have obtained the character of principles or governing laws in the mind, II., 354. After moral combats, conscience is either killed, or wounded, or victorious, *ibid.* A contented mind may exist without a good conscience, II., 52.

CONTINGENT. Those things appear contingent that are to become present successively during formation, 237. See *Embryo*. Apparent contingents are in reality necessary consequents, 238. Every contingent is regarded from the cause upon which it is contingent, II., 328.

CONTINUOUS. See *Substance*. Forces and modes that appear to be destitute of degrees and moments, are seen as incomprehensible and continuous, II., 30, 234. See *Life*.

CORONARY VESSELS, &c. See *Blood, Circulation, Foramen Ovale, Heart, Vessels*. The coronary vessels, both arterial and venous, arise from the heart, and not from the aorta, 380, 407. Anatomy forbids us to conclude that the blood is sent from the aorta through the coronary arteries to the surface of the heart, 380. Morgagni was fully aware of the difficulties suggested in this respect by anatomy, 381. In many hearts the aortic valves overlie some, or all, of the orifices of the coronary arteries; and the law of nature (see *Nature*) forbids us to attribute to one heart, or to one of two orifices of the same heart, what is plainly denied to the other, 383. Even though the orifices were free, the motion of the ventricle and the

turgescence of the aorta during the heart's systole, would close the canal of the coronary arteries, *ibid.* The same remark applies to the canal between the base of the heart and the large coronary orifice of the right auricle, 384. To suppose that the blood is supplied to the coronary arteries by a retrograde action of the aorta, is repugnant to all the laws and circumstances of the case, *ibid.* The so-called coronary arteries communicate nowhere on the heart's surface with the so-called veins, nor *vice versâ*; indicating that both classes of vessels are similar in kind, 385, 390. It is repugnant to suppose that the heart holds its life by tenure from its own artery, *ibid.* The blood flows from the heart into the lacunæ, especially under the carneæ columnæ, 387. These lacunæ receive the firstling blood, 387, 389, 397, 449. From the lacunæ it is pressed into the fleshy ducts or oscula opening under the columns, *ibid.* And from the fleshy ducts into the muscular or motive fibres, 388. From the fibres into the coronary vessels, both arteries and veins, *ibid.* See *Muscle*. The fleshy ducts and lacunæ communicate with the coronary vessels both from the surface towards the interiors, and from the interiors towards the surface, 388, 389. There are certain ducts leading from the lacunæ into the muscular substance, and which we term *immissaries*: also ducts leading from the muscular substance into the coronaries, and which we term *emissaries*; and ducts running immediately from the lacunæ to the coronaries, and from the coronaries to the lacunæ, and which we term *commissaries*, 390. During systole the blood escapes through the great arteries, and all the immissaries and emissaries, but not through the commissaries, 391—393. The commissaries are opened during diastole, 391, 397. From the coronary vessels the blood passes into the aorta and right auricle, 393. The superfluous blood in the coronaries runs back into the lacunæ and ventricles, 396. All these vessels depend entirely on the action of the heart, 397. Both they, and the motive fibres, fleshy ducts and lacunæ, are set and disposed in the stream of its motion, 398, 406. All the vessels at the surface of the heart are veins, the corresponding arteries being in the substance of the heart, 400; II., 158. The coronaries have all the characteristics of veins, *ibid.* See *Vein*. The fleshy ducts are the arteries of these veins, being so many least aortas or pulmonary arteries, *ibid.* They have all the marks of arteries, *ibid.* See *Artery*. The coronary and auricular vessels perform their diastole when the heart and auricles perform their systole, 401. The coronary vessels, in a certain sense, are in place of the foramen ovale and ductus arteriosus, 407. See *Proper Vessels of the Heart*. They equilibrate the arterial and venous blood of the heart, 416, 419. See *Circulation of the Heart*. The quantity of blood is not small that passes through the coronary vessels, *ibid.* The equilibrium of general pressure is represented by the distinct determination of the coronaries, 418, 419.

CORPOREAL. See *Body*.

CORRESPONDENCES. The sensations belong to the bodily organs: imagination corresponds in a higher degree to sensation; thought to imagination; and the representation of the universe, or the intuition of ends, to thought, II., 50. To the body, relatively to its countenance, disposition, and peculiar actions, corresponds the animus; to this, the mind; to this, the soul, *ibid.* Forces correspond to actions; powers, to forces; to powers, in the highest degree, living force, or in animals, life, II., 51. To pleasure corresponds cupidity; to cupidity, desire of the future, which produces will; to will, the representation of ends for self-preservation, *ibid.* To the act of venery corresponds the allurements and cupidity of love; to this a purer love [conjugal love], which has no name at present; to this, the representation of

self, in the preservation of the race for universal ends, II., 52. Gladness corresponds to laughter; content to gladness; good conscience to content, *ibid.* To pride, considered as belonging to the body, corresponds elation and inflation of the animus; to this, ambition of mind; to this, ambition of ambition, which may be either spurious or legitimate, II., 53. To avarice, considered as the possession of goods, corresponds the lust of possessing them; to this, the representation, by those goods, of all possibilities in the world; but avarice ascends no further, being without the representation of universal ends, *ibid.* To heroic action corresponds courage; to this, the preservation of self and kindred; to this, the preservation of the same as a mean to the preservation of society, *ibid.* The sounds of the ear correspond to the images of the eye and animus, II., 250.

**CORTICAL SUBSTANCE.** Each spherule of it is a least cerebellum, 249; II., 41, 167, 190, 192, 290. See *Animation, Brain, Cerebrum, Cerebellum, Fibre, Nerves.* Each spherule expands and contracts like a heart, and serves as a coreulum to the fibre suffixed to it, 451, 463; II., 153, 157, 158. Each spherule is clothed with a membrane, like the brain itself, which membrane is composed of villi and capillaries, II., 41, 42. The spherules are the internal sensories, II., 42, 190, 293. They are the last and first ends of the arteries, nerves, and tunics; and summits or centres from which animal nature surveys all that is passing in all the appendages of the brain and body, *ibid.* They put forth rays into the whole circumference of their dominions, *ibid.* They are formed in motion, and for motion, II., 46. They can act either separately or conjointly, II., 47. There is no influx of the soul into the body, except mediately, through these substances, *ibid.* Influx does not take place even by or from them, immediately, *ibid.* The cortex is the principal substance of the brain, II., 133. It is placed in the first term of the fibres, and the last of the arteries, II.; 134, 138, 197, 290. Like Janus it looks two ways; backward, on the side of the arteries, to the crasser blood; forwards, on the side of the fibres, to the spirituous fluid, II., 138. It is placed in the middle, and thereby extracts from the blood the purer essences and animal spirits, and transmits them immediately into the finest medullary filaments, and ultimately into the nervous filaments of the body, *ibid.* It does not admit the serum of the blood, II., 139, 148. The blood when divided into purer blood passes through the middle bed of each cortical substance, and into the little canal of each fibre, *ibid.*; 143, 145—147, 151. When divided again, or into pure spirituous fluid, it penetrates into the subtlest threads constituting the surface of each cortical spherule, and so runs into the surface of the fibres of the above canals, *ibid.*, 143, 149, 151. Each cortical spherule has a middle cavity, II.; 146—148, 153. The vessels that weave the parietes of the cortical particle are in some respects analogous to the carneo-motive fibres and superficial vessels of the heart, II., 149, 175. The cortex is that from which the brain animates, II., 153, 163. All the other substances of the body are but appendages, either anterior or posterior, to the cortical substance, *ibid.* The motion of the cortical centres is systaltic mication, II., 154. It cannot be verified by the senses, *ibid.* Boerhaave admits the impulsive force of the cortex upon the nervous fluid, II., 155. Each spherule is surrounded by a little space to allow its motion, II.; 156, 164, 166, 173. At the earliest stages the heart of the body was like a cortical spherule. But the difference was, that the primitive coreulum, like the adult heart, was embraced by veins, whereas the cineritious coreulum of the brain is surrounded by arteries alone, II., 158. The cortical spherules are hearts for the pure blood, while the grand heart of the body is for the gross or red blood, *ibid.* When they are expanded, the entire mass of the

brain, including the surface, the blood vessels, and the medulla throughout, is constricted, and *vice versâ*, II., 160. The number of these cortical sources of motion is immensely great, *ibid.*, 164. They are astonishing in their distribution, distinction, multiplication, and communications, II., 164. There is a universality of their particularities, *ibid.* In the cerebrum they can animate either singly, several at once, or all in common; but not so in the cerebellum and medullæ, II., 166. The cortical and cineritious substances throughout are most wonderfully subordinated and coördinated, II., 168. It is the determinant, though not the prime determinant, of the actions of the body, II., 174, 175, 197. It necessarily requires the spirituous fluid, II., 175, 197. It is by eminence everything that performs any office in the body, II., 185. Each part of it is by eminence a muscle, *ibid.* And a gland, II., 187, 188. See *Glands*. It performs all the characteristic operations of the glands, II., 188. It is a lung, a womb, and a stomach, by eminence; and by eminence a microcosm when the body is regarded as a microcosm, II., 190. The last receiving rooms of all modes are in the cortex, which is the internal organism corresponding to that of the five senses, II., 190, 191. The series of cortical substances is as the series of sensations, II., 192. There is a perfect harmonic variety between the spherules, *ibid.* They are of an oval form, nearly like that of the brain, *ibid.* Each puts forth a fibre circumgyrated by almost invisible canals, just as the brain puts forth the spinal marrow, II., 193. These spherules admit of changes of state according to the contingencies existing either in externals, or internals; just as the auras of the world, with whose changes, theirs may fitly be compared, *ibid.* Whatever state or mind they assume, the like is at once diffused into the continuous fibres and whole system, II., 196. See *Genesis of Faculties*. The cortex is the first determination of the spirituous fluid; the centre of operations, partaking of both the soul and the body; and the unit of the brain, II., 290.

COURAGE depends upon the arterial blood being restrained in the arteries, and not suffered to run away unduly into the veins, 192, 337. See *Artery, Death, Fear, Proper Vessels of the Heart*.

CRASSAMENTUM. See *Blood*.

CREATION. The act of creation is represented momentarily in the human mind, II., 356. Human souls are the ultimate subjects of creation, *ibid.*

DEATH. At the time of death the general pressure of the arteries overcomes the impulse of the heart, and the circulation ceases, 148, 161, 191. When the body perishes, mere accidents perish, II., 27.

DECORUM. The becoming is the essential form of the useful and honorable, II., 320. It is not in itself an end, but when assumed as such is pure vanity, *ibid.* The consistently decorous is identical with the honorable, II., 321.

DEGREE: see *Cause, Order*. Distinct conceptions must be formed of different degrees, and distinct terms used to express them, 54, 144. See *Blood, Salt, Simple*. There are degrees of universality and priority, 76, 144; II., 25. Unless the animal kingdoms proceeded most distinctly from degree to degree, they could not live as they do, 122, 242. All things are more perfect in the higher degrees, 144, 178. See *Succession*. Nature is introduced into degrees and moments as soon as into her world, 227. Words borrowed from a lower degree to express the adjuncts of a higher, will hardly portray a single part of it, 232, 285. See *Formative Substance*. The highest degree cannot act upon the lowest except through the intermediate degrees, 242; II., 15. See *Sleep, Soul*. The doctrine of series and degrees teaches the nature of order, and its rules, as observed in the succession of things,

II., 1, 203. It dissipates occult qualities, II., 2, 203. It teaches the mode that nature observes in the subordination and coördination of things, and which she has prescribed for herself in acting, II., 4, 203. It is a principal part of the natural sciences, *ibid.* Degrees are the distinct progressions, while one thing is being subordinated to another, and coördinated by the side of another: there are therefore degrees of determination and degrees of composition, II., 5. They cannot exist but in things successive, *ibid.* The knowledge of natural things depends upon a distinct notion of series and degrees, and their subordination and coördination, II., 8, 203. See *Genius*. In substances where there are but two degrees, there is no complete determination, for every perfect determination requires a triple progression, II., 15. See *Unit*. The doctrine of series and degrees conjoined with experience, will lead to an intimate knowledge of nature, II., 35, 203. Rules must be discovered to shew us what things in a higher degree correspond to those in a lower, II., 48. This correspondence may be inferred when, 1. A thing in a higher degree is a general and universal dominant in many things that stand under it. 2. When it is so distinct from the thing below it, as to subsist by itself, either with the other, or without it. 3. When it is unknown to be the superior correspondent, except by analogy and eminence; and its quality is unknown except by reflection, or by the knowledge of lower things, as in a mirror. 4. When it has to be signified by an entirely different term from the lower. 5. In order for two things to be the superior and inferior substances of a series, there must be a nexus between them; otherwise there would be no dependence or mutual relation, II., 49, 363. To discern these points is a work requiring both experience and genius, *ibid.* The properties of the spirituous fluid cannot be explored without the doctrine of series and degrees, and the philosophy of universals, II., 199, 217, 271. These will exalt the rational sight, as artificial instruments exalt the bodily sight, II., 200, 313. To attempt to attain the sublimities of nature without them, is to attempt to climb heaven by the tower of Babel, II., 203. The doctrine of series and degrees only teaches the distinction and relation between higher and lower, prior and posterior things; but has no adequate terms to express those things that transcend the familiar sphere: hence the necessity for a mathematical philosophy of universals, II., 203, 217. See *Mathematical Philosophy of Universals*. The rise from one degree to another takes place in a triplicate ratio, II., 271.

DELIGHT: see *Liberty*.

DEPENDENCE. Everything is a relative and dependent being, 228. See *Blood, Cause, Degree, Order*.

DESIRES: see *Cause*.

DETERMINATIONS: see *Vessels*. The essential determinations of coexistents are successive, 64. Unless the blood were exactly determined, the animal economy could not exist, or the animal being live in action, 103, 286. See *Animation, Animal Spirit*. By the phrase, to determine, as applied to a muscle, we mean to construct and endow with a form, II., 185.

DIGESTION. The chylopoietic menstrua form a series; viz., the saliva, the liquor œsophagi, the gastric and pancreatic juices, the bile, the gall, 318. All these humors are species of one genus, 319.

DISEASES originate more seldom from the brain than from the body, II., 94. The diagnostics of diseases of the brain may be gathered from the respiration more clearly than from the pulse; but best, from both together, II., 98. In proportion

as diseases spring from a deep or high source, they fall with greater certainty on the parts below, and spread more widely, II., 110.

**DISTINCTION:** see *Liberty*. The distinction between individuals is maintained by Providence in an infinity of ways, II., 328.

**DORSAL NERVES,** the, prove the concordance of motions between the brains and lungs, II., 80, 81.

**DUCTUS ARTERIOSUS:** see *Circulation, Heart*. The lungs after birth attract the blood that previously flowed through the ductus arteriosus, and so contribute to render the latter impervious, 331, 332. Various causes at the aortic end of the duct contribute to the same effect, 333. See *Circulation of the Heart, Coronary Vessels, Dura Mater, Embryo, Proper Vessels of the Heart, Vessels*.

**DURA MATER.** It is the uniting mean between the motions of the brain and heart, II., 61, 106. Its motion is mixed, consisting on the one hand of a motion from the arteries that directly communicate with those on the outside of the head; on the other, of a motion from the brain, propagated through the three sinuses, II., 103. It receives no blood from the internal carotid, after that vessel climbs the brain, *ibid.* It is expanded and contracted by the subjacent brain, II., 104, 162. These motions are not so perceptible to touch as its pulsatile motions, II., 105. Authors are wonderfully unanimous in asserting two motions in the dura mater, II., 106. The inner lamina of it belongs to the brain; the outer, to the heart; and the middle, where the arteries run, to both conjointly; but in infancy, the latter belongs rather to the heart; in old age, rather to the brain; in middle age, to both equally, II., 106. It is passive, and belongs equally to the inferior and superior regions, II., 107, 162. After birth it seems to undergo nearly the same changes in regard to the course of its blood-vessels, as the body throughout, and particularly the heart, *ibid.* In adults a large portion of its vessels is obliterated, and changed into quasi-tendinous fibres, like the ductus arteriosus and umbilical vessels, II., 108.

**EAR.** It is formed to correspond to the modulation of the air, 138; II., 250, 255, 269, 270. See *Animal Spirit, Undulation*.

**EFFECT.** See *Cause*. Nature, in her more perfect spheres, elicits many effects from one and the same thing, 273. The efficient cause is brought to light by a careful consideration of the effect, II., 34.

**EGG.** In the living point of the cicatrix there is a perpetual animation carried on in the purest substances, 283. The inappreciable quickness of this animation produces a semblance of rest, 284. The albumen is next actuated to animation by the living point, but not till the warmth of incubation prepares it, *ibid.* Thus the animation becomes plural or compound, *ibid.* This produces a universal circulation, 285. See *Circulation*. The primitive animation is life in the general, *ibid.* The animations of the living point produce vesicles around it, and zones around the vesicles, 289. These vesicles attract adequate fluids from the whole egg; and the living point institutes a circulation and general equation of such fluids, *ibid.* See *Fluid*. These fluids form passages, which themselves expand and contract in the general animation, *ibid.* Nothing is supplied but what is suitable and determined, *ibid.* All things take place under the governance of the first and highest vesicle, 290. The vesicles are obliterated, and the members of the chick formed and brought into play successively, *ibid.* See *Formative Substance*. All things contained in the egg are pure, while the materials contained in the womb are often contaminated by the animus and mind of the mother, 323.

**ELEMENT.** The first aura is identical with the first element of the world, II., 302.

**EMBRYO.** In the formation of the embryo all things are carried on most distinctly, 224, 233, 235, 290. Nature acts with prodigious distinctiveness in the first rudiment or living point, 225, 233, 290. The members are produced successively, there being no type of the body in the germ, *ibid.*, 290. Each viscus is formed successively, and not by the simple expansion of its germ, 226, 270. In the egg and womb all that can be contingently present, is already provided and prepared, 237, 288, 289. The embryo draws from the mother's store whatever it requires, 238, 288, 289. Vivid impressions made on the mind of the mother descend to the brains of the embryo through the vascular and fibrous passages, 240. The cause that operates to produce preternatural marks on the body of the embryo, is the same which marks on the substance of the body the forms of the successive viscera, *ibid.* See *Formative Substance*. The embryo passes through four distinct states: the first, when the initiaments of the brains and medullæ are delineated by the spirituous fluid, 248. This is the first of the ages of innocence; the period preceding which, is not proper to the embryo, but common to it and the parent, 249. In the second state or age the simple texture of the heart is provided by the purer blood, 249. The second age commences with the first appearance of the heart, 251. The third age is more particularly that of the purer blood, as the second was that of the spirituous fluid, *ibid.* The third age is that in which the lungs are produced by the red blood, 252. The first age of the lungs is the second of the heart, and the third of the brain and spinal marrow, *ibid.* The fourth age is ushered in when the lungs begin to breathe the external air, 253. Perfect unanimity between the brains and heart must reign everywhere in the new empire of the embryonic body, 259, 417. See *Animation, Brain, Heart*. The vessels of the body in conjunction with the brains are the only classes of citizens now in existence, and generate all the other members of the community, *ibid.* In this state the fibre cannot act against the blood, nor *vice versâ*, 260, 317, 417. In cases of drowning, suffocation, &c., the brain returns to something like its embryonic state, 267, 415. The primitive age is consecrated to perpetual ignorance and deep oblivion, 303, 417. See *Circulation*. The textures of all the viscera are primarily formed out of the fibres of the spirituous fluid, *ibid.*, 317. See *Liver, Meconium*. The brains of embryos emulge the mother's blood by a kind of suction, 329. See *Ductus Arteriosus, Foramen Ovale*. In the embryo the middle blood alone passes from the right ventricle to the lungs, 344, 345. See *Coronary Vessels, Proper Vessels of the Heart*. In embryonic life, the internal cause acts not in opposition to the external; nor does the external seduce the internal, 417. See *Muscle*. At this time the action of the blood of the inferior cava is subject to the action of that of the superior cava, 511.

**END.** The end provides the means, 42, 234, 235. No creature is aware by anticipation of coming ends until it is actually in them, 228. See *Use*. Everything is a mean to an ulterior use and end, *ibid.*, 234; II., 53, 355, 356. Primary, middle and ultimate ends are present to and in the formative substance simultaneously and instantly, 234. All things flow from an end, through ends, to an end, 276; II., 53, 247, 355, 356. There is a gradation of ends, II., 53, 355, 356. Ends always ascend when nature descends, II., 222. What is cause and effect in nature is end in a living subject, II., 225. See *Life, Nature*. The end continuously follows the progression of means, or the ordination of effects, II., 226, 356. We live only in so far as we regard ends beyond ourselves, *ibid.* Human life is great and



excellent in proportion to the intellect exerted in the regard of the more universal ends, *ibid.* There is an intelligent Being who governs nature suitably to ends, *ibid.*, 355, 356. See *God*. The order of nature exists for the sake of ends, II., 243, 355, 356. The more intelligently the mind seeks an end, the more does it so will and conclude, as that things may proceed of themselves, and their own accord, II., 310. See *Heaven, Love*. The universe is no other than a complex of means to a universal end, II., 356.

**EQUALITY.** See *Series*. Nature perishes in equality, II., 8. Society would be impossible in equality, II., 286.

**EQUATION.** See *Equilibrium, Fluid*.

**EQUILIBRIUM.** In the body there is a perpetual loss and restitution of equilibrium, and change of equation, 189. An equilibrium is required between the blood flowing into the heart from the head, and that flowing into it from the body, 511. See *Motion of the Heart, Vena Cava*.

**ESSENCE.** See *Substance*. All things are made into essences by Him who is essential being and wisdom, II., 356.

**ETHER.** See *Air, Aura, Blood, Eye, Oil, Salt, Serum*. The ether employs its powers and forces in holding together and animating the parts of the body adequate to its nature, II., 36. The higher ether likewise, *ibid.* The ether can exist without the air, II., 250.

**EXPERIENCE.** Nothing but experience can lead to a knowledge of causes, 4, 123. The speculative force of the mind, without experience, carries us into error, nay, into errors, and errors of errors, 4, 123. We must deduce principles from experience, not experience from assumed principles, 4. Particular experience, however ample, is never sufficient for exploring causes, 5, 103, 123, 449, 453, 457, 574; II., 133, 149, 150, 159. General experience, embracing all the sciences, will now suffice for that purpose, 5, 6, 188, 449, 574. Particular experience, concerning one object, can never exhibit thoroughly all its hidden qualities, 5, 103, 188, 449, 453, 457, 574; II., 138, 149, 150, 159. Only obscure notions come from particular experience, but which are developed and made distinct by general experience, 6, 449; II., 138. Any fact may form a part in different series of reasonings, 7. We must never assent to propositions unless general experience sanction them, 7. The faculty for discovering causes is rarely combined in the same individual with the faculty for gathering experience, 8. See *Plan*. A general and particular experience of all the things that reach any sensory, will indicate the essence of the leasts of the same degrees; as well as of the simpler correspondent leasts of the still higher degrees, II., 34, 159.

**EYE.** It is formed to correspond to the modification of the ether, 138; II., 250, 269, 270. The difference between the modes of the ear and eye is almost indefinite, II., 270.

**FACT:** see *Experience*.

**FACULTIES.** Various dangers beset those who do not measure their faculties by the standard of nature, 10, 11. They are enclosed in their own net, and enshrouded in darkness, 10. The sciences blind, and learning infatuates them, 10. They are ambitious to narrow the limits of knowledge, proclaim that nature is beyond human comprehension, claim all wisdom as an adjunct of memory, and imitate the character of others, but omit their own, 10, 11; II., 208. See *Cause*. We limit our faculties if we place ourselves in bondage to the judgment of others, II., 208.

**FAITH** without love is mere knowledge; in fact, is faith without life, or

dead faith, II., 326. Faith enters the mind *a priori*; perception, *a posteriori*, *ibid.*

FAT. In times of want the veins feed upon the fat, 166, 174. The fat at the base of the heart is produced by substances, such as free urinous salts, expelled from the blood through the muscular layers, 424.

FEAR causes the blood to run away from the arteries into the veins, 140, 161, 191, 192, 198, 337. See *Artery, Death, Proper Vessels of the Heart.*

FIBRE and vessel are perfectly conjoined, and most universal, in the body, 37, 115, 259; II., 196. See *Artery, Circulation, Cortical Substance, Nerve, Vessel.* A fibre is a vessel by eminence, 113, 451. The nervous fibres terminate entirely in the blood-vessels, and embracing them, constantly expire their proper life or fluid, 115, 116, 191, 451. The fibres do not decrease in size as they proceed, but accumulate into a fascicle, which however large, comprises only fibres of the first order, 120. A fibre is a unit of the first order; a fascicle is a unit of the second; and a nerve, of the third order, *ibid.* In the fibre the unit is determinate; in the fascicle and nerve, indeterminate, 120. The essential fibre carries a most pure fluid, *ibid.*, 457. In the interspaces between such fibres, a less spirituous fluid is conveyed, *ibid.*, 457. The fascicles carry a lymphatic fluid, *ibid.*, 457. In the first fibres the spirituous fluid is pure; in the second, mixed homogeneous; in the third, mixed heterogeneous, *ibid.* The action of the fibres does not depend on the action of a single great heart, but on the actions of an infinite number of little hearts, *viz.*, the cortical and cineritious spherules of the brains, 144, 182, 183, 260, 451, 463, 490. In the field of least blood-vessels, the nervous fibre dwells in its simplicity, perfection, universality and highest presence, 194, 489. See *Embryo.* The fibres of the spirituous fluid do all the business of the body, public and private, 317, 452. The fibre puts on the animus of the brain, and carries the affections and passions thereof into the modes of the circulation, 416, 452, 490; II., 196. Both artery and fibre resemble a continued heart, 451, 489. They correspond to each other in the way of degrees, 451, 489; II., 50. There is no living solid in the body but the fibre, 452, 487; II., 196. The fibre is a continued brain, 493, 497, 565; II., 196. Fibres of all kinds represent forces and powers, 499, 519, 522; II., 186. They are at once dilated and extended every time their fluids permeate them, II., 183. A certain most pure fluid glances through the subtlest fibres, remote from even the acutest sense, II., 211. The way of communication through the fibres must be opened, before we can feel, perceive, and understand, II., 275. Our faculties are perfected in so far as the mediate substances, constitutive of the fibres, are adapted, *ibid.* What happens without the body, does not immediately touch the fluids, but the tunics, II., 280. The little tunic of the first fibre consists of the very material of the spirituous fluid, reduced to a compact form, and thereby to continuity, II., 280, 281. See *Memory.*

FINITE. Nothing terminates in the finite universe, but all things in the first *Esse* of created things, II., 20. Whatever is natural is finite; only the end beyond nature is not finite, II., 226.

FIRE, glowing and luminous, arises from the resolution of the particles of the auras, and their passing into natural gyration, 58, 282; II., 6. See *Flame, Series.*

FLAME is a smoke or soot consisting of numerous molecular burning coals, 58.

FLUID. All parts of the system are fluid before they are solid, 47, 133, 273. The law by which parts solidify, is founded on the law of their action as fluids, *ibid.*,

133, 278. The fluxion of the fluids of the body corresponds to the extension of the solids, 61, 278. The fluids of the animal world are living, 131. The fluids are the causes of the existence and subsistence of the solids, 133. There is a certain equation of quantity and quality in the fluids, pervading the system, and to which nature aspires with all her might, 189, 285, 322, 323, 328, 329, 397, 542. See *Animation, Egg*. The derivative fluids live only in so far as they rightly and determinately contain the spirituous fluid, 487 ; II., 211, 212. See *Animal Spirit, Forces*. The fluids in the fibres are modifiable like the auras, and distinct from each other in the general sensorium, II., 191, 215. The spirituous fluid is the cause of the fluidity of the blood, II., 212. The highest fluids are not visible except by their effects, II., 215.

FONTANELLE. Its pulsation, synchronous with that of the heart, is the pulsation of the arteries of the dura mater ; not of the longitudinal sinus, or the brain, 266.

FOOD. Human food contains three principles, viz., spirit or oil, salt and earth, and water or phlegm, 42. There is a greater store of imperceptible or insensible, than of perceptible aliments, 45. See *Aura, Lungs, Skin, Vessels*. The purest food is conveyed into the least vessels ; the less pure and grosser into the larger and largest, 163. See *Hunger*.

FORAMEN OVALE : see *Circulation, Heart*. It is necessarily closed after birth, when the influx from the venæ cavæ is no longer successive but simultaneous, 330. A variety of causes may keep open the foramen ovale for some time after birth, 334. Whatever tends to disturb or destroy the equation existing between the blood-stream in the right and left auricles, prevents the closure of the foramen ovale, *ibid.* It may be forced open in adult life by various circumstances, as palpitation, terror, suspended animation, &c., &c., 335. In some cases it may be open from the left auricle towards the right, 336. Under such circumstances the coronary vessels afford an outlet, 337. When it is open from the left auricle to the right, it is a sign of the greatest robustness in the heart, arteries and muscles, *ibid.* See *Circulation of the Heart, Coronary Vessels, Proper Vessels of the Heart*. The coronary vessels shew why it is closed after birth, 414. The brains and heart of the embryo being in perfect unanimity, the foramen ovale lies open, and receives the entire stream of blood ascending from the body through the cava, and which the left ventricle transfers to the brains, and the brains back to the body ; and so on, 417.

FORCES may be compared to fluids, since the fluids represent the forces of active nature ; therefore forces may be said to flow, and influx may be predicated of them, II., 29, 215. Active or living force is the analogon or eminent corresponding to gravity, II., 38. There are as many series and degrees of forces as of substances, II., 215. Force without mutation is a nonentity, *ibid.*

FORM : see *Matter, Substance*. In the lowest degree, form means the structure of a thing, internal or external ; in a higher degree it means image of the animus ; in a higher still, idea ; in a higher still, the universe, as the form of forms, II., 231, 232. When the purest animal fluid is termed the form of forms, we are to conceive of it as a representation of the universe, II., 232. Nothing in the universe is *anything* except by its form ; that is, there is nothing but is a series, and in a series, II., 267. Things apart from form are apart from order, *ibid.*

FORMATIVE SUBSTANCE OR FORCE. There is a formative substance or force, that draws the thread from the first point of life, and continues it to the last, 230, 290 ; II., 212. This substance or force is not without, but within the body, *ibid.* ; II., 253. In the subject formed, formation and reformation still persist, *ibid.* ; II.,

212. See *Monster*. The formative force is identical with the principle that repairs the body when dilapidated, 231; II., 212. From the deficiency of language, hardly anything adequate can be said of the formative substance, 232, 235. See *Terms*. It is the first, most perfect, universal and simple of the substances and forces of its kingdom, 233, 235; II., 211, 212. Within this kingdom it enjoys a kind of omnipresence, power, knowledge, and providence, *ibid.* It goes from end to end, through the mysteries of this world's arts and sciences, *ibid.*, 285. It is the demi-goddess, tutelar deity, and genius of the microcosm, 234. Its power is so far limited, that it has nothing but what it receives from the Author of nature, and is almost entirely confined to the microcosm, *ibid.* It is perfect in proportion as it is dependent upon Him, *ibid.* See *End, Soul*. It represents to itself the state about to be formed, as already formed; and the state already formed, as about to be formed, 236, 253, 270, 351. It is higher than the mind, involving the principle of reason, the force of forces, and the substance of substances, *ibid.*, 283. The series of all the contingents, as they appear, so as to perfect the work of formation, is instantly present to and in it, 237, 284. See *Contingent*. Causes pass into effects according to the nature and state, and to the intuition and representation, of the formative substance, 239, 241, 290. Every animal has its own proper formative substance, *ibid.*, 241. See *Embryo*. The formative substance itself, and not any condition of the organism, is the prime cause of the internal faculties, 241. It causes animals to be ignorantly impelled to ends by an instinct analogous to reason, 242, 243. It cannot descend into the body immediately, but descends by three or four degrees, *ibid.* It is identical with the soul, 245. The spinal marrow represents the first and golden age of the formative force, 250. All the miracles predicated of the formative substance are really due to the Divine Providence, 277. See *Cause*.

FREE CHOICE: see *Liberty*.

GANGLIA. They promote the circulation of the nervous liquid and spirituous fluid, 456, 457. They serve as places to unfold and relax the tunics of the nerves and nervous fibres before they proceed to the most active muscles, as those of the heart, trachea, tongue, &c., *ibid.* They are manifestly muscular, *ibid.* See *Muscle*. They extinguish reflex motions in the nerves, and prevent them from disturbing the brains, 457. They reduce the various and subordinate natural motions to the one universal motion of the brains, 458. They combine in one centre the nerves contributing to any common or particular action, *ibid.*

GAPING is one means of rousing the sleepy or lazy brain, 263.

GENERAL, the, must exist before the particular can live; and the particular must exist that the general may live, and live distinctly, 132, 282, 286; II., 279. Indurated and ossified parts perform a general cause in the place where when their fibres were distinct they performed every particular cause, 487, 523. See *Motive Fibre*. *Tendon*. Particulars constitute the general, 528. The general embraces or contains, successively or simultaneously, the whole series with its degrees, II., 198. The red blood is the general or common fluid of the body; the artery and vein, the common vessels; and the carneo-motive fibres are the common muscular fibres, *ibid.* In a series of three degrees, the general is what involves them all; in a series of two degrees, the inferior universal is also the general; in a simple series, the general coincides with the universal, II., 199. See *Particular, Universal*. The general state may be reformed by singulars, but not *vice versâ*, II., 308. See *Influx*.

GENESIS OF FACULTIES. The operation of the spirituous fluid is the soul, II., 289. See *Soul*. The operation of the soul in the organic cortical substance, is the

mind, II., 290. The affection of the entire brain, or common sensorium, is the animus, II., 293. The faculty of feeling is in the sensory organs, and the faculty of acting, is in the motory organs of the body, *ibid.*

GENIUS. Human genius is perfect, in proportion as it can skilfully dispose in order those things that are to be determined into action, so that there may be a series of effects flowing from their genuine causes, II., 8.

GLANDS. The glands, being formed by the vessels (see *Vessel*), are of a three-fold order; namely, compound, simple, and more simple; or glands, vesicles, and pores, 124; II., 189. The brain is the effigy of all the glands, and exhibits all their wonders, 126, 339; II., 187—190. The cerebellum is homogeneous to the second degree of glands, or to the cortical tori of the brain, 127. A gland is a body that secretes essences from the blood; mingles or separates them when secreted; and transmits or sends them out for use when thus mingled or separated; or else excretes them outwards, II., 188.

GOD is essential life and wisdom, II., 228. See *Influx*. Whatever is in God is infinite and unbounded, II., 237, 238. Whatever is in God, and whatever law God acts by, is God, II., 239. He wills that we should understand his attributes by comparison, and through nature, *ibid.*; II., 240. As the sun is the fountain of light and the distinctions thereof in its universe, so God is the sun of life and of all wisdom, II., 240. The presence of the one may be cautiously compared with the omnipresence of the other, *ibid.* God is not the soul of the universe, *ibid.* See *Soul*. As the sun of the world flows in one only manner, and without union, into the subjects and objects of its universe, so also does the sun of life and of wisdom, II., 241. God is himself the first and last end of creation, *ibid.* As the sun of the world flows in by mediating auras, so the sun of life and of wisdom flows in by the mediation of his spirit, II., 244. As the sun of the world flows into subjects and objects according to the modified character of each, so also does the sun of life and of wisdom, *ibid.* See *Wisdom*. God is a necessary being, II., 285. God is his own attribute, II., 344.

GOVERNMENTS exist, simply to direct our free choice, and bend it to the public and private weal, II., 327.

HARMONIC VARIETY. By harmonic variety we mean all those differences collectively that can possibly exist between individuals of the same genus and species, in accidents and modes, while the general form and nature, or the essence and its attributes, continue the same, II., 17, 304. The most perfect harmonic variety exists in the auras, but which is imperceptible to the human understanding, *ibid.* Harmony alone seems predicable of the first substance of the world, but not harmonic variety, II., 18. The fluids of the microcosm, like those of the macrocosm, possess the most perfect harmonic variety, II., 19. The cortical spherules exhibit the most perfect harmonic variety, II., 192. Also the spirituous fluid; and thereby the soul knows all that happens without and within the body, and that comes in contact therewith, II., 309.

HARMONY. See *Substance*. The connexion of all the parts of series, by their determinant and subdeterminant substances, produces coestablished harmony, II., 15, 48, 51, 283. This harmony is perfect in proportion as the simple substances are distinctly discriminated from the compound, *ibid.* And substances of the same degree from their fellows, their essence and attributes remaining the same, II., 16, 283. See *Harmonic Variety*. Such is the coestablished harmony of all substances and adjuncts in the same series, that they mutually correspond to each other, with

only a difference of perfection according to degrees, II., 30. There is no such thing as præestablished harmony, II., 51. Disharmonies in nature are discussed by perpetual harmonies, II., 305.

HEART. Were the blood poured by the veins into the heart with the same violence as by the heart into the arteries, the heart would be subject to all the changes of the arteries, 161. See *Artery, Blood, Circulation, Vein, Vessel*. In the right side of the heart there is a commixtion and fusion of all the aliments received into the blood, 163, 421, 543. See *Leasts*. The corculum of the chick is traversed by the purer blood before the red blood passes through it, 251, 303. See *Animation*. It takes its origin by the side of the spinal marrow, in order that it may be under the influence of its motion and that of the brain, 259, 306. Its influence after birth does not extend to the arteries of the brain or spinal marrow, 264. The primitive corculum, in its character and action, resembles both the veins and arteries, 269, 418. Its intermediary receptacle, consisting of three oval vesicles, is the result of vessels of dissimilar character and mode meeting together, 270. Its fabric reveals the state that awaits the adult heart and arteries, 270, 307. The pulse is triple in the primitive heart, double in the adult heart, 272. What is successive alternate in the heart, is successive continuous in the arteries, *ibid.* The three cardiac vesicles of the primitive heart, and particularly the middle vesicle, are in the exactest state of equilibrium, 274, 307, 418. The red blood traverses the primitive corculum before the white blood, and the spirituous fluid, before either, 303; II., 158. It acts at first as a triple vesicle, not as a cone, 304. It merely receives the blood as it comes, and throws it out again, 306. The heart is designed to minister in a subservient way in the formation of the body, *ibid.*, 307; II., 67. See *Brain, Embryo, Motion*. The muscular series in the heart are not only proper to each ventricle, but also common to both, 311. See *Carotid Artery, Ductus Arteriosus, Foramen Ovale, Vertebral Artery*. The heart endeavors to equilibrate the blood contained in its various cavities, 336. See *Coronary Vessels, Heart of the Turtle*. Nothing demands more present abundance and supplies of blood, which is its own property, than the heart, 385, 397, 423. The fleshy ducts of the heart are its minute and proper arteries, of which the lacunæ are the minute and proper ventricles, 391, 423. The heart sends its first blood into the lacunæ, before a drop goes to the aorta or pulmonary artery; for the life of all parts depends on that of the heart, which is the first organ to live, and the last to die, 397, 423, 449. It is the mover of its own proper blood; and acts upon its own proper vessels immediately, and not mediately or reflexly through the aorta, 398. The cardiac nerves that supply the muscular fibre are distinct both in origin and progress from those that beset the coronary vessels, 403, 484. By this means the systole of the heart and coronaries is enabled to be alternate, and not synchronous, 403, 484. Many anomalies and varieties occur in the auricles, and particularly in the right auricle, 404. To meet these, a number of orifices are provided for the coronary or auricular blood, *ibid.* The right auricle can beat two or three times without the ventricles, *ibid.* There is a universal variety in hearts, and especially in human hearts, *ibid.* The motion of the right auricle begins from the vena cava, 406. See *Proper Vessels of the Heart*. No member sustains more severe shocks than the heart; viz., from all the venous blood on one side, and from all the arterial on the other, *ibid.* It is placed between two forces, active and reactive, *ibid.*, 418. There is a representation in the heart of the state both of the body and animus, and the general pressure and circulation are regulated according to this state, 418, 419, 420, 421. Numerous

passions and affections may properly be attributed to the heart, according to the usage of common discourse, 420. The heart is the first organ that operates to compound the blood, 421. Or is a vessel preparing and disposing liquids for composition into blood, 422. See *Motion*. All the cavities of the heart, great and small, lie in the stream of its motion, 424. Its vessels exert a physical attraction on the blood, 425. See *Cause*. It is in all respects a muscle, 486; II., 186. See *Motion of the Heart, Pericardium*. Its pulsation does not extend to the brains, II., 99. Before the existence of the red blood, the little heart of the body is an oval spherule or vesicle, almost like the cortical spherules of the brain, II., 157.

HEART OF THE TURTLE. It has three ventricles, in order that the turtle may live either under water, or in the air, 355. In the air, and while the lungs are open, the three ventricles and two auricles are all in play; each auricle simultaneously with the intermediate ventricle, and the right and left ventricles simultaneously with each other, 356. The anterior large artery issuing from the right ventricle is analogous to the ductus arteriosus of the embryonic heart, *ibid.* The posterior orifice between the right and left ventricles is analogous to the foramen ovale, 357. This quasi foramen ovale and ductus arteriosus appear to be closed when the turtle is under water, which is its proper element, *ibid.* If it lived constantly under water, the left and middle ventricles would combine, as in fishes, 358. If it lived constantly in the air, the ductus arteriosus would be closed, and the foramen ovale would be permeable from the left ventricle to the right, but not *vice versâ*, 359. This mechanism of the heart shews that the turtle enjoys the active and full life of its senses and muscles when it is under water, 360. Likewise that it is stimulated by a natural instinct to inhale the air with open nostrils, and frequently to plunge into the water, *ibid.* And that, after decapitation, it may drag on a merely corporeal existence for a considerable period, *ibid.*

HEAT. See *Blood*. Heat in the body is the tremulation and gyration of the active parts or of the spirituous fluid, 56, 136. It proceeds from the contremiscence of the salino-volatile particles of the first and second degrees, *ibid.*, 136. Whatever makes these particles, and the auras and spirituous fluid, to undergo such contremiscence, is a cause of heat, *ibid.*, 136. Corresponding to the three degrees of salts, there are three degrees of heat in the blood, 57. The activity of the animal spirits is not like sensible heat, but is the life or origin of heat, *ibid.* The seeds of heat lie in the activity of life, 58. See *Color, Fire, Salt*.

HEAVEN. In the universal society of souls there must be a moral difference between the members, arising from their respective reception of life, II., 327. There is a society of souls in the heavens, and the city of God upon earth is the seminary of this society, in which, and by which, the end of ends is regarded, II., 355—357. In this society the end of creation is regarded by God, and by it God is regarded as the end of ends, II., 356. See *City of God*.

HIGHER, the, can exist and subsist without the lower, but not *vice versâ*, 51. A higher power is required to judge of a lower, II., 30, 246.

HOLY SCRIPTURE. Its rules are not so dark or obscure as the philosophy of the mind, and the love of self and of the world would make them, II., 357. They may be drawn out pure enough for the use of the members of the church universal, without violating any form of ecclesiastical government, *ibid.*

HONOR. The essentials of the honorable (*honestum*) are the various virtues, II., 319. It cannot extend beyond the principles impressed upon the mind by way of the senses, II., 320. The seeds of it are derived either from parents, or out of



true principles breathed upon by the spirit of life and wisdom, II., 320. See *Decorum*.

HUNGER and thirst are affections of the blood, expressive of its general want, 174. Aversion and appetite in brutes often have respect to the quality of food and drink; but in the human subject almost always to quantity alone, 175.

HYPOTHESIS. See *Truth*.

IDEAS, whether material or immaterial, are real essences, just as the modifications of the auras, II., 270. See *Ascent and Descent of Forms*. Intellectual or rational ideas coincide with the modes of the second aura, II., 271. The materialist and idealist may both understand their ideas thus, *ibid.* No modification or idea can extend beyond the continuity of substances, or of their fluxion, II., 273. There are no innate ideas in the mind, but all ideas are connate in the soul, II., 275—277, 286, 287, 318, 354.

IMAGINATION: see *Animus, Correspondences, Form*. The more deeply we can penetrate into the truths of the sciences, the less shall we trust the imagination, 9. Animals possess imagination, but not thought, II., 261, 339. Imagination survives the external senses, II., 263. It is a kind of general thought, and cupidity a general will; all such affection being purely animal, II., 293, 339.

IMMORTALITY. The human spirituous fluid is safe from harm by aught that befalls in the sublunary region, II., 342. It is immortal; yet not immortal *per se*, but through God, II., 342, 343. See *Higher, Prior*. We can no more doubt its conservation, than we can doubt the omnipresence, omnipotence, omniscience, and universal providence of God, II., 344. Many reasons lead us to think, that this fluid cannot be absolutely released from its earthly bonds, except by the searching action of an extremely pure fire, II., 345. When emancipated from the body, it will still assume the complete form of the body, II., 345, 346. See *Animal Spirit, Body, Soul*. It is then no longer the body, but the soul under the form of the body, II., 346. It can never again enter into the flesh by nutrition; for the passages for such nutrition are abandoned; nor by an ovum, for its volume is great, and can never again begin *e minimo*, II., 346, 347. The coherence of the soul or spirituous fluid is even naturally possible by the mediation of the aura of the universe; and much more is it possible supernaturally by the thorough and intimate action of the Spirit of Life, II., 347—349. The soul will live a life pure beyond imagination, II., 351. Myriads of its moments and degrees will equal but one of ours, and yet myriads of ours will not appear to it as one appears to us, II., 351. See *Memory*. Every deed done designedly in the life of the body, and every word uttered by consent of the will, after death will appear in the bright light of an inherent wisdom, before the tribunal of the conscience, II., 351—355. The soul will call itself to account, and will pronounce its own sentence, II., 355. See *Conscience, Heaven*.

INFINITE. Those who attempt to explore the Divine and Infinite by mental philosophy, suffer for their temerity; their rational eye being afterwards beset by a speck or shadow, which makes them blind in broad daylight, 277. See *Revelation*.

INFLUX: see *Forces*. It is useless to attempt to deduce *a priori* how the soul flows into the mind, and the mind into the body, II., 39. There is no such thing as occasionality of causes, or physical influx, II., 51. The divine life and intelligence flow with vivifying virtue into no substances but those that are accommodated at once to the beginning of motion, and to the reception of life, II., 229. Hence its influx into the most simple, universal, and perfect substances of the animal body; viz., into the spirituous fluid, II., 230. And so into the less simple, universal, and

perfect substances ; all of which manifest the force, and lead the life, of their first substance, II., 231. See *Animal Spirit*. The manner in which the Divine Life and Wisdom flow in, is infinitely above human comprehension, II., 237. It may be compared with the influx of solar light, II., 240. See *Comparison, God*. We cannot judge of the influx of sensations but from the connexion of organic substances, II., 262, 287—289. The intercourse between the soul and the body is as between the last organic forms produced by the blood, and the first produced by the spirituous fluid, II., 288. This intercourse is nothing more than the translation of common modes into singular modes in the soul, and the translation of the singular forces of the soul into common forces, *ibid*. The nexus of substances must teach the particulars of influx, II., 289. A diligent and rational anatomy, combined with psychological experience, will shew the nature of the intercourse between the soul and the body ; and prove that the soul can communicate with the body, but through mediating organs, according to their state, natural and acquired, II., 294—297. Sensations, as such, do not constitute the intercourse between the soul and the body, but remain sensations even in the cortical substance, II., 295. A form and distinctness require to be induced upon them, as senses in, or additional to, sense, II., 295, 296. The fibres are affected generally first, singularly afterwards, II., 352.

INSECTS are as various as the soils that produce, the leaves that nourish, and the sun-beams that vivify them, 239.

INSTINCT. Natural instincts are all those operations that do not come to mental consciousness ; such as the economic and chemical operations of the body, the action of the heart and arteries, &c., &c., 243. See *Brutes, Cerebellum*. Animal instincts exactly counterfeit reason, 244. The outlines of the body in the egg and womb are traced by an instinct similar to that of animals, *ibid*.

INTERCOSTAL MUSCLES. They have no antagonists, 265, 332, 349 ; II., 81. See *Lungs*. They are proper inspiratory muscles, 349.

INTERCOSTAL NERVE. It is the vicegerent of the cerebellum in the body, 265, 350, 465, 546. See *Lungs*. It and the par vagum govern the heart, 458 ; II., 109. It has the universal charge of the body, transfusing and dispensing the spirituous fluid and nervous juice everywhere, 461, 537. See *Cerebral Nerves*. It can never fail of its fluid, since it has a fresh origin at every point of the spinal marrow, and is in the stream of the motion of the brains and both medullæ, 463 ; II., 78, 79. Wherever any natural motion is going on, it associates with the par vagum to form retiform plexuses, 465. It arises from the medulla cerebelli, though no anatomist can give ocular demonstration of this fact, but it is shewn by examining the ultimate effects of the nerve, and comparing them with the known offices of the brains, *ibid*. See *Par Vagum*. It and the par vagum cause all the special and particular motions of the body to terminate in the universal motion of the brain, and the common motion of the lungs, II., 109. Both these nerves are influenced to expand and contract by the expansion and contraction of the lungs, II., 183, 184.

JUGULAR VEINS. The right jugular vein, like the right lateral sinus, pours its blood before the left into the right auricle of the heart, 541. The fluxion of these veins is synchronous with the respirations of the lungs, II., 80.

LAUGHTER is a means of exciting the brain through the lungs, 263, 343. And of promoting the descent of the spirituous fluid from the brains into the blood, 343. It may exist without gladness, II., 52. It can only exist in man ; and arises most freely in the empty-minded and the selfish, II., 53.

LEASTS. In the purest and least things animal nature exists in its totality, and

observes no laws but those of the universe, 122, 194, 282. By its pure and least principles it has relation to everything, *ibid.*, 194. See *Circulation, Compound*. The blood flows with accelerated velocity through the least vessels, 141, 142, 143. The tunic of the least arteries is most perfectly adapted to the blood-globule, and presses upon it at a thousand points; whereas in the large vessels it is not so much as touched, 143. The least vessels occupy one extremity of the sanguineous system; the heart, the other, 193, 419. In the field of least vessels nature especially exerts her powers and celebrates her games, 194, 419. The heart is surrounded with a field of least vessels, 194, 419, 422. The field of least vessels is more immediately under the control of the brains than the larger vessels, *ibid.*, 419, 488. See *Fibre*. Nature has placed her veriest laboratories in the field of least vessels, and transferred thither the animus of the brains, 195, 419, 422. In the universe we may see the character of its least substances, 182. The nervous fibre acts upon the least vessels first, 489. Nature is the same in the least sphere as in the greater and the greatest, II., 87. In the field of leasts it is dangerous to proceed to the particulars of universals, until all the effects in the animal economy have been distinctly traced to their causes, II., 159.

**LIBERTY.** There is liberty of acting, relatively to lower things; liberty of suffering oneself to be acted upon, relatively to higher things; and liberty of disposing oneself, by virtue of the two former conditions, II., 23. Every rational mind pants for its own golden liberty, II., 208. The essential part of liberty consists in being able to choose the good, and to omit the evil, II., 311. Liberty is the companion and spouse of the human understanding, *ibid.*, II., 326. All possible means are provided to ensure the perfection of both, II., 311—313. The free power of doing, or leaving undone, is granted to human minds as a means to the ultimate end of creation, or the glory of God, II., 326. Liberty is the essence of human delight, *ibid.* By mere liberty we are distinguished from the brutes, and by our use of liberty, from our fellow-mortals, *ibid.* The moral distinction of souls, and the natural distinction of bodies, arise entirely from the gift of free choice, II., 327.

**LIFE.** The fluids of the animal world are living, 131. See *Animation, Egg, Fluid*. Determinate and distinct animation constitutes life, 285. Sensitive life, when raised to higher powers, constitutes the highest life, *ibid.* See *Artery, Science*. By the coöperation of the motions of the brains and lungs we are enabled to live distinctly, II., 108. Nature's life consists in the continuity of her parts, and the perpetual circulation of her fluids, II., 137. The circulation of the spirituous fluid is the circle of life, II., 182. The most eminent aura does not live, but is the instrument that enables us, while we live, to be modified and move distinctly, II., 195. Life is one thing, and nature another, II., 224. What is light and distinction of light in nature, is life and intellect of life in living subjects, II., 225. Nature is the instrumental cause of which life is the principal cause, II., 225. See *Animal Spirit, Aura*. Life regards ends, but nature promotes ends by effects, II., 226. God is essential life, II., 228. Life must not be in an organic substance to enable it to live and understand, but must come as an accident from without, II., 245. Life is the universal essence of singulars, and is perfect in proportion as it is singular, II., 277.

**LIGHT.** The general modification recognized by the eye as illumination, probably arises from the animations of the solar ocean, 130. See *Ether, Eye*. Light is not an efflux of material atoms, II., 244.

**LIVER.** It is a laboratory for the purification of the blood, 317. Before birth,

the blood about to go to the brains is first transmitted to the liver, *ibid.* In adults, the hard, old and obsolete blood and serum are sent to the liver, *ibid.* See *Bile, Digestion, Embryo.* The maternal blood, when diseased, is purified in the embryonic liver, 319. See *Meconium.*

LOVE. The love of self should stand far below; and above it, the love of country; and above this, the love of God, II., 268. The love of an end is a kindling heat to intellectual light, II., 310. See *Faith.* Love in animate beings corresponds to likeness and harmonic agreement in inanimate things, II., 349. Parental love arises from the fact that the soul of the offspring is derived from that of the parent, *ibid.* The nature of love is to be investigated by the mathematical doctrine of universals, *ibid.*

LUNGS. The little veins of the lungs suck in atmospheric salts that agree with them, 42. See *Air.* The lungs are a stomach consisting of an infinity of lesser stomachs, and feeding on aerial food, 44, 163. See *Animation, Blood, Embryo.* They live by expansion, but expire and die by constriction, 262. See *Brain, Laughter, Motion.* All the blood that passed through the brains before birth, passes through the lungs after birth, 331. When they are expanded, the pulmonary arteries are expanded, but when the brain is expanded its arteries are constricted, *ibid.* They contract by their own effort, but are expanded by the influent air, 332. The purer blood permeates them through the pulmonary artery prior to the red blood, 346. See *Circulation.* Their action is equally universal with that of the brains, and any part devoid of it, is soon dissociated from other parts, 348, 350; II., 66. See *Respiration.* Where they do not act upon a part palpably, still they are in the effort so to do, 348, 350; II., 66. By their expansion and constriction they act on the two general nerves of the body, viz., the intercostal and par vagum, 350, 537; II., 183. The aerial elements, in the new chyle particularly, are ejected from the blood in the lungs, 421. Their motion is mixed, or both spontaneous and voluntary, 471; II., 65. They keep the præcordia in the universal motion, 535, 537. The relationship and conjunction between them and the heart is intimate, *ibid.* The heart is held and embraced by their two arms, namely, the pulmonary artery and veins, 536. The muscular fibre of the right ventricle traverses them to the left ventricle, *ibid.* They are not the proximate cause of the motion of the heart, 535—537. They are in the universal motion of the brains, 537. They concur wonderfully in promoting the circulation of the nervous juice through the nerves, II., 183.

MAN did not begin to exist till nature's kingdoms were completed, in order that the entire universe might be exhibited in him, 3; II., 7. He subsists as a compound of all the elements of the world, 45, 199; II., 7. See *Brutes, Microcosm.* He has the power to ward off the blood from the cortical substances of the brain; lest the body should invade the rational sphere, 182, 242; II., 68, 197, 285, 292. Nothing in the world is more perfect than he, and yet nothing is more imperfect if he abuses his faculties, 199. All nature is developed in him, *ibid.*, II., 7. In man those things especially are multiplied, that are more perfect, and belong to causes or principles, *ibid.*, II., 285. External motives and incitements should produce no act in man without receiving a specific determination from reason, 200; II., 285. His growth and instruction occupy lengthened periods, while other animals attain their perfection quickly, and are born with adequate knowledge, 276; II., 285, 337. There is an internal man that fights with the external, II., 264.

MATERIALISM: see *Ideas.*

MATHEMATICAL PHILOSOPHY OF UNIVERSALS: see *Soul, Terms.* It is the

philosophy of the soul itself, II., 55, 204, 218, 307, 349. If rightly digested, it will be the one science of the natural sciences, because the complex of all, *ibid.* ; II., 204, 205. By its mute terms and technic signs, it will prove infinitely more loquacious than rational philosophy, with its ideal prattling and indeterminate forms, II., 199, 204. It will not only signify high ideas by letters proceeding in a simple order, but will reduce them to a philosophical calculus, not unlike the analysis of infinities, II., 203. The doctrine of the order, series, and degrees of the world and nature, is the only path to this science, II., 205. We cannot anticipate the use of it by bare thought, but by application to examples, *ibid.* It is of no use without experience and the phenomena of the senses, II., 206, 217, 307. The author has as yet hardly advanced beyond its first principles, II., 217, 348. See *Love*.

**MATTER**, joined to form, constitutes substance, II., 28. Matter cannot think, II., 223.

**MEANS**. All things in the finite universe are but means, for the first Being is both the beginning and the end, II., 20.

**MECONIUM**. It comes from the liver and the gall-bladder, 319.

**MEDICINE**. Nearly all medicines aim to restore the proper state of the blood, 48. As the blood is the fountain of life, so it is the fountain of those sciences that have the perpetuation of life for their object, *ibid.* The empiric art, II., 196.

**MEMBER**. Each member of the body has its own specific sciences of angiology, adenology, myology and neurology, 106.

**MEMORY**. The memory of things is not impressed on the spirituous fluid, but on the fibres of the fluid, II., 282, 283. It is an adaptation of the fibres *a posteriori*, II., 282, 283, 352. The memory is in itself most happy, and never loses any object once impressed, II., 352, 353. See *Immortality*.

**MICROCOSM**, the, and the macrocosm appear to be ordained and to exist for each other, 131 ; II., 270. See *Formation*. Man is the microcosm of the macrocosm, II., 7. The microcosm teaches the nature of the macrocosm, and *vice versâ*, II., 270.

**MIND**. Nothing induces more darkness on the mind, than the interference of its providence in things that belong to the Divine Providence, 11. The muses love a tranquil mind, 12. See *Causes, Correspondences*. The mind should begin where artificial sight terminates, II., 135, 142, 154, 200, 313. We must divide the blood into its parts by thought, since we cannot divide it by sight, II., 213. The mind partakes both of life and nature ; hence it can hardly see either of them separately, II., 224. If we seek for the mind out of the body, thought will lose itself in some non-permanent accident, II., 234. The infinitely small is as little comprehensible to it as the infinitely great, II., 237. It cannot understand anything that is not attached to somewhat natural, *ibid.* See *Organ*. The soul enters by influx into the mind, II., 258, 259. The office of the mind is, to understand, think, and will, II., 260. See *Animus*. The animus is distinct from the mind, and the mind from the soul, II., 264. The mind is a centre, to which there is an ascent from the lowest sphere, and a descent from the highest, II., 268, 279, 313. Before the mind can be illuminated by the soul, it must be imbued with principles *a posteriori*, or through the organs of the senses, by the mediation of the animus, II., 279. The intellectual mind arises from the meeting between the soul and the senses, *ibid.* As the mind is instructed, and the way opened, so it communicates with the soul, which has determined and provided that the way leading to it shall be opened in this order, II., 284. There are no innate ideas, or imprinted laws, in

the human mind, II., 286. See *Genesis of Faculties*. There are as many portions of mind as there are cortical and cineritious substances in the brains, II., 291, 293. In proportion as the purer blood flowing through the cortical substances abounds in ethereo-volatile particles, or is unclean and gravitating, in the same proportion this substance, and the mind, partake of the body, II., 291. The mind has the power to elect whatever it desires in a thought directed to an end; hence to determine the body to act; whether according to the animus, or the contrary, II., 309. But in those matters only in which it has been instructed, and in which it views the useful, the honourable, or the decorous, as an end, II., 318. In higher and divine things the mind can will the means, but in respect to the end, it must permit itself to be acted upon by the soul, and the soul, by the Spirit of God, II., 322—326.

MODE : see *Substance*.

MODERNS : see *Times*.

MODESTY is the characteristic of those that love and discover the truth, 10.

MODIFICATION : see *Motion, Undulation*. The undulation of the ether constitutes modification, 130, 133. See *Eye, Ideas, Light, Mutation*. The perfection of modification increases with the perfection of substances, II., 274.

MODULATION. The motion of the air constitutes modulation, 130; II., 269.

MONSTER. The formative force is present in monsters, disposing anew the order of things, and suggesting the manner of using them, 231, 237, 573.

MOTION. Everything in nature is formed in motion, according to motion, and for motion, 129, 133, 137, 278, 519. There are three species of motion in the world; local or translatory, undulatory or modificatory, and axillary or central, 130, 137, 278. See *Brain, Conatus, Modification, Modulation, Mutation, Undulation*. Motion is perpetual conatus, 135, 278; II., 310. In regard to motion, a part may be simultaneously in any circumference, or radius, in any point of either, and in any number of centres, 136. There are three general sources of motion in the body, viz., the brains, the heart, and the lungs, 254, 267. Authors appear to concede motion to all organs excepting the brains, 255. The brains and lungs are a more general cause of motion than the heart, 267; II., 108. A mass or volume of one and the same body may undergo a general, a less general, a particular, and an individual motion, all at once, and without the one motion interfering with the other, 268; II., 107. To local, undulatory, and axillary motion, must be added animatory, or alternately contracting and expanding motion, 278. Unless these motions are understood, we cannot know what nature is and means, *ibid.* See *Animation, Axillary Motion*. When corpuscles of different kinds, and separate from each other, are impelled by the same force, the elastic travel the fastest, while the heavy and inert travel only with a velocity equal to the difference between the force impressed, and the force lost by resistance: and this rule is applicable to the multifarious corpuscles or substances mingled in the venous blood of the heart, 422. See *Muscle*. There is not a law of animal motion but may be found, when the causes and effects are given, and the means duly investigated, 500. See *Motion of the Heart*. Where alternate motions are to be produced, a single constantly acting force is often employed for the purpose, 505, 563. The fluxion of the fibres determines the extension of motions, 519. Two or more motions may exist simultaneously in one body or extense, II., 107. A knowledge of the motions that do, and do not concord in the animal system, is of vast importance to anatomy, medicine, and physiology, II., 108. The motions of the living body form an entire series, II., 109.

MOTION OF THE BRAIN: see *Animation, Aura, Brain, Cerebellum, Cerebrum, Cortical Substance, Lungs, Motion.*

MOTION OF THE HEART: see *Circulation of the Heart, Coronary Vessels, Heart, Proper Vessels of the Heart.* The origin of this motion cannot be understood from the particular experience respecting the heart alone: it requires a general anatomical knowledge, 449. The proximate cause of the diastole is the continued pressure and action of the blood of the venæ cavæ upon the right auricle; the proximate cause of the systole is the stretching of the nervous fibres: so that when the blood acts the fibre yields, and *vice versâ*, 503, 515, 517, 518, 526. The sanguineous system is dilated concurrently with the auricles, the ventricles alone being compressed, *ibid.* The manner in which the venous blood occasions these alternate motions, is purely mechanical; the nerves producing it by their alternate relaxation and constriction, 505. The blood that distends the auricle does not act beyond the nervous girths that surround its vestibule, or upon the vena cava, 506, 510, 516, 526. Nervous girths also surround the ventricles, running between them and the auricles, and the ventricles are not expanded beyond these cinctures, the law being the same with the ventricles as with the auricles, 507, 526. The proximate cause of the motion of the ventricles is the action of the blood and nerves in the auricles, *ibid.* The cause of the heart's motion is continuous, and describes a circle from the left ventricle, through the whole sanguineous system, to the right ventricle, *ibid.* Every point in the system contributes to the motion of the heart, 508. See *Vena Cava.* The right auricle can vibrate many times while the right ventricle vibrates once, 509, 510, 512. Without a different extension of the motion of the two venæ cavæ, that of the heart could not be continued, 511. The field of action proper to the auricle extends from the nervous belt surrounding its vestibule, to its extreme border in the ventricle; and hence the auricle can be moved separately and alternately, 516, 529. Its divided and conjoint action is testified by its partitions, 517. It receives a general excitation to motion from the superior cava; a particular excitation from the inferior cava, *ibid.* The attempt of the proper blood of the auricle to flow from the fleshy ducts into its motive fibres, and the passage of the blood of the superficial vessels through its coronary orifices, are concurrent causes of the diastole of the auricle, 517. The efficient cause of its systole is, that the nervous twigs on the surface are expanded with the surface itself, *ibid.* But this effect cannot exist until there is an abundant influx of the blood of the auricle into the right ventricle, or elsewhere, 518. The systole of the auricle is the cause of the diastole, and *vice versâ*; the balance of the motion is the surface, or the superficial vessels collectively; and the two venæ cavæ are the perpetually acting power, 519. The motion of the right ventricle is to that of the right auricle, as that of the right auricle is to that of the vena cava, 521. The same rules of motion apply to both, *ibid.* The auricles and ventricles expand and constrict according to the fluxion of their fibres, 519—526, 530. The alternate motion of the heart depends upon, and is determined by, the auricles, and the right auricle particularly, as its wheel and lever, 526, 531, 532. The right auricle extends its action as far as the left ventricle, which must be constricted at the same moment as the right, but cannot be expanded unless the left auricle aids it, 529—532. All parts of the heart are so connected, that whichever comes into motion, contributes to its reciprocation, 532. The parts and the whole are so balanced, that the least thing turns the hinge of the motion, and the resistance, which in the natural state is very slight, is easily overcome, 533. The lungs, and the brains and medullæ, are the remote efficient causes of the heart's motion,



534. See *Lungs*. The pulmonary vein is the proximate cause of the diastole of the left auricle, and the associate cause of the diastole of the vena cava, 535. The heart's motion is an inferior universal motion, 537. The venous blood sent down by the brain is the cause of this motion, considered as arising from the blood, 540. The brain determines its blood more especially towards the right auricle, for instance, towards the right jugular vein, not towards the left, 541. See *Jugular Veins*. The action of the cerebrum upon the voluntary muscles is a very remote cause of the heart's motion, 544. The cerebrum is a more remote cause of it than the cerebellum, 545. It may be continued for a time without the assistance of any of its remote efficient causes, 565.

**MOTIVE FIBRE** : see *Muscle*. Everything in the body that lives by action, has a motive fibre, which is what acts, and its fluid is what lives : hence motive fibres of different kinds are the main constituent of the body, 486 ; II., 14, 185. Even tendinous and osseous parts consisted in their infancy of motive fibres, 487 ; II., 14. The doctrine of the motive fibre holds a principal place in the science of the animal economy, *ibid.* There are as many distinct degrees of motive fibres as of fluids in the vessels, and these fibres are subordinated to each other, as the causate to the cause, *ibid.* ; II., 185, 186. The first motive fibre is called the medullary fibre in the brain, the nervous fibre in the body, *ibid.* ; II., 185, 186. The second, derived from the first, is the vessel of the purer blood, or the white motive fibre, 488 ; II., 185, 186. The third, composed of the first and second, is the vessel of the red blood, *ibid.* The fourth is the muscle, *ibid.* ; II., 185, 186. The simple motive fibres act in the same manner as the compound, only more perfectly, *ibid.* The various orders of motive fibres can act upon each other, producing action and reaction, *ibid.* If any part of the body loses its motive fibre, it changes its active for a passive character, and lives no longer in particular, but only in general, II., 14. Motive fibres are subdeterminant and mediant substances, *ibid.*

**MUSCLE**. A muscle is four-fold in origin, order, nature, composition, and name : there is the muscle itself ; then the fleshy motive fibre, or the fibre of the red blood ; the white motive fibre or that of the pellucid blood ; and lastly the nervous fibre, 109, 191, 452, 487, 488 ; II., 50, 185. A fibrated vessel is the one force and substance proper to a muscle, 116. The motive fibres are formed of blood-vessels, 191. The muscles are necessarily constricted when their arterial blood is expelled, 191, 388. The muscles attract their own blood as they require it, 329, 333. See *Motive Fibre*. The action of the spirituous fluid through the fibres, and the reaction of the blood through the vessels, is the efficient cause of the motion of the muscles, 489 ; II., 66. Without the general equilibrium of pressure exercised by the arteries, muscular motion would be impossible, 490. Muscular action exists from two causes ; one on the part of the brain, the other on the part of the body, 490—499. The causes on the part of body are as numerous as the natural motions, 493. They comprise all the various species of touch in all the viscera, that excite the fibre conformably to its simple or compound structure, 497. So long as the animation of the brains coincides with the pulsation of the heart, as in the embryo, no muscular motion save that of the heart, arteries and veins, is possible, 501 ; II., 66. As soon as the muscles begin to act individually, the change incites the birth of the embryo, 502 ; II., 66. See *Motion of the Heart, Tendon*. The cortical spherules are the eminent muscles, II., 186. See *Genesis of Faculties*.

**MUTATION**. The principle of modificatory activity in the supreme aura is sometimes called mutation, 131, 133, 283 ; II., 303. The power of expansion and com-

pression in the auras, is their *accidental or natural mutation*, II., 303. Perfect and persistent constancy in form and essence ever accompanies the perfect mutability of the higher entities, II., 304, 305. No *real* or *essential mutation* can happen to the spirituous fluid in regard to its principle of motion, II., 304—306. It is capable of a *superior essential mutation* in regard to its reception of life, II., 306—308. But this, only of the most general kind, II., 308. The superior essential mutation of the soul springs entirely from the free choice of the mind, II., 317.

**NAME.** When the name given to an unknown quality becomes familiar, we think that we understand all it comprehends, 49. See *Term*.

**NATURE**; see *Chemistry*. Nature's real state is activity: hence nature is an active force, 129. Nothing impedes her progress, because she proceeds according to degrees, from principles, through causes, to effects, 164. See *Astronomy, Motion*. Her law is constant in its causes and effects, 383. She is always in her art, and in the rules of her art, 454. Nature, without degrees and moments, or without a complex and series of things, is not nature, II., 5. By the nature of a thing we mean its principle of motion and rest, in which it is of itself, and not by accident, II., 37. Nature is everywhere self-similar, II., 157. Nature, in itself, is dead, and only serves life as an instrumental cause; and is altogether subject to the will of the intelligent being, who uses it to promote ends by effects, II., 223, 298. The worshippers of nature are insane, II., 243. See *End*. The circle of nature is made up of perpetual other lesser circles; and these, of least circles; and each point in every circle respects its centre; and by this the common centre of all the circles; being, therefore, in its circumference, II., 268. We must gain a clear perception of life or wisdom as distinct from nature, II., 298.

**NECESSITY.** What is done of necessity and compulsion is not regarded as proceeding from any cause in the agent, II., 328.

**NERVES.** The fibrils of the nerves are the third order of vessels, 111, 112. See *Fibre, Vessel*. The nervous fibres terminate in the blood-vessels, 115, 191. See *Neurology*. The nervous fibre, in its simplicity, may most fitly be compared with the artery; being an artery by eminence, 451, 489; II., 151. The fibre of the nerve carries the simple or spirituous blood; that of the artery, the compound or material blood, *ibid.*, 489. The nerves, in their principles, are formed with a view to the uses they are to perform at their extremities, 452. In their ultimates they again fall into almost simple fibres, as in their primes, *ibid.*, 489, 501. They fall into simpler fibres where they have to receive sensations; into less simple fibres where they have to execute motions, *ibid.* They are nearly similar at both ends, but in the intermediate course are properly nerves, 453, 489. All the actions possible in any one subject are represented by its nerves, 453. See *Ganglia*. The nervous fibre, at its extremities, when permeated by its fluid, expands both in length and breadth, like the artery, 489. See *Nervous Fluid*. Before it enters the muscular tissue, it loses the nervous fluid contained between its fascicles, 501. Through the tunics of each nervous fibre run exquisitely fine spiral vessels, II., 151. Through the tunic of the nerve runs the spirituous fluid; through its canal, the purer blood; between its fibres, the most volatile salts and serum of the purer blood; between the fascicles of fibres, other saline corpuscles, with their serum, *ibid.*

**NERVOUS FLUID**, the, is the fluid between the fascicles of the nerves, as the spirituous fluid is that within their fibres, 501.

**NEUROLOGY.** The science of the nerves must be approached from above, after we have understood the cortical and medullary substances of the brains, 451.

**NOSE.** The air received through the nostrils excites the brain to contraction at the moment it is passing through the trachea to the lungs, 261, 262; II., 88, 89. See *Brain, Respiration, Sneezing.*

**OCCULT:** see *Author, Degree.*

**OIL.** Salts of the second degree produce oils; the surface of the oil-particles being constituted of such salts, while the internal cavity is occupied by ether, 54. Oils in combination with fixed salts form urinous, grossly sulphurous, fatty, nitrous-aërial and other prevailing vegetable and animal matters, 54. See *Salt, Spirit.*

**OPPOSITES** may be measured by each other, 200.

**ORDER.** According to the order of nature, an obscure and common notion precedes a distinct and particular one, 3, 6. We must go through orders and degrees to pass from the sphere of effects to that of causes, 51, 62, 227. See *Blood, Degree.* The blood-globule is a subordination of causes, 64, 178. An understanding of the subordination of things is necessary to a knowledge of causes, 51, 178, 229; II., 1, 203. Subordination is preëminently exemplified in the human body, 199, 233. See *Succession.* Before anything is coördinated, it must be subordinated, 227, 245. See *Use.* The formative substance subordinates and coördinates all things most perfectly, 233. Without complete subordination of one thing to another, there would be no life in the body, 286. Without the doctrine of order it is impossible to follow nature when she passes inwards, II., 2, 203. Order exists in perfection in the animal kingdom, that kingdom being therefore a living exemplar of all other things in the world that observe any order, II., 4. Successive and simultaneous in the animal kingdom are identical with subordinate and coördinate, II., 5. In the bodily system one thing is so subordinated to, and coördinated with, another, that all things are mutually respective, and mutually dependent, II., 20. The perfection of an order results from the perfection of the first substance in the series II., 26.

**ORGAN.** The instruments in living bodies are organs, II., 232. See *Animal Spirit.* The spirituous fluid is the supereminent organ of the body, II., 253. An organ necessarily comprises a series of things, and a form of things, *ibid.* The organ under the soul or spirituous fluid, is the mind, II., 260. The next lower organ is the animus, II., 261. Fourth or last there are the organs of the five external senses, II., 262. And also the motory organs, the last of which are the muscles, *ibid.* The motory and sensory organs constitute the body, II., 263. Notwithstanding the number of degrees, yet the animal system consists of nothing but the soul and the body; for the intermediate organisms are but determinations of the soul, and partake of both it and the body, II., 265. These determinations or organisms partake of the body only in so far as the derived fluids partake of terrestrial particles, II., 267.

**ORGANISM.** The condition of the organism is not the cause of the internal faculties, 241, 243. When the intermediate organism is injured, the soul cannot pass into the ultimate degree except according to the state of such organism, 242, 243. See *Organ.*

**PARTICULAR:** see *General.* We learn the general texture of organs by careful anatomical investigation; but the particular, by the intellect, in the analytic way, from a close examination of the general, II., 280.

**PAR VAGUM.** It is an offset of the cerebellum, 265, 350, 471, 546. See *Intercostal Nerve, Lungs.* It arises by a single root, not by multiple roots like the intercostal nerve, 465. It is sent to all those viscera where any natural or spon-

taneous motion is going on, 471. Its origin must be explored, not by sight, but in the same way as that of the intercostal nerve, 472. It brings with it as many bundles as there are origins of natural motion in the body, *ibid.* Because it descends as a single trunk on each side, it requires to be associated throughout with the intercostal nerve, to keep up its supply of spirituous fluid, 473, 476. These two are like a married pair; the intercostal doing the husband's office; the *par vagum*, the wife's, 474. Both are necessary, to subordinate and coördinate the natural motions, *ibid.* By descending as a single trunk, it produces concord among the diverse natural motions of the viscera, 474, 475. It acts everywhere from causes arising in the body, 496.

**PERFECTION.** The greatest perfection of any entire, determined series, is when it corresponds to the perfection of the determining principle: but the highest perfection can only be predicated of it when the perfection of its first determinant corresponds to the perfection of the first determinant in the world, II., 26. The microcosm and macrocosm are in themselves most perfect, but we are the cause of our own imperfection, II., 27. See *Brutes, Man.*

**PERICARDIUM.** It obeys the motion of the lungs and brains, 538. By means of the pericardium, the heart enjoys a liberty of its own, and is enabled to move achronously with the lungs, 539.

**PHILOSOPHY:** see *Holy Scripture.*

**PLAN,** the author's, is, to premise the experience of the best authorities; next to form a general induction; and then to confirm this by the previous experience, 15. After proceeding analytically, the author changes the order, and proceeds from the causes already arrived at, or synthetically, 69. See *Author.*

**PLEASURE:** see *Cause.* Cupidities and pleasures are harmless in themselves, and serve as the proper fuel and incentives of bodily life, II., 315, 316.

**PRINCIPLES.** It is God who emprinciples the principles of things, 277; II., 217, 218. In thinking of principles it is difficult to discard notions conceived from effects, II., 38. Certain things are more manifest from examples than from principles, II., 221, 301. See *Animal Spirit, Cause.* The principles belonging to the sciences, and which are in agreement with the truth of things, approach very nearly in their nature to the soul, II., 281.

**PRIOR,** the, can exist without the posterior, but not *vice versâ*, II., 27, 343. See *Order, Series, Substance.*

**PROPER VESSELS OF THE HEART:** see *Circulation, Coronary Vessels, Embryo, Heart.* The *refundent vessels* are those whose blood received from the fleshy ducts of the right auricle, circulates through the auricle, and is soon poured back into the same: their blood performs the shortest circuit of any, 408. The left auricle also has refundent vessels, 408. As soon as their blood is refunded, it is sent through the lungs, *ibid.* The *retorquent vessels* arise from the lacunæ of the right ventricle, gain the surface, and carry the blood back into the right auricle, 409. Their blood visits the auricle and ventricle twice before it is sent to the lungs, *ibid.* It is doubtful whether the left ventricle has retorquent vessels, or not, *ibid.* The *anticipant vessels* belong particularly to the left auricle, 410. They arise from its muscular substance, and pour the blood directly through the two foramina into the aorta, pre-occupying this vessel, since their blood does not pass into the left ventricle, *ibid.* The *transferent vessels* convey the blood from the right ventricle into the coronary arteries, and so into the aorta, 411. The transferent vessels of the right auricle convey the blood into the aorta by a still shorter passage, *ibid.* The *retroferent*

*vessels* carry back the blood from the left ventricle to the right auricle, 411. Some also carry it back from the left auricle to the right, 412. The transferent vessels of the right ventricle and auricle are the so-called coronary arteries, 413. They are analogous in office to the foramen ovale and ductus arteriosus, 407, 414, 415. When the transferent vessels are unduly numerous or open, it indicates a weak, timid and unsteady condition of mind and body, 419. When the retroferent vessels are very numerous and open, it indicates firmness and strength of the nervous and vascular systems, 420. When the refundent vessels of the auricles are multiplied and expanded beyond due proportion, it signifies frequent changes of the body and animus, *ibid.* Irregular motions and impulses occurring constantly, alter the very fabric of the heart, and superinduce a nature that rushes with blind instinct into corresponding lusts, *ibid.* There is a great likeness between the proper vessels of the heart and of the brain, 424.

PROVIDENCE. The circumstances exhibited in the formation of animals in the womb and egg, are plain proofs of an infinite and omnipotent Divine Providence, 276, 277. Providence is absolutely universal even in the merest particulars, 276. It is more becoming to be lost in mute astonishment at the wonders of Providence, than to overburden ourselves with proofs of its existence, *ibid.* See *Formative Substance, Principles*. The providence of man's reason is respectively nothing, while the providence of God's wisdom is all in all, 277.

PSYCHOLOGY is the first and last of the sciences that conduce to a knowledge of the animal economy, II., 1.

PULSE: see *Blood, Circulation*. The causes of the variation of the pulse are internal and external, 196, 404, 574. They cannot be obtained from particular, but only from general experience, 574. The doctrine of the pulse is the last that can be completed, 574.

PUNISHMENT. The penalty of transgression is derived from the parent to the offspring, so far as relates to the body, but not so far as relates to the soul, II., 317.

QUALITY: see *Substance*.

QUANTITY. Magnitude is inferior quantity; multitude, superior quantity, 177. There are three successive fluids as quantities in the animal kingdom, viz., the red blood, the middle blood, and the spirituous fluid, II., 32.

REASON: see *Experience*. It is futile to rely either on reason without experience, or on experience without reason, II., 49.

RELATION: see *Dependence*. That which is regarded by another thing, is prior to it, and that which regards another thing, is posterior to it, 229.

RESPIRATION: see *Animation, Brain, Nose*. During deep thought we breathe through the mouth, and not through the nose, lest the entering air should excite the brain, 263; II., 67, 90, 91. The varieties of the respiratory motion are so great as to appear irreconcilable, 349.

REVELATION. He is wise who knows with certainty that in divine things he can know nothing beyond what is revealed, 283; II., 202, 230, 237, 238, 239, 246, 247. See *Infinite*. The truth of nature and the truth of revelation are separate but never at variance, II., 209, 230.

SALIVA: see *Digestion*.

SALT. Common salt, in the investigation of different salts, is the head of the saline family, 53. Its individual parts are generated between the particles of water, *ibid.* See *Water*. They are identical in form with the interstices between these

particles, *ibid.* They are diminutive cubes with six sides and eight angles, *ibid.* If the particles of common salt or pure acid be comminuted, the resulting quadrangular or triangular solids form volatile ærial salts, 54. If the particles of these be divided into similar particles still more minute, we have the most volatile ethereal salts, *ibid.* Saline particles of whatever degree are all similarly cubical or pyramidal, hard or inert, immoveable without aqueous or atmospheric substances, fixed and fixating, inexpandible and non-elastic, and they temper the fluidity of actives, 54. The higher salts are more universal, simple and perfect than the lower, *ibid.* See *Degree*. Salts of the lowest degree, by the interposition of particles of water, auras, oils and spirits, form all kinds of fixed salts, *ibid.* Salts of the second degree produce oils, *ibid.* See *Oil*. The saline elements of the highest degree generate spirits, *ibid.* See *Spirit*. Common salt is the measure and type of the particles of liquids, 55, 65. The doctrine of salts is of high use and vast application, *ibid.* See *Blood, Color, Heat*. The earthy and saline parts of the blood are deposited at the mouths of the vessels where the division of the blood begins, 63, 113, 167. The particle of common salt is the base, fulcrum and mould of the blood-globule, 65, 73, 76. See *Skin*. The most volatile saline substance, with its serum, after passing between the fascicles of the nervous fibres, is carried through the periosteum and vertebral theca to the dura mater and pericranium, II., 153.

SCIENCE. One science meets and enlarges another, 6 ; II., 56. See *Truth*. The sciences are an ocean of which we can catch but a few drops, 10, 291. See *Ancients, Moderns, Times*. Nature operates in all the perfection of art and science in the animal kingdom, producing all things that the public and the private weal require, 73 ; II., 254—256. See *Member*. What constitutes life in the animal, constitutes life in the sciences relating to the animal, II., 108. To mount from the posterior to the prior sphere, we must advance through sciences and arts, rules and laws, II., 254. We have that within us whose activity is essential science, and whose action embraces all science, II., 256. See *Soul*. The order of the universe teaches us the sciences, II., 270.

SECRETION and excretion are carried on in a triple order, 127. Secretion takes place through stamina that issue from the minute arteries, 184. During the expansion of the arteries these stamina are drawn into them, and form considerable excipula, which take up the serosity at the periphery of the current ; and again when the arteries contract, these excipula become tubules, and project their contents, *ibid.* The mechanism of secretion depends upon the circulation, *ibid.*, 191, 320. See *Absorption, Circulation*. During secretion and absorption, the artery and vein expel and absorb their liquids, not synchronously, but alternately, 185. Innumerable humors may be elaborated by secretion alone, 187. In extracting all these, nature uses but one method, *viz.*, rejects to the circumferences or parietes the least fluent subject, but contains the blood and the more fluent in the median or axillary line, *ibid.*, 320 ; II., 148. The blood continually projects to the parietes, first the mixed heterogeneous, and next the mixed homogeneous substances, *ibid.*, 320 ; II., 148. So also the purer blood and spirituous fluid, *ibid.* Therefore the secretion can never be the same at any two points, *ibid.*

SENSE. The organs of the senses are fashioned in correspondence to the modifications of the auras, 50 ; II., 21, 263. See *Nerve*. All things in the auras and on the earth have senses adequate to them in the microcosm, II., 21, 263. All the organs of the body enjoy sensation ; and from the connexion of substances we may

judge of the influx of sensations, II., 31, 262, 263. Sensations are series, and in a series, *ibid.* The senses lead only to the threshold where nature begins to act distinctly, II., 142, 154. See *Animation, Mind, Vision*. Truly human brains have the power of blunting the external senses, II., 179, 263. External sensations reach no goal beyond the cortical spherules, II., 190. No individual part of the cerebrum corresponds to any sensorial organ of the body, but the cortical substance in general corresponds, II., 192. The senses practise continual and gross trickeries upon the mind, II., 199, 225. They exist for the sake of the soul, II., 222. They cannot discriminate the principal cause from the instrumental, II., 232. The soul appears incomprehensible and continuous to all the lower sensories, II., 234. See *Organ*. The external senses are blunted as the internal are sharpened, II., 263. The sensations of the body are distinct from those of the animus, *ibid.* Sensations ascend from the body to the mind, II., 268. In the end they should be perfected by the judgment, II., 285. See *Genesis of Faculties, Influx*.

**SERIES**: see *Degree*. Series embrace successively and simultaneously things subordinate and coördinate, II., 4, 214. There are in the world many series, universal and less universal, II., 5. The universe itself is the most universal series, *ibid.* This embraces three higher series, and three lower, II., 6. The first is a series of substances simply derived from the first substance by order of succession [finites], *ibid.* The second is the series that the same substances constitute when left to themselves, or allowed to gyrate, and comprises both the solar and the lower elemental fire [actives], *ibid.* The third is the series of the auras of the world, arising from the union of the two former, as its actives and passives [elements], *ibid.* The mineral, vegetable and animal kingdoms are the general terrestrial series, *ibid.* Each of the mundane series contains under it many proper and essential series, and so also does each of the latter series again, II., 7. There is nothing in the visible world but is a series and in a series, II., 8, 213. The first substance of the world is the only one that does not fall under the idea of series, *ibid.* All things in the world are series, beginning in the first, and ending in the first, *ibid.* In equality, or where there is no series, nature perishes, *ibid.* See *Order, Substance*. In every series there is a circle, through which the first thing has reference to the last, and the last to the first, II., 20. Essences, attributes, accidents, and qualities, are series, and in a series, II., 28. See *Unit*. There are series of two, three, four, or more degrees; which according as they are conjoined and communicate, are series of an order, II., 214.

**SERUM**. It surrounds the blood, and is the atmosphere in which the blood floats, and from which it obtains its elements, 41. Such as the serum is, such is the blood, and *vice versâ*, *ibid.* The serum has in it all the components of which the blood is formed, *ibid.*, 42. It is a means exactly proportioned to the blood about to be made, *ibid.* Spirits, salts and oils of all kinds are conveyed to it by the chyle, in water as a vehicle, 42. Nitrous and volatile substances floating in the atmosphere are carried to it by the air through the lungs, *ibid.* Still more volatile substances are conveyed into it through the ether or purer air, 44. Urine, mucus and sweat reside in it, and try to intrude into the blood, 46. See *Blood, Circulation, Vessels*. The blood sent from the arteries into the veins is probably not quite purified from serum, 170. See *Absorption, Artery, Secretion, Vein*.

**SIMPLE**. To suppose pure simples as antecedents to simples, is to prescribe so many ultimate goals to the human understanding, 51. See *Blood*. The substances that enter the blood-globule, are the simples of their respective degrees, 76. There



are degrees of simplicity, *ibid.*, 119. Nature exalts herself in passing from compounds to simples, 280. The simple is a type of its universe as it exists in that degree, 282. See *Unit*. A thing is simple in proportion as it is near to the first cause, II., 230. In proportion as substances are not simple, they are imperfect, and remote from the truth of nature, *ibid.* The simpler substances are pellucid; the less simple, colored, *ibid.*

SINGULAR: see *Life*.

SKIN. It imbibes from the air numerous substances for concocting and renovating the blood, 45. See *Blood*. It conveys subtle ethereal aliment to the blood, 44, 163. It expires the saline substances contained between the fascicles of the nervous fibres, II., 153.

SLEEP. Wakefulness and its concomitants open the lacteal and close the aërial passages: does sleep produce the inverse effect? 46. See *Gaping*. During sleep causes are busy in repairing the losses that occur in causes during the day, 544; II., 184. One viscus sleeps and wakes differently from another, *ibid.* The cerebellum and its nerves are more widely awake during the sleep of the cerebrum than at other times, *ibid.* Sleep is caused by the red blood passing into the vessels of the white blood in the brain; in consequence of which, all distinction of degrees perishes, *ibid.* During sleep the circulation of the nervous fluid is not disturbed by the voluntary determinations of the cerebrum, II., 184.

SNEEZING. The brain is contracted in the act of sneezing, 262. By sneezing the brain expels the pituita that blocks its doors, 262; II., 89. See *Brain, Nose*. The dura mater is contracted in the act of sneezing, II., 89. Sneezing is the highest excitation, or expansion and constriction, of the brain and lungs, II., 90.

SOLID: see *Fluid*.

SOUL, the, enjoys a kind of omnipresence, knowledge, power and providence, within the limits of the body, 200, 233; II., 198, 204, 234. See *Body, Formative Substance*. As rational a soul resides in the infant, or idiot, as in the greatest genius, 243; II., 48, 176, 267, 277, 279. See *Brutes, Instinct, Organism*. The predicates of the soul and of the formative substance are exactly coincident, 245; II., 233, 234. See *Substance*. Nothing adequate can be predicated of the soul by the formulas of the lower degrees, 285; II., 203. See *Degree, Life*. Without a mathematical philosophy of universals, and a doctrine of degrees, the manner in which the first and successive mutations are effectively produced in the formative substance or soul, cannot be treated of, *ibid.*; II., 203, 206. It is impossible to rise to a knowledge of the soul without gaining a particular and general knowledge of the low and visible phenomena of the animal kingdom, II., 1, 204, 206. And without ascending through the same degrees by which the soul, in the act of formation, descends into the body, *ibid.*; II., 203, 284. The mathematical doctrine of universals is the mute language of the soul, by which it abstracts from all things their nature and essence, and distributes words into a quantity of quantities, II., 204, 205, 218. The disputes of the learned concerning the soul, unhinge our minds and contract our faith, II., 208. If we deprive it of all material predicates, we are likely to reject it as an *ens rationis*, II., 209. What it intends from the beginning, the universe carries into effect, II., 227. The soul intends to proceed from the prior world into the posterior, *ibid.*; II., 250—253, 284. Also that the surrounding universe shall serve it as a means for obtaining wisdom, *ibid.* The learned world has afforded a general but unconscious testimony to the doctrine, that the animal spirit is the spirit and soul of the body, II., 233. The soul is circumscribed, in repre-

sentations and intuitions, by the same limits as the universe, II., 234, 238, 258. Habitation and place, parts, magnitude, force and form, may be predicated of the soul as a substance, provided the properties be abstracted that are generated in compounds, *ibid.* The soul is indefinitely finite, II., 238. It is within nature, and below the first substance of the world, *ibid.*, 297. A soul may be defined as a natural subject, accommodated at once to the beginning of motion, and to the reception of life, II., 240, 297. See *God*. Two distinct principles determine the spirituous fluid or soul; the one, natural, enables it to exist and be moved in the world; the other, spiritual, enables it to live and be wise, II., 249. Of these a third, which is properly the soul's own, is formed; viz., a principle of determining itself into acts, suitably to the ends of the universe, *ibid.* Thus it determines itself into acts of itself, and regards ends beyond itself, *ibid.* This latter principle regards the earth, where the determination takes place; hence the soul, thus emprincipled, must descend by as many degrees as distinguish the substances and forces of the world; and form a body adequate to each degree in succession, II., 250—253, 284. See *Organ*. As the spirituous fluid is the soul, it is seated so high above all the other faculties, that it is their order, truth, rule, science, law, II., 254. The soul naturally *is* as it acts, II., 255. Its office is to represent the universe; and this it does not only naturally, but intellectually, thereby representing the universe *to itself*, II., 257. Therefore it represents the causes and effects of nature, as ends, *ibid.* Its office also is, to be conscious of all things, and principally to determine, II., 258. The soul, as a substance, is kept within the limits of the body, *ibid.* It is distinct from, prior and superior to, and more universal and perfect than, the intellectual mind, *ibid.* A notion of it can hardly be procured while we live in the body, II., 259. The first determination of the soul is the mind; the second is the animus; the third is the essential body, II., 266. Degrees of perfection are not to be predicated of the soul, but of the organisms, II., 267. It is the all in its whole, or the singular in its universal, *ibid.* It descends with light and virtue into the mind, II., 268, 272, 296, 297. It grasps the lowest things at the same time as the highest, II., 272. A single mode of the ear involves indefinite myriads of corresponding modes in the soul, *ibid.* The soul does not flow so much into the sensations and perceptions of its organs, as into the formation and motive forces of its body, II., 275. We must distinguish well between its operations within the fibres, and its operations without them, *ibid.* See *Fibre*. From the very beginning of conception, the soul is accommodated at once to the beginning of motion, and to the reception of life; or to all its intuition and intelligence, and these it takes with it, from the first stamen and earliest infancy, to the most extreme old age: but not so the mind, *ibid.*, 279—282. The observations applied to life relatively to the soul, may be applied to the soul relatively to the mind and to sensations, II., 277, 278. See *God*. The soul is derived from the parent, but not from the mother, II., 278. It acts as a mind in singulars; as an animus or sight in comparative generals; and as hearing, touch and taste, in positive generals, II., 282. It is not the wisdom, but the science of the world, II., 284, 285. Were we born in possession of the perfection and science of the soul, it is doubtful whether either natural birth or death could take place; and certainly there would be no thought, no speech, and no society, II., 285, 286. Unless ideas and laws were connate in the soul, there could be neither memory nor understanding; nor could any organic subject participant of life, exist or subsist, II., 286, 287. The soul is a real essence and communicable substance, running without a break in the organic forms of the

brain and of the body, II., 289. As the eye is the organ of sight, so the spirituous fluid is the eminently organic substance of the soul : or its faculty of operating is properly speaking the soul, *ibid.* It is indifferent whether we call the fluid itself, the soul, or its faculty of representing the universe, and regarding ends, *ibid.* See *Genesis of Faculties*. Its speech is really angelic speech, II., 296. We look in vain in ourselves for a self-intelligent soul, II., 297. Both materiality and immateriality are predicable of the soul, II., 298—300. See *Harmonic Variety, Mutation*. It applies its force to those things that occur within the body, and gives its consent to those that happen without, II., 309. See *Immortality*.

**SOUND.** The recurrent nerve is the general regulator of vocal sound, 478.

**SOUNDNESS.** Respecting the conditions of a sound mind in a sound body, see especially, II., 292.

**SPHERE.** The forces of nature and the substances of the world have many distinct spheres of activity, each terminating in its own peculiar unit, 51.

**SPHERICAL FORM.** It is the fittest form in which nature can act, the genuine form of activity or motion, and the principle, basis and measure of all the other forms, 68. See *Spiral*. The cortical substances of the brain are minute spherules, and the cerebrum and cerebellum themselves approach to the spherical form, II., 41.

**SPINAL MARROW.** Its arteries are beyond the power of the heart, 264, 557 ; II., 77. It moves systaltically with the brains [and lungs], and during its movements expels its own blood into the venæ cavæ, 555—557 ; II., 77, 177. See *Animation*. Voluntary acts become natural and spontaneous by habit through the medium of the spinal marrow and medulla oblongata, 569 ; II., 173, 177, 178. The fibre of the brain does not go off into nerves, but traverses the marrows, 570. The spinal marrow affords the best evidence of the coincidence of motion between the lungs and the brains, II., 76. The coördination of the cortical substances in the medullæ, shews how the will is determined into action by them, II., 178.

**SPIRAL.** The continuous chain of fluids and solids in the body is a perpetual circle or infinite spiral, 61. The spiral is the principle of the sphere or circle, 68. Nature betakes herself to spirals as she recedes from the posterior world into the prior, 69, 134, 280. See *Undulation*. Nature commits the highest execution of her forces to the spiral form, 134, 135, 280. The curves of the vessels serve for the elimination of non-sanguineous particles, which cannot follow their gyres, 171. The spiral volutions of the heart and brain are not meant to enable those organs to twist and untwist spirally, but only to expand and contract with greater ease, 279, 523. See *Animation*. The spiral is perpetual in the simpler substances, 280. See *Axillary Motion, Sun*.

**SPIRIT :** see *Salt*. The saline elements of the highest degree generate spirits, 54. Spirits consist of spherical particles ; having their surfaces composed of the saline elements, and their cavities occupied by ether, *ibid.* They are highly rectified oils, 55. In combination with other substances, they form the volatile, subtly-sulphurous, and fine fatty matters of the body, *ibid.* The particles of oils and spirits are of the same size as those of water, *ibid.*

**SPIRITUOUS FLUID OR ANIMAL SPIRIT.** It is the principal substance and vital essence of the red blood, 36, 61, 64, 290, 351, 452, 543 ; II., 49. It is conceived in the cortical and cineritious substances of the brains and medullæ, and emitted through the nerves into the blood, *ibid.*, 347 ; II., 42, 212. It is also poured by the ventricles, infundibulum, &c., into the sinuses, and so into the jugular and subclavian vein, just where the thoracic duct is inserted, *ibid.*, 42, 340,

347, 421, 543 ; II., 182, 212. It is there at once associated with the chyle or lymph coming up from the body, *ibid.*, 42, 421. See *Blood, Circulation, Heat*. By means of a volatile substance derived from the ether, it produces the middle blood, 61, 65. Its extreme volatility is tempered by ethereal elements, 62, 64, 68, 114, 291. It differs in different animals, 65. It and the middle blood are highly elastic, sociable, pliable, and plastic, but to whatever form they are reduced, they naturally aspire and tend to return to their own most perfect form, 67, 341, 490. It suffers no loss of any force received, but communicates it entire to other things, far and near, 68, 452, 490. Nothing can exceed it in all the properties of fluidity, and all the modes of efficient causation, 69, 543. See *Vessels*. It is blood by eminence, 113, 452, 487 ; II., 49. Before the blood can become spirituous fluid, it must be released from the ethereal elements that temper, copulate, determine and perfect it, 114 ; II., 144, 145. Nature carefully guards against the loss of any portion of her spirituous fluid, 117 ; II., 152. See *Absorption, Secretion, Undulation*. The soul is its life, spirit, and determining principle, 246. In point of unanimity it is the other self of the soul, *ibid.* See *Animation*. Every point of it involves determinations representative of the microcosm, which fact constitutes its life, 286 ; II., 195. See *Heart*. In its course into the basal sinuses, it passes over the sonorous and vibratory regions at the base of the skull and bordering the ear, and is actuated by their motions, 343. There is nothing really substantial or alive in the animal kingdom but the spirituous fluid in its fibre and in the blood, 351, 452, 487, 547 ; II., 12, 25, 35, 181. Wherever this fluid is not present, the brain is not present, *ibid.* The denial of this fluid involves the denial of all the causes in the animal kingdom, 453, II., 211. See *Ganglia*. To live in action it must be in a fibre, and be distinctly determined thereby, 487, 489 ; II., 218. It is placed in a state of general pressure by the animation of the brains, and the circulation thence arising, 493, 529. See *Nervous Fluid*. It is the all in every part, II., 15, 25, 35, 181, 197, 211, 212. It is the simple and only substance of the animal kingdom, II., 35, 197, 211, 212. All the other substances are derived from it, *ibid.*, II., 197. It is most perfectly determined by the first aura of the world, II., 36, 180, 195, 251. This empowers it to be the formative substance of the body, II., 37. Which involves life, and consequently soul, as the principle of the things existing in the whole series, II., 38, 181, 195, 197. Materiality cannot be ascribed to the human spirituous fluid, *ibid.*, 180. It knows nothing of resistance, weight, or lightness, *ibid.*, 180. It does not communicate with the body immediately, but mediately, through organic substances, II., 47. Our view of the circulation of the animal spirits is founded upon general experience, II., 139. It expires into the blood, II., 152. The soul dwells in it, II., 175. With those who deny its existence we hold no disputation, II., 179. It is not generated from anything in the animal, vegetable, or mineral kingdoms, II., 180. Its formation cannot be understood without the doctrine of series and degrees, and the philosophy of universals, *ibid.*, 216, 217, 219. The proximate cause of its conception is the soul's representation of her universe, *ibid.* Its circulation is from the cortex into the universal fibres, from the fibres into the blood, from the blood to the brain, and so back to the cortex, II., 181. It glances through every point, and continues, irrigates, nourishes, renovates, forms, actuates and vivifies everything in the body, II., 181, 211, 212. In time, universality and excellence, its circulation far precedes that of the red blood, *ibid.* The moments of this circulation are synchronous with the respirations of the lungs, which wonderfully concur to promote it, II., 183. It involves all things that ever

come to the rational sight and bodily senses, II., 197. It is the prime determinant of the microcosm, *ibid.* It must be explored, if we would explore aught else in the body, *ibid.* See *Universal*. Everything in the body confirms its existence, II., 211. By its action we live, and by its life we act, *ibid.* Wherever it glances through its fibre, it is analogous to the auras, *ibid.*, 219. It is in the third degree above the red blood, *ibid.* It enters the blood as the first, highest, inmost, remotest, and most perfect substance and force of its body, the sole and proper animal force, and the determining principle of all things, II., 214. It derives its being from a still higher substance, and proximately from those things on which the principles of natural things are impressed by the Deity, and in which the most perfect forces of nature are involved, II., 217—219. To the body it is the form of forms; to the microcosm what the first aura is to the macrocosm, II., 219. It is the formative substance, II., 220. See *Formative Substance*. The bodily system exists for the sake of it, II., 221. It can by no means be said to live; much less, to feel, perceive, understand, or regard ends, II., 223, 297. Yet it has a principle of life from the first *Esse*, in a word, from the God of the universe, II., 228, 297. It is a substance with principles imprinted upon it, II., 231. See *Influx*. On account of the influx of the Divine life, which is the principal cause in the animate kingdom, this purest fluid, which is the instrumental cause, is the spirit and soul of the body; hence we call it the *spirituous fluid*, II., 232—234. It is the purest of all the organs of the body, *ibid.*; II., 253. See *Organ*. Its office is, to represent the universe, to regard ends, to be conscious, and principally to determine, II., 253. Its first determination is the organic cortical substance; its next is the brain; the third is the body, II., 266. In proportion as those things that are insinuated *a posteriori* approach in nature and essence to those that exist in the spirituous fluid, the communication between the soul and the body is opened, II., 181. See *Harmonic Variety, Mutation*. It is the natural life of its kingdom, and all the denominations ascribed to the cortical substance, belong to it in a higher degree, II., 303. See *Immortality*. Time and space, distance and hindrance, can only be predicated of it analogically or transcendently, II., 348.

STATE. All natural and finite things are capable of assuming a succession of different states, 239.

STOMACH. It is the chemical retort of animal nature, 42. It pours upon the food a vital extract, endowed with exquisite properties, and animated by a spirituous essence, *ibid.* See *Blood, Lungs*.

SUBSISTENCE. The law by which parts subsist is founded on that by which they exist, 47, 291. Subsistence is perpetual existence, 64, 237, 291, 351. The blood, in order to subsist, must be perpetually coming into existence, 351.

SUBSTANCE: see *Formative Substance*. In the order of forces and substances, the spirituous fluid is next to the soul, the purer blood is next, and the red blood next, 245. All these are substances and forces in their own degree; the soul being the vital and presiding substance of all, 246. To the intent that we may advance from general beginnings, we must commence with substances, which are the subjects of accidents and qualities, II., 9, 271. Substances are manifold, yet of all in the universe there is but one first substance, from which all proceed, II. 10. On the first substance, as a principle, the principles of natural things are impressed by the Deity, *ibid.* It subsists by itself, but does not sustain accidents, *ibid.* Every series has its first and proper substance, which, however, is dependent for existence on the first substance of the world, II., 11. See *Series*. The first and proper sub-

stances of series are not absolutely primitive and simple, but are so only in relation to the compounds of their series, *ibid.*; II., 13. The first substance of every series is its simplest and only substance, and reigns in the whole individual series, II., 12, 20. From it, and according to its nature, proceed all things that we see determined in the entire series, II., 13, 20, 230, 231. From it, in successive order, by combining media, more compound substances are derived, which are its vicegerents in the ultimates of the series, *ibid.*, 20, 230, 231. And so are determinant of the things existing in that series, *ibid.* By the determination of these substances others more compound are formed, and which are mediant and subdeterminant, II., 14. By the latter the essential and proper series that constitute the integral series, are combined and held together, II., 15. And this, so perpetually and mutually, that no unconnected part can be proper to the series; whence coestablished harmony, *ibid.*, 20. See *Harmonic Variety, Harmony*. The simpler series and substances are rendered conscious of all changes that happen in the compound, II., 21. Whatever is determined into act, is done either by the determination, or with the concurrence and consent, of the simpler substances, II., 22. This takes place according to natural order, from a lower substance to the next higher, or *vice versâ*; but never from the highest to the lowest except through the intermediates, II., 23. The simple, compound, and more compound substances that are determinant of things in their series, in proportion to their simplicity or composition, are prior or posterior, superior or inferior, interior or exterior, remote or proximate, efficient causes or effects, II., 24. Prior substances are more universal, and more perfect in every quality, than posterior, II., 25. As are the substances, so are all their adjuncts, II., 28, 288, 289. Matter joined to form is substance, *ibid.* The adjuncts of substances, like substances themselves, admit of degrees of simplicity, priority, height, inwardness, universality and perfection, II., 29. The higher adjuncts influence the lower, and *vice versâ*, according as the substances are formed, and as they intercommunicate, II., 29, 287—289. Those adjuncts that occupy the higher place are incomprehensible, and appear as continuous, to the sensory of lower things, II., 29. Those occupying the lower are comprehensible, and appear as contiguous, to the sensory of higher things, II., 30. The lower regard the higher as analogues and eminent, *ibid.* A higher substance is the analogue of the next lower; a still higher, the eminent; a still higher, the supereminent, II., 31. See *Aggregates*. The universal substance is the spirituous fluid; the general substance is the red blood, II., 198. Substances and their forces are regarded as identical, II., 214, 289. They discover their character by the mode of their forces, II., 216. See *Influx*. Their quality is determined by their form, II., 231. Every prior substance represents to itself its posterior substances, II., 257. And this representation extends as a cause to all causates, *ibid.* The posterior also represents the prior, the formula being true in either direction, *ibid.* The mutations or accidents of substances do not extend a hair's-breadth beyond substances themselves, II., 271, 273, 274. See *Ideas*.

SUCCESSION: see *Embryo*. All things are put forth in successive order, 226; II., 5. Whatever coexists must become extant successively, *ibid.*, 272, 312, 511; II., 5. See *Contingent, State*. The purest fibrils are first produced, then the vessels of the purer blood, and lastly those of the red blood, 247, 290. See *Degree, Order*.

SUN. As the universal vortex includes an active sun, so the least vortices or parts of the universe include substances having a similar activity or gyration, 282. The sun is the principle of motion in the universe, II., 229, 230. See *God*. Beyond nature there is a purely moral sun, II., 246.



**TENDON**, Tendinous fibres act in general as museular fibres act in particular, 523.

**TERMS** change as substances pass out of one degree into another, 105, 232 ; II., 49, 203. See *Degree, Formation, Name, Vessel*. As nature ascends through her degrees, she lifts herself from the sphere of particular and ordinary terms, into that of universal and eminent ones, II., 49, 203. In the highest region of the animal kingdom, where the soul abides, there is no corporeal language that can adequately express its nature ; still less the nature of things higher still ; whence the necessity for a mathematical philosophy of universals, with characteristic marks and letters, II., 54, 55, 203.

**TIMES**. The ancients surpassed the moderns in wisdom, in the art of distinguishing things, and in conjectures respecting the unknown, 13, 14 ; II., 56. The moderns surpass the ancients in the accumulation of facts, 13, 14. Each period occupies its province, and its place in the purposes of Providence, 13, 14. The time has come when we must elicit wisdom from experience, 14. Men at present regard the known as unknown, the true as probable, and the probable as false, II., 207.

**THEOLOGY**. The mind cannot penetrate by philosophy into the sanctuary of theology, II., 246. See *Revelation*.

**THORACIC DUCT** : see *Animal Spirit*. When the thoracic duct is not supplied with chyle, it carries the fine lymph returned from the arteries, 42.

**THOUGHT** consists in revolving intelligible materials according to the order of the nature of things, II., 260. It is higher than imagination, II., 261, 297. It approaches somewhat to the most general intuitions of the soul, II., 297.

**THRESHOLD**. There is a threshold between the vessels of the brain and heart, but the vessels of the body immediately enter the heart, as their own proper organ, 512 ; II., 76.

**THYMUS GLAND**. Its lobular substance surrounding the great arteries habituates them to sustain the force of the blood, 273.

**TRUTH**. When it is present, all experience, and all the rules of true philosophy, attest it, and such hypotheses as are founded on any common notion, coincide with it, or indicate points of contact, or approximation, 4, 125, 138, 266 ; II., 3, 63, 68, 209. The mind that has known the pleasure of discovering the truth, is carried away wholly in pursuit of it, 10. The lovers of truth esteem the arts and sciences only as aids to wisdom, 10. To suspend our belief in truths till the microscope makes them visible, is but to appeal to future generations, which will certainly cheat our hope, II., 254. Order is truth, *ibid*.

**TUNIC** : see *Fibre*. The first tunics are formed by the fixation of the spirituous fluid, II., 304.

**UNDERSTANDING**. Nothing is further from the understanding than what is most really present to it, II., 202.

**UNDULATION** is the propagation of local motion once begun, without the translation of the volume or mass on which the first local motion was imprinted, 130, 133. The undulatory motion of the air constitutes modulation, *ibid*., 132. The undulation of the ether is modification, *ibid*., 133. See *Aura, Light, Modification, Motion*. There are three common springs of undulation in the body, *viz*., the brains, the lungs, and the heart, 132. Undulation is manifold in origin, nature, composition, order, and appellation, 132. Undulation in the blood constitutes systole and diastole, or circulation ; in the purer blood, respiration ; in the spirituous



fluid, animation, 133. The progression of undulation is unobstructed till it terminates in conatus, 134, 135, 162. In the fluids it advances by perpetual spirals, 134. No doctrine comprises so many scientific laws as that of undulation, 136, 137. See *Color, Heat*. In one volume, undulation is produced from a thousand centres, simultaneously and successively, 136. It is impossible to understand the animal economy without we have a knowledge of undulatory or modificatory motion, 137. See *Blood*. The undulation of the sonorous and vibratory tracts of the head, neck, and chest, consociates the homogeneous parts of the blood, discusses the heterogeneous, and augments its fluidity, impelling the spirituous fluid to copulate with the purer blood, 343. Undulation and modification correspond to each other as degrees, 451, 489.

**UNIT**: see *Sphere*. The blood-globule comprises the determined units of every degree, 76. The division of things continues, without change of nature, to their component units, but no further, 119, 232; II., 33, 213. A part or unit of any homogeneous mass, is its least volume, *ibid.*; II., 213. The parts of a whole are homogeneous with their determining units, *ibid.*; II., 213. When the roots of things are extracted, we come to another kind of unit, which is heterogeneous to the former unit, 119, 120; II., 33, 213. See *Degree, Fibre*. The passage of the blood, membranes and vessels of one order, into those of another, is not effected by continuous decrease, but by the division of each unit, 121, 232; II., 213. A unit of a lower degree is composed of aggregated units of a higher degree, with an accessory substance to copulate, determine, and perfect them, 121. A unit of a higher degree is compounded successively, and resolved successively, *ibid.* See *Series, Substance*. Aggregate entities of the same degree and series refer themselves to their units, as their simplest parts, and are homogeneous with them, II., 32. Units are not absolutely simple substances, incapable of resolution; but they are the leasts of each degree in any series, *ibid.* In a series of three degrees there are three distinct units, or quantities of units, *ibid.* Essences, attributes, accidents and qualities, like substances, have their units, *ibid.* Units are the parts and elements of philosophical matter, *ibid.* A unit is a series of many things, II., 33. A higher unit, and the next lower in the same series, are to each other as a root to its cube, *ibid.* The units of terrestrial things are determined in quantity and quality, those of the auras are indeterminate and varying, *ibid.* The form, nature, and peculiar action of aggregates, shew the form, nature, and peculiar action of the parts or units, II., 34.

**UNIVERSE**. Everything in the body has relation to some higher correspondent in the universe, II., 232. The universe is divided into singular universes, II., 302. See *Aura*.

**UNIVERSAL**: see *General*. The universal reigns everywhere in the entire series, with all its degrees, and in the general itself, II., 198. The spirituous fluid is the universal substance; the medullary fibre, the universal vessel; the motive fibre of the first degree, the universal motive fibre, *ibid.* From the universal, the series principally derives its essence and nature, and is distinguished from other series, *ibid.*

**UNIVERSALITY** consists in ensuring at once the general and particular good of all things, 233.

**USE**. All things are fashioned in anticipation of the use they are to perform, 227, 228, 233, 235. No member is formed for its own use alone, but for the general use of all its fellows, and of innumerable successors that lie in it, and are its ulterior

ends, 228, 233, 234. See *End*. To arrive at the use of a member we must contemplate its relations in the subordination of things, 229. See *Order*. The antecedent exists for the use of the consequent, but this use must be previously represented in the antecedent, 234. The sphere of the useful involves all the endowments of human life, constituting either its essence or adjuncts, II., 318.

UTILITY. We are right in measuring all things by their utility, II., 108.

VARIETY: see *Harmonic Variety*. The perfection of the whole arises from the variety of the parts, II., 286. The higher entities of nature are the most susceptible of variety, and the most prone to change of state, II., 301. By this means they are the causes of infinite varieties in the posterior sphere, II., 302, 303.

VEGETABLES derive their individuality and coherence from the ether of the third order, II., 350.

VEIN: see *Artery*. In the veins there is no circulation, but mere impletion and depletion, or pressure upon their contents in every direction equally, 155, 267, 269, 514. The blood enters the veins at different moments from various parts of the body, 158, 162, 163, 267, 514. The blood in the veins is dissimilar to that in the arteries both in quantity and quality, 159, 167, 198, 199, 291. The natural chemistry of the body, and the recomposition of the blood, could not be carried on, if the blood were propelled into the veins by the same violent motion as into the arteries, 160, 291. The veins are the receptacles or passives of the arteries, 161, 169, 185, 186, 191, 291. See *Fat*. The entire composition of the blood is effected in the veins, 168, 172, 198, 291. There is no secret power of attraction exercised by the veins, but an extrinsic power allocates at their mouths the matters they seize and swallow, 172, 173, 321. The veins seek out and procure those substances that the blood and the kingdom require for renovation and preservation, 174. The innermost membrane of the artery is the outermost membrane of the vein, 138, 184, 185. Absorbent stamina depend from the little veins, 184. The veins do not put forth their absorbent stamina, but these stamina insinuate themselves into the veins, and with the arteries, constitute them, 185, 191. See *Coronary Vessels, Courage, Death, Fear, Heart, Vena Cava*.

VENA AZYGOS. Almost all the veins from the respiratory field meet in it, 264, 559; II., 77. Receiving the blood from the spinal marrow, it gives the last aid to the motion of the heart, 562. It pours its blood into the vena cava synchronously with the respiratory movements, II., 78.

VENA CAVA: see *Circulation, Foramen Ovale, Motion of the Heart*. The venæ cavæ move with the ventricles, 506. In regard to pressure, action, and influx of blood, they are to the right auricle as the right auricle is to the right ventricle, 508. They can vibrate many times while the auricle vibrates once, 509. The superior vena cava acts as far as the nervous girth at the vestibule of the auricle: the inferior, as far as the mouth of the right ventricle, but to no distinct vestibule, 510, 517. See *Embryo, Threshold*. The tunic of the vena cava makes common cause with the blood, 512. The action of the venæ cavæ is continuous or perpetual, and identical with active pressure or living conatus, 513, 517, 519. See *Vein*.

VENTRICLE: see *Coronary Vessels, Heart*.

VERTEBRAL ARTERY: see *Brain*. When it reaches the brain and spinal marrow it no longer obeys the action of the heart, 325; II., 68, 69. It enlarges on entering the cranium, 326. It expands and contracts with the brain, and not with the heart, 327; II., 69. It undergoes reflection and infraction in passing to the foramen of the skull, II., 69.

VESSELS. They are only determinations of the blood, 1, 48, 103, 286. All parts of the body, in the tenderness of their infancy, consisted of vessels and fibres, 2, 47. See *Circulation, Fibre*. There would be no action unless the blood were determined by vessels, 104, 286. The coats of the vessels are threecfold in origin, degree, nature, composition, and name, 104. The vessel and the blood conjointly are one thing, 105, 138, 143, 512. The tunic or coat is of the blood, and the blood is of the tunic, *ibid.*, 138, 139, 141, 143, 144, 512. The blood being given, the nature of the tunic may be inferred, and *vice versâ*, *ibid.*, 138, 512. The membranes of the vessels correspond to the degrees of the blood, 106, 138, 167, 178. The vessels have three essential membranes or coats; the others are but auxiliary to the sanguineo-muscular coat, *ibid.*, 108, 109, 149. The most universal coat is the inmost or nerveo-membranous, *ibid.* The next in universality is a nerveo-motive membrane discoverable in the smallest vessels, 107. The third is the sanguineo-muscular, 108. The latter coat belongs to the vessels of the lower region, or of the body, but not to those of the brain, *ibid.* Of the coats of the vessels, one is prior to, and more universal, simple and perfect than, the other, 109. Three tunics convey the red blood, 110, 191. Fewer and simpler tunics enclose and carry the purer blood, *ibid.* A single membrane encloses and conveys the spirituous fluid. *ibid.* The vessels of the first degree are the blood-vessels: those of the second, the exsanguious vessels: those of the third are the fibres of the nerves, 111. See *Nerve*. The third degree of vessels is not succeeded by the second except in the brains, 112, 114, 144, 167. As the red blood passes from its own vessels into those of the second order, it is divided into the purer blood, 113. As the blood passes from the vessels of the second order into those of the first, it is divided into spirituous fluid, 114, 167. After passing through the fibres, the blood returns into the second and third (or first) orders of vessels, and is recompounded as it was divided, 115. The blood-vessels have their determinate maximum and minimum, and proceed from their maximum to their minimum, and *vice versâ*, 119, 120. Also the vessels of the second order, and those of the first, or the fibres, 120. See *Artery, Blood, Cause, Glands, Vein*. More blood is contained in the minute vessels collectively than in the trunks, 141. The muscular coat of the vessels is required to promote the general pressure and circulation, 149. In the muscular coat lie all the strength and force of the artery, 150. An inner membrane is required to collect the muscular rings of the arterics, and determine them into effect, 153. The heads of the science of the vessels are as follow: I. That proper liquids and elements be conveyed to the blood. II. That they be duly mingled with it, 163. III. And duly insinuated into, and presented to, the blood, 164. IV. And duly separated, viz., the heterogeneous from the mixed homogeneous, and the latter from the pure, *ibid.* V. And sequestered, 165. VI. And after sequestration, eliminated, or reabsorbed, 166. The perpetual anastomoses of the vessels prevent undue aversions of the arteries, or appetencies of the veins, from injuring the animal economy, 176. See *Leasts, Muscle*. The mutations are perpetual in the field of least vessels, being according to the actions and affections of the brains, 195. Every mutation in this field, which is one extreme of the blood-system, produces a corresponding result at the other, or in the pulse of the heart, 196. Besides the ductus arteriosus and umbilical vessels, there is an infinity of others in the body that become impervious, forming various kinds of cords and fibres, 334. All lower vessels, as being produced by the fibre of the spirituous fluid, may be called derived fibres, 487.

VISCUS : see *Embryo*.

VISION. At the point of no vision, infinitely more numerous and distinct things begin than the eye can ever detect, II., 135. When we arrive at this point, the mind must take up the subject, *ibid.*

WATER : see *Serum*. The particles of water are rough spherules, somewhat hard, and nearly inert, 53. See *Spirit*.

WILL. The will is not determinable into bodily acts without the cortical substance, and the disposition of it we see in the cerebrum, II., 176. It proceeds always *pari passu* with the science possessed by the cerebrum, or with the understanding, II., 183, 311. It is really the conclusion of the judgment, II., 233, 261, 309, 314. Our will calls forth the Divine consent, but God's will never compels us to act, II., 244, 324, 329. Action is perpetual will, and all the essentials of action lie in the will, II., 310, 323. A single will is formed of as many wills as there are intermediate ends leading to whatever is regarded as the ultimate end, *ibid.* The more intelligent the man, the more free his will, II., 311. See *Liberty, Mind*. Will is perpetual determination to act, II., 323.

WISDOM. The means by which we can mount from ignorance to wisdom, are not provided by the soul, but by the Creator, II., 285. Wisdom makes all things into something, II., 356. See *Soul*.

WOMB : see *Egg*.

WORLD : see *Aura*.



## APPENDIX.

SWEDENBORG'S PHYSIOLOGICAL MANUSCRIPTS IN THE LIBRARY OF THE  
ROYAL ACADEMY OF SCIENCES OF STOCKHOLM. MEMOIR THE SECOND.  
BY DR. P. E. SVEDBOM, LIBRARIAN TO THE ROYAL ACADEMY OF SCIENCES  
OF STOCKHOLM, PH. D., A.M.

IN addition to those works of Swedenborg which I mentioned in my former Memoir,\* there are in our collection others of physiological and philosophical import, which perhaps may be worth the attention of those who take an interest in Swedenborg's Manuscripts. Among these, the first place appears to me to belong to a volume which I will now endeavor to describe a little particularly.

This book, which is in Swedenborg's own hand-writing, contains 130 leaves, *fol. max.* On the back it has the title, (printed by the binder,) 'Physiologica et Metaphysica,' and it bears the same title also in the old manuscript catalogue of our library.

On the first page, without any title preceding it, we have the word '*Praefatiuncula*,' and this little preface extends over two leaves, not numbered in the series of the book, and in which the author, as it seemed to me from a cursory reading, principally discusses his manner of investigating the intercourse between the Soul and the Body.

Then there follow, on the two next leaves, some fragments on the Blood and the Fibres (without a title); but I do not know whether these fragments are really connected or not with the other contents of the work.

The remaining leaves or folios of the volume are regularly numbered, the leaf which is really the fifth in the book being numbered 1, and this order continuing to leaf 127, which concludes the book. But leaf 110 is wanting.

In fol. 1—14, the author treats in various chapters (whose titles are numbered from cap. xv. to cap. lxxvii.) of Sensation, and the Organs of Sensation, particularly of Touch, Taste, Smell, and Hearing, (pp. xxviii.) On the opposite side of leaf 14 [fol. vers.] we have the heading, Sight, the explication of which subject is continued to the opposite side of fol. 18. (pp. ix.)

\* Animal Kingdom, Vol. II., p. 653.

Then follows: Perception,\* Imagination and Memory, and their ideas, fol. 18 vers.—21. (pp. vi.)

Pure Intellect, fol. 21 vers.—24 vers. (pp. vi.)

Intellection, Cogitation, Reasoning and Judgment, or the Human Understanding, fol. 24 vers.—28. (pp. viii.)

The Intercourse between the Soul and the Body, fol. 28 vers.—32 vers. (pp. ix.)

Harmonies, and the Affections and Cupidities arising therefrom, treated generally, fol. 33—35 vers. (pp. 5.)

Then we have on fol. 35 vers., the title, The Animus and its Affections treated specially; and the treatise on this subject is continued, if I am not mistaken, to fol. 55, although the several chapters into which it is distributed, from fol. 36—55, are distinguished variously by particular titles: as Joy, Sadness;—Loves in general;—Venereal Love;—The Hatred and Crimination of ditto;—Conjugal Love;—Conjugal Hatred;—Love of Parents towards their offspring, or *storgē*;—Love of Human Society and one's Country;—Love towards Associates, and Friendship;—Hatred;—Self-love, ambition, pride, haughtiness;—Humility, contempt, want of courage;—Hope and Despair;—The Love of posthumous Immortal Fame;—Generosity, Magnanimity;—Pusillanimity and Envy;—Avarice;—Prodigality, Liberality, Contempt of Riches;—Mercy, Charity;—Fear and Dread;—Fortitude, Intrepidity, Courage;—Indignation, Anger, Fury, Zeal;—Patience, Mildness, Tranquillity of Mind, Impatience;—Shame;—Envy;—Revenge;—Misanthropy;—Love of Solitude;—Cruelty;—Clemency;—Intemperance, Luxury;—Temperance, Parsimony, Frugality.

Next follows: The Animus and the Rational Mind, fol. 55—64. (p. xix.) And then: The Loves and Affections of the Mind treated generally, fol. 64. (p. i.) The dissertation on this subject (in special) is continued under the following titles:—The Love of Understanding and being Wise;—The Love of knowing occult things, and Wonder;—The Love of Foreknowing the Future;—The Love of Truths and Principles;—The Love of Good and Evil;—The Affirmative and the Negative;—Conscience;—The summum bonum and summum verum, or the greatest good and the greatest truth;—The Love of Virtues and Vices; the *Honestum*, *Decorum*, &c., &c.;—Conclusion from the foregoing, showing the nature of the animus, and of the spiritual and rational minds;—The rational mind is properly the Man. The whole of this Dissertation occupies fol. 64 vers.—71 vers., or xv. pages. After which we have Free Choice or Election of moral good and evil, fol. 72—80 (pp. xvii.); the heads or chapters of this Dissertation being numbered regularly from 1—25;—The Will, and the Liberty thereof, and the nature of the understanding relatively, fol. 80 vers.—84. (pp. viii.) *Discursus*;—Human Prudence;—Simulation and Dissimulation; Astuteness, or Cunning, and Malice;—Sincerity;—Justice and Equity;—Science, Intelligence, Wisdom;—The Causes that Change, or pervert and perfect the state of the intellect and rational mind;—The Loves of the Soul, or Spiritual Loves;—The Love of one's associate as of one's self;—The loving Society as many selves;—*Amor proximus esse Amato*:—The Love of surpassing in happiness, power, wisdom;—The Love of propagating heavenly society by natural means;—The Love of one's body;—The Love of immortality;—Spiritual Zeal;—The Love of propagating the Kingdom and City of God;—The Derivation of Corporeal Loves from Spiritual Loves, and the Concentration of them in the Rational Mind;—Pure or

\* The words 'first internal' are here crossed out.—(P. E. S.)



Divine Love regarded in itself. This Dissertation, reckoning from the chapter headed *Discursus*, (see above) occupies fol. 84 vers.—96 vers., or xxv. pages.

Then follows, fol. 26 vers.—fol. 101: The influx of the animus and its affections into the body, and of the body into the animus;—the influx of the rational mind into the animus, and by means of the animus into the body, and the influx of the animus into the rational mind;—The influx of the spiritual mind or soul into the animus, and of the animus into the spiritual mind;—The influx of the spiritual loves of the soul into the rational mind, and *vice versâ*;—Inclination;—Temperaments;—(pp. x.)

On fol. 101 we have the heading, 'Minds of Brute Animals,' but this title is crossed out, and has no subject matter.

The MS. then treats of Death, fol. 101, vers.—103. (pp. iv.);—The immortality of the Soul, fol. 103 vers.—105, (pp. v.);—The state of the Soul after the death of the body, fol. 106—109 vers. (pp. viii.) But here fol. 110 is wanting, which makes it doubtful whether this Dissertation on the State of the Soul, &c., is complete, or not. For the same reason the heading and beginning of the next Dissertation, which is contained on fol. 111, 112, (pp. iv.) are wanting. Fol. 113 treats of Hell, or the Society of unhappy Souls, (pp. ii.) but folio 114—116, of Divine Providence, (pp. v.)

Fol. 116, vers.—117 vers., Universal Mathematics, (pp. iii.) containing, as it seems, some observations on the philosophy of Locke.

The remainder of this book, from fol. 118—127, (pp. xx.) is occupied by a Dissertation which has the title 'Ontology' prefixed to it at the head of fol. 118. From the commencement of this Dissertation, certain subjects are considered in general, and are afterwards treated severally under various heads. These heads are as follow:—I. Form, Formal Cause; II. Figure; III. Organ, Structure; IV. State, Changes of State; V. Substance; VI. Matter, Materiality; VII. Extense, Extension, Continuum, Continuity; VIII. Body, Corporeals, (the other heads are not numbered);—Essence, Essentials;—Attribute;—Predicate;—Subject;—Affection;—Accidents;—Contingencies;—Modes;—Modification. As for the manner of treatment, the opinions of Wolff, Baron, and others, are for the most part stated first, and the author's own opinion then given, or at least intimated. But, like many other things contained in Swedenborg's MSS., this Ontology is not complete, being only a sketch, which the author proposed to develop afterwards.\* further.\*

The whole book is closely written, and in some parts in a cramped hand, and will be difficult to read and decipher.

And this is what I have to offer with respect to the merely external and bibliographical knowledge of this Manuscript. But as for a more internal and perfect knowledge of the argument, I have not yet had leisure to acquire it. I dare not, therefore, judge of the value or weightiness of the Dissertations whose titles I have given, or of the relation in which they stand to the author's other works, published or unpublished. But I am well persuaded, at all events, that the contents of this

\* And the same remark holds, if I am not mistaken, of many other portions of this Book. Thus, after the part on Divine Providence, mentioned above, I find the following written by Swedenborg on fol. 116:—'But respecting Providence, fate, fortune, predestination, and human prudence, there is more to be said, which see, and add.'—(P. E. S.)

book are, for the most part, eminently worthy of a more accurate investigation, but which can scarcely be instituted until they are made more easy to read and understand, for certainly, at present, it is no small task to decipher them.

P. E. SVEDBOM.

Doctor of Philosophy and Master of Arts.

Stockholm ; the Library of the Royal Academy  
of Sciences, July, 1845.

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### CORRECTIONS IN THE WORK.

Vol. I., page 40, line 20, for "generic," read "genetic."

Ibid., page 234, line 19, read "according to the law, (since the soul has ceased to be his image,) that so far as it is dependent upon him," &c. : and line 22, dele from "but so far as it," to the end of the paragraph : also the note at the bottom of the page.

Ibid., page 511, line 34, for "veins," read "brains."

Ibid., page 518, line 18, for "or else of blood from some other source," read, "or elsewhere." Again, line 24—27, instead of, "We have said," &c. down to "there is an influx also from," read, "Or elsewhere ; for in some subjects there is an efflux through the foramen ovale ; and also from," &c.

Vol. II., page 25, line 20, after "things," insert (De Interpret., lib. i., tr. iv., cap. vii.) : line 23, after "individuals," insert (x) the mark of an unverified reference.

Ibid., page 37, line 16, after "animated," insert (De Cælo, lib. ii., cap. ii.) ; and line 17, after "intellect," insert (x). Line 23, after "accidents," insert (Natural. Auscult., lib. ii., cap. i.) Line 25, to "privation," insert a note as follows : (Sec edition of Aristotle, Paris, 4 vols. fol., 1654 ; vol. i., p. 64, in the Synopsis Anal. Doct. Peripatet. : also Aristotle, Natural. Auscult., lib. i., cap. vii.) Line 34, insert as a note (See the same Synopsis, Ibid.) Line 39, after "potency," insert (De Anima, lib. ii., cap. i.)

Ibid., page 38, line 1, after "understand," insert (Ibid., cap. i.) Line 5, after "first," insert (x).

Ibid., page 48, line 12, after "body," insert the same. Line 15, after "first," insert the same.

FINIS.

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