

A RATIONAL PHYSIOLOGY.

Swedenborg's Economy of the Animal Kingdom.

THE influx of Life from the Lord is unceasing and continuous; perfectly and infinitely one, as it descends through an unbroken chain from its eternal source, even to the most gross and inert subject of the mineral kingdom, it is modified and adapted to its numerous and varied recipients. Yet, varied though they are, the life they receive impresses upon each, more or less perfectly, the image of its creator. Thus, from mineral to plant, from plant to animal, all seem to emulate the Human Form which is the most perfect, the crowning work of all. As if endowed with formative intelligence, the hard, unyielding substances of the earth crystallize into forms resembling plants. Ascending higher, we again see a wonderful analogy between the forms of vegetable and animal life; from the humblest alga to the statliest tree, from the amoeba to the most highly developed animal, all are imbued with the endeavor to emulate the human form—the complex and epitome of all that the universe possesses. The ancients rightly termed the body a microcosm, for there is not a principle or a form in the whole range of Nature, but what finds some representative counterpart therein. A just comprehension of the one, therefore, aids and furthers the conception of a true understanding of the other. Hence arises the importance, nay, the necessity, of some knowledge of anatomy and physiology. How few there are, who can boast of anything more than a vague smattering of these subjects, how few who have learned even sufficient to insure bodily comfort and safety. They have not been taught the necessity of such knowledge.

But, supposing one of an inquiring turn of mind undertakes the task of informing himself, whither will he turn for information best suited to his needs? In this age of modern progress, it is only natural to suppose that science, in all its branches, is fast reaching a high degree of perfection, and that the science of Physiology compares favorably with the rest. Such, however, is not the case. Scan the literature on this subject from beginning to end, and you will discover naught but a heterogeneous mass of facts, many of them valueless, interspersed with a few flimsy and childish theories. Hosts of laborers in this field have come and gone, having spent their life and energies in digging out a few new facts or framing some new system of theories, to hold sway in the minds of the physiological public, till another, destined to be equally

as ephemeral, thrusts it aside. Materialism reigns supreme. The soul is relegated into the background or totally ignored. All manifestations of life are degraded to the level of mechanical and chemical processes, so that the body becomes a machine, just as liable to disarrangement as any of the mechanisms wrought by the hand of man. Encouraged by recent discoveries in the laboratory, where a few of the composite substances, previously formed only in organic bodies, have been manufactured artificially, some physiologists have been audacious enough to assert that all vital phenomena will, in time, be placed upon a physico chemical basis. The recent utterances of Prof. Howell, of Johns Hopkins University, are a typical example of this agnosticism: "In the early part of this century, many prominent physiologists were still so overwhelmed with the mysteriousness of life that they took refuge in the hypothesis of a vital force or principle of life. . . . It seems evident that a doctrine of this kind stifles inquiry. Nothing is more certain, than that the great advances made in physiology during the last four decades, are mainly owing to the abandonment of this idea of an unknown vital force, and the determination, on the part of experimenters, to push mechanical explanations to their farthest limit." (*Am. Text Book of Phys.*, p. 25.)

Swedenborg foresaw this materialistic tendency, and somewhere in his writings he predicts that, unless the scientific thought of the day be elevated out of the sensualistic mire in which it grovelled, science would be hurried into an untimely grave. And his prediction has been realized to its fullest extent. The science of this day is a catalogue of dead facts, scarcely meriting the appellation of "system," and to which the term "rational" is entirely foreign. That which may be called *rational* never grows obsolete; it is self-sustaining, irrefragable, and, raised above the kaleidoscopic changes of ordinary affairs, the lapse of ages in no wise detracts from its validity. Such in an eminent degree is the Rational Physiology of Swedenborg. Though presented to the world over one hundred and fifty years ago, it is just as true, just as practical and capable of application as it was when fresh from the pen of its illustrious author. It is based upon and deals with facts, the results of experiment and physical investigation, yet these are marshalled in new array, are coördi-

nated and classified under universal laws, reinforced by an iron interframework of sound reasoning, which results in an entirely new and unique system. Such a system can scarcely help but find an acknowledgement of its worth in an unbiased and affirmative mind; it speaks for itself.

The author's humility and implicit trust in a Divine Father who rules in all things, shine forth on every page. Indeed, the objection might easily be raised, that this new science is tinctured too deeply with a theological hue, to be strictly scientific. This would be a valid criticism from the standpoint of the modern scientist, who requires no great perspicacity to discern the fact that science and religion so-called, have nothing in common, that they clash at every turn. Technically speaking, Swedenborg's physiological works are more philosophical than scientific, and in a broader sense than is usually understood by the former term. For his philosophy soars far above that of an ordinary sort, and yet descends to the very confines of scientific truth. Thus it is that it forms a connecting link and bond of union between a true science and a true religion, the one forming an ultimate, stable basis for the other, which in turn gives vitality. In the philosophy of Swedenborg, religion seems to fit and take its place naturally, instead of stalking before us in black stock and long frock coat—it never palls.

In view of what has been said, we are not surprised to find that this philosophy, so gigantic and all-inclusive, is, nevertheless, consistent in every detail. Probably no author ever wrote so voluminously and yet with such remarkable unity throughout. The reason of this is evident from the works themselves. In all his studies, Swedenborg was guided by universal doctrines and principles formulated by himself. Chief among these were the Doctrine of Order and Degrees, the Doctrine of Series and Society, the Doctrine of Influx, the Doctrine of Correspondence and Representation, the Doctrine of Use. To these may be added the following axioms: Nature is the same in greatest as in least; "all things are formed and completed in motion, according to motion and with a view to motion," (*Economy*, Vol. I, p. 133;) the end is simultaneously in cause and effect, etc., etc.

These and a few other universal principles were talismans that opened the gates to nature's most occult recesses. By their means Swedenborg was enabled to obtain a grasp of the animal economy and its inmost workings that is simply marvelous. The Doctrine of Use was his guiding star; by its means he established the wonderful economy of Nature—not a cell, not an interstice, not even the the minutest fibril, but what was created for use

and in use. "The use or effect," he says, "which carries out the end must be the first object of our inquiry. The nature and quality of a member or organ is known from use. Use determines what a thing is in itself or in its own form." (*Animal Kingdom*, Vol. I, p. 32.) With these truths in mind, and by the help of his Doctrine of Series and Society, he was enabled to assign uses to organs, which had previously baffled the investigations of the most illustrious observers. The pineal gland, which Descartes thought to be the seat of the soul, assumes guard over the ventricles and regulates the lymph that flows into them, besides having some influence on the sense of sight. The infundibulum and pituitary body constitute a sort of gateway, through which the animal spirits and its adjuncts are distilled on their way to the jugular veins. The sheaths of the olfactory filaments, descending through the cribriform plate of the ethmoid bone, are excretory channels of the brain, drawing off the impure and effete humors that would clog its delicate machinery, and extruding them into the cavity of the nose. The spleen is promoted to the dignity of a blood-purifying laboratory; the thyroid gland secretes a glutinous lubricating and digestive humor into the canal of the oesophagus; the supra renal capsules, to this day one of the stumbling blocks to the physiologist, are found to assist the kidneys by drawing off the surplus of pure blood from their arterial current, besides promoting a serous circulation through the intricate windings of the intraperitoneal space; the little appendix, too, so long neglected in its out of the way corner, is assigned the function of elaborating and pouring out the last and most searching of the digestive menstria into the pouch of the caecum.

The Doctrine of Degrees taught the just value and relative position and distinction of all things; the Doctrine of Influx, how the lower were governed by the higher. By his knowledge of the fact that nature was similar in greatest as in least, he was enabled to study the sun and its atmospheres, and penetrate with the eye of reason to the innermost degrees of the body, where he describes subtle forms and modes of activity far beyond the ken of the most perfect microscope. He demonstrates the existence of an animal spirit, which was known to men of his period, for Glisson says that it was believed in "by nearly all physicians and by all philosophers," but is rejected by modern materialism.

Between the years 1741 and 1744, Swedenborg devoted his time almost exclusively to the study of anatomy and physiology. Judging from the list of authors he quotes, the amount of reading he accomplished must have been enormous. He did some dissecting, but abandoned this as calculated

to detract rather than aid his investigations, (see *Economy*, p. 18.) He therefore depended, for the most part, upon the labors of other men, to afford him the scientific facts he needed, contending that "there are some that seem born for experimental observation, and endowed with a sharper insight than others, as if they possessed naturally a finer acumen; such are Eustachius, Ruysch, Leeuwenhoek, Lancisi, etc."—(*Ibid.*) At the time Swedenborg began his study of anatomy, the subject had been receiving a new impulse from the great minds that had entered its field. The crudities and misconceptions engendered by the dissection of the lower animals, or by no dissections at all, were gradually being dispelled. For, as the popular and religious prejudice against mutilating the human body weakened, the examination of the cadaver itself became more prevalent. The circulation of the blood had been demonstrated by Harvey, the existence of the lymphatics had become an accepted fact, and many other important discoveries in the realm of anatomy and physiology were daily being written about and discussed. Thus it was, that our author found a wealth of facts at his disposal, and he set about the task of mastering them with indefatigable energy. He seems to have spread out before himself all the facts at his command, choosing some and rejecting others that failed to respond to the test of his formulated principles. With remarkable acumen, he sifts the dross from the gold; often does it occur, that an insignificant remark, apt to be overlooked by the casual reader, is seized by him as a prize, and augmented and exalted into a pillar of the temple he is building. Often does it occur, that statements in his authorities, apparently of great import, are contradicted point blank.

With principles of such wide and universal bearing as his allies, is it to be wondered at, that Swedenborg has in very many instances anticipated modern discoveries? It is safe to say, that no author has had so many of his discoveries attributed to other and later writers. To give a full list would not only be difficult, but we have not space to do so. We will cite a few of the most important. Thus he proved conclusively the permeability of animal membranes, anticipating the later discovery of osmosis and endosmosis. In his consideration of the lymphatic system, he anticipated the "beautiful theory of Dr. Prout." The expansion and contraction of the brain, synchronous with that of the lungs, the discovery of which is usually attributed to J. D. Schlichting in 1750, was described by Swedenborg as early as 1741, in an exhaustive treatise of the subject in the *Economy of the Animal Kingdom*. He also showed that the movements of respiration pervaded the entire system, a fact dem-

onstrated in 1846 by one Dr. Piégu, who published a "note on the Double Movements observed in the Limbs," in which he describes experiments plainly showing that not only the pulse, but also the motion by the lungs was communicated even to the toes and finger tips. The discovery of the cerebro-spinal fluid is attributed to Contuguo, in 1764, yet Swedenborg was aware of its existence thirty years previous to that date. He may also be said to have discovered the foramen of Magendie, (see *The Brain*, Vol. II, p. 714) as well as the foramen which now bears the name of Monro. He also hints at a channel leading from the fourth ventricle of the brain directly into the centre of the spinal cord—yet the central canal of the medulla spinalis was given to science at a much later date. The corpora striata, Swedenborg tells us, are "vicarious cerebra, and succeed in the place of the crebrum whenever the latter is deprived of its power of acting." Ferrier and his followers have confirmed the same. Further, in a short treatise on the Red Blood, as well as in several other places, Swedenborg distinctly asserts that the red blood is a living substance, and notably in the *Economy*, he calls it the corporeal soul. The experiments of a French philosopher, M. Dumas, (1847) as well as of later investigators, show that the blood corpuscle possesses a remarkable, inherent vitality, especially in the presence of oxygen. In the *Animal Kingdom*, the author lays great stress upon the use of the saliva in digesting the food in the stomach, in fact almost totally ignoring the gastric juice *per se*. Only just recently a Dr. Kellogg has waked up to this fact and comes out in the *Annals of Hygiene* with the apparently original statement that the saliva is the most important secretion of the digestive tract, and therefore food should be well masticated to insure most thorough insalivation. The list of facts above instanced, are drawn from the domain of physiology; it does not claim to be even proximately a complete list, yet there are innumerable besides in the various branches of science which do not properly come within the scope of this article. For, so universal is the bearing of Swedenborg's principles, that into whatever field he entered, they were constantly at his side.

From his own confession it is clearly manifest that Swedenborg, in all his studies, had in view the one aim of investigating the human soul, and he left no stone unturned, that would aid in the furtherance of his object. He says: "To accomplish this grand end, I enter the circus, designing to consider and examine thoroughly the whole world or microcosm which the soul inhabits." But after years of labor, and when what he so ardently desired was almost within his grasp, it be-

came evident to him that the soul was too far above human comprehension to admit of investigation by reason, without the aid of Divine Revelation. From this period his career as a theologian began. But did all his previous work go for naught? By no means. From the very first he was undergoing preparation for the sacred mission he was destined to perform in being the means of promulgating the doctrines of the New Church, and each step, though preparatory, yet was irrefragable and formed a stone in the mighty edifice he was building. Can we not draw from this an argument establishing still further the importance of a study of his Rational Physiology? To obtain the fullest conception of it, a study of all his works is of course necessary, but the mastery of one will impart in a general way a knowledge of the principles he inculcates.

Probably the work best suited to accomplish this is the *Economy of the Animal Kingdom*. From one point of view it is the most comprehensive and hence the most important of all his physiological treatises. It occupies a similar position in regard to the human body or microcosm, that the *Principia* does to the universe or macrocosm. The Latin original was published by the author in Amsterdam, 1740-41, following the appearance of the *Principia, Outlines of the Infinite*, and *Intercourse between the Soul and the Body*. An English translation by the Rev. Augustus Clissold, including the first and second part, but not the third part, of the work, came before the public in London, 1845. It must be noted that Swedenborg derived the word "animal" from the Latin *anima*, "soul," so that, translated literally, the title should read: "*Economy of the Soul-Kingdom*," and such the work is. In the *Principia*, Swedenborg wrestles with the stupendous problems of the elementary structure of the universe, and the laws governing its ponderous gyres. In the present work he ushers us into the mysteries of the elementary structure of the kingdom of the soul, the universe in miniature. A perusal of the book opens up a new field of thought. Our ideas of this domain, are for the most part, formed crudely upon the rough models of the lecture room, the conventional plates of the text books, the shrivelled corpse on the table of the dissecting room. All these are, doubtless, necessary in their places, but after reading a chapter or two in the *Economy*, we begin to see how dry and lifeless is a science based upon these alone. Swedenborg instils a new vitality into the dry bones and shapeless mass of flesh, till it rises up and lives before our mental vision. The best recommendation for the work is found in the fact that the reader need not be a professional scientist to adequately understand the intricate subjects with

which it deals. To enter into details and for the purpose of a critical study, a thorough knowledge of practical anatomy is necessary. But even a tyro can read these pages with interest and benefit. Each step is so carefully taken, each point so clearly stated that we seem not to be learning at the feet of a great master, but rather studying *with* him. Emerson says of the work: "The *Economy of the Animal Kingdom* is one of those works, which by the dignity of thinking, are an honor to the human race. . . . His varied and solid knowledge, makes his style lustrous with points and shooting spiculae of thought, resembling one of those winter mornings when the air sparkles with crystals." And Coleridge writes in evident pleasure and admiration: "I remember nothing in Lord Bacon superior, few passages equal, either in depth of thought or in richness, dignity and felicity of diction, or in the weightiness of the truths contained in these articles." The style of the *Economy*, however, is by no means as ornate as that of the *Worship and Love of God*, nor of the *Animal Kingdom*, which are rich in metaphor and poetical ideas — it is more simple and direct.

Part I treats of the Composition and Genuine Essence of the Blood; the Arteries and Veins, their Tunics and the Circulation of the Blood; the Formation of the Chick in the Egg, and the Arteries, Veins and Rudiments of the Heart; the Circulation of the Blood in the Foetus, the Foramen Ovale and Ductus Arteriosus; the Heart of the Turtle; the Peculiar Arteries and Veins of the Heart, and the Coronary Vessels; the Motion of the Adult Heart.

Part II considers the Motion of the Brain, showing its Animation coincident with the Respiration of the Lungs; the Cortical Substance of the Brain; the Human Soul.

Part III treats in a masterly manner of the Fibres, the Arachnoid Tunic of the Brain, and the Diseases of the Fibres. It is still untranslated, though the last section is appearing serially in *New Church Life*.

The plan of the work is similar to that of the *Animal Kingdom* and others. Swedenborg, in nearly all of his writings, used the analytical method of procedure, deeming it the only safe and reliable means of studying the secrets of Nature. (See *Animal Kingdom*, Vol. I, p. 7.) Each chapter, with the exception of one or two, is preceded by quotations from standard authorities. This is followed by the "Introduction," composed of one or more short, concise paragraphs, and so carefully prepared that each word is pregnant with meaning, and the unity of the whole would suffer by its omission. These paragraphs, distinguished by the lines being more widely separated, constitute

the gist of the work, and, taken collectively, would form almost a complete abstract of it. To each is subtended several minor sections, each taking up a sentence or clause from the main paragraph and explaining its meaning in detail.

Swedenborg teaches that the blood as well as its circulation is "triplicate": 1. The spirituous fluid (or animal spirits). 2. The white or purer blood, (the lymph) and 3. The red blood, each having its own vessels and separate circulation. In considering the cause of the pulse, he far outstrips his contemporaries. In this connection a valuable treatise on motions, and especially that of undulation, is given.

The growth of the chick in the egg, forms a centre about which is grouped the story of the formation of the embryo in the womb. We are instructed how the spirituous fluid, the vice-gerent of the soul, forms to itself a material envelope. "The most pure fibrils are first produced, then the vessels of the purer blood, and finally the vessels of the red blood; one of which is prior to the other, and then, as they are compounded, one acts with the other." We at once see that this is not an ordinary treatise on embryology.

The chapter on Foetal circulation draws much from the preceding, and not only do we read of the circulation of the red blood, but also of the cycle of the purer blood and animal spirit in the infant before birth.

The Heart of the Turtle is given as an instance of the structural differences necessary in an animal that lives both on land and in water; also the difference in the circulation of the blood.

What Swedenborg says regarding the coronary arteries would revolutionize the prevailing ideas about these vessels, were it generally known. He shows by conclusive evidence that they are in reality veins, that the heart muscle obtains its blood from within, by means of the lacunae entering its walls, and which empty into the superficial vessels during the systole or contraction of the heart, and that the blood is then sent through these vessels into the aorta and right auricle, respectively.

The Motion of the Adult Heart next receives attention. Its proximate cause is the ingress of blood from the vena cava, and its maintaining cause is found in the cerebrum, cerebellum, and medullae. In describing the heart muscle, Swe-

denborg finds opportunity not only to trace the intricate gyres of its fibres and complicated layers, but also indicates why they are so placed.

The Introduction to a Rational Psychology prepares the way to a study of the soul itself. It includes the Doctrine of Series and Degrees mentioned above, and the most simple substance of the body, which is the spirituous fluid, describing how it gathers together the requisite substances in lower degrees in the formation of its body, which constitutes a compound series.

The greater part of the article on the motion of the brain, is taken up in proving that it coincides with that of the lungs, instead of the heart beat, as is the opinion of all whom he quotes. The nerves descending from the cortex of the brain are not simple threads, but hollow tubules which carry the spirituous fluid and its connate spirits to every minutest part of the body. Each fibre emerges from its own cortical gland, which is like a little heart or corculum, and the animation or expansion and contraction of these collectively, produces the animations of the brain.

The final chapter of Part II seems to be one of several preliminary essays on the Soul, which appear here and there throughout Swedenborg's works. In the preface of the *Animal Kingdom*, he thus characterizes it: "Not very long since, I published the *Economy of the Animal Kingdom*, a work divided into distinct treatises, but treating only of the blood, the arteries, and the heart, and of the motions of the brain and the cortical substance thereof; and before traversing the whole field in detail, I made a rapid passage to the soul and put forth a prodromus respecting it. But on considering the matter more deeply, I found that I had directed my course thither too hastily and too fast. . . . I took the step, impelled by an ardent desire for knowledge."—(A. K., No. 19.) It considers the soul and its vice-gerent the spirituous fluid, the *mens* or higher mind, and the *animus* or common sensorium, and the intercourse between the soul and the body. This is a brief resume of what is contained in the work. We have but skimmed the surface, but a careful perusal will well repay the trouble it entails. The *Economy of the Animal Kingdom* is a mine of scientific wealth.

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NOTES.

Rev. John Worcester sends us a translation of an important passage from *The Last Judgment Posthumous*, bearing on the subject of Degrees, which we

here give. In this we find it stated that besides the three spiritual atmospheres there are also three derivative spiritual atmospheres below the natural