SWEDENBORG'S VIEW OF THE BRAIN[*]

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Introduction

This article presents several basic historical facts regarding Swedenborg's view of the brain and his theory concerning the cerebral cortex and its functions. Using his studies of scientific literature in the field, autopsies, and observations on experiments with animals, Swedenborg worked his way to his own conceptions of the brain.

Swedenborg lived from 1688 to 1772, and it is in this time perspective that we approach his thoughts on the connection between the life of the soul and the functioning of the brain. He was born in Stockholm on January 29, 1688, on Regeringsgatan 18, baptized "Emanuel" in St. Jacob's congregation there, and died March 29, 1772, Baker Street in London. As an eleven year-old he matriculated in the Västmanland-Dala region student group at Uppsala University, where he defended his graduation thesis in 1709 at the age of 19.

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Professor Wetterberg described the circumstances in which he gave a lecture in 1992 on the subject of this article, as follows: "This article was based on a lecture of the same topic, with about 50 slides, which I presented at the lecture hall of the Academy of Arts, Stockholm, in the evening of Tuesday December 15, 1992. I could during my lecture—through the window of the lecture hall—point to the streets in Old Town of Stockholm where Emanuel Swedenborg and his friend Carl von Linné were walking on January 29, 1741, to the Swedish Academy of Sciences where Emanuel Swedenborg, on his fifty-third birthday, presented the Academy with a set of his *Ecomony of the Animal Kingdom* including his view of the human brain."

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To London, Leiden and Paris

The year after he defended his thesis he traveled to London to broaden his perspective and gather international experience for himself. Being of a practical bent, in order to be able to learn various technical skills during his foreign studies, he took lodgings with different craftsmen, such as a watchmaker, cabinetmaker, instrument-maker, copper-engraver, and learned their crafts. In 1712 he traveled from London to Holland in order to become acquainted with the writings of the great Dutch scientists Huygens and Lemerys, as he had done with Boyle. In Leiden, within a short time he learned lens grinding. He continued his trip to Paris where he studied geometry and mathematics. During this period he sent home drawings for fourteen inventions he had made: drawings for a submarine, new methods for constructing locks, a steam engine, a "universal music instrument," and an airplane.

Scientific Journal in Swedish

In the years 1716–1718, working from Uppsala he published the first Swedish scientific journal, *Daedalus Hyperboreus,* in six volumes. In the words of contemporary specialists in the field, Swedenborg's publication was judged to be "shining with learning, diversity and a wealth of ideas." Toward the end of the I710s he began seeking to form an holistic conception of the human being and the life of the human soul—the connection between the soul and body, between spirit and flesh—a focus of his attention that with age was to claim more and more of his time.

The Brain as the Gland that Separates the Vital Fluid

When Swedenborg began his studies of the brain, what we now call the cerebral cortex was regarded as a gland, the gland containing the vital fluid, the *spiritus animalis.* He was also interested in the brain's two true glands, which secrete hormones directly into the blood—the upper appendage of the brain, the *epyphysis* or pineal gland, and the *hypophysis* or pituitary gland.

Descartes' Conception of the Function of the Brain and the Seat of the Soul

Before Swedenborg, René Descartes (1596–1650), also known as Cartesius—who had among other things lectured at the Stockholm palace for Queen Christina—expressed ideas about the localization of the brain's different mental faculties. Descartes saw the brain as a machine and regarded pictures and memories as being fastened on the walls of the brain's cavities (the ventricles), where, according to Cartesius, the nerves reached their terminus.

In pictures that have become well-known, Cartesius illustrated his concept of the localization in the brain. In such pictures we can see how he thought inner and outer stimuli are reproduced on the walls of the brain's cavities. Among other things he gave a picture of a french lily and a star. Through the eye, which serves as the soul's mirror, stimuli are sent along the nerves to the openings of the nerves, which Cartesius regarded as going out from the cavities in the brain. The nerves were hollow tubes through which the *animal spirit*, the nervous fluid, could stream further from the brain's cavities to all of the body's parts to which the nervous system ran.

The most interesting part of these openings was the place provided for the soul itself, which as Cartesius envisioned it was situated in a simple, bean-sized bipolar organ in the middle of the head, in the *corpus pineale,* the pineal gland. The objects that were imaged on the retina stimulated the nerve endings in the retina and led to their being reproduced on the brain cavity's wall, where the soul could have a view over the surrounding world. From its central place the soul controlled the outer and inner sense impressions and read from the pictures on the ventricle's walls. In a drawing that Cartesius showed to Queen Christina, one sees how the heat and flames at the foot of a person who has happened to step in a fire stimulate the nerve openings, and how the aroused vital spirit expands the nerve tubes and streams up to the soul, which, upon receiving the message on what is happening, reacts and pulls back the foot. When a message is repeated frequently, a memory picture is formed in the brain's cavity. With a nod of the head one can again bring forth the stored-up memory

pictures. According to Cartesius' explanation, the soul had its specific place precisely there in the *corpus pineale*.

Investigation of the Brain's Anatomy

Herman Boerhaave (1688–1738), a respected Dutch physician at the time of Swedenborg's studies in Leiden, thought that just as every sense organ—sight, hearing, taste, touch and smell—had its outer receptor, there were specific regions in the brain that corresponded to the peripheral sense organs.

One method used to study the human brain and the branching of the nerves to the periphery was first to boil the brain in oil, and then dissect it with blunt instruments, dividing the nerve fibers and following the course of their pathway. While making his studies, Swedenborg had an insight into the fact that it was the brain's cortex, the gray matter, that served as the basis for physical phenomena—as the basis not only for conscious perception but also for will-directed impulses to the motor realm. As far as can be ascertained there was no one before Swedenborg who had expressed this view so clearly. Swedenborg was the first person to understand the real significance of the *cerebral cortex*. He developed this knowledge further through several sharp-sighted observations, of which we can mention the following.

During his studies Swedenborg found several descriptions of brain diseases and injuries to the head, particularly in the works of Antonio Pacchionis (1665–1726). Injury to the cerebral cortex paralyzed the muscles, or at the least in every case muscle power was diminished. Swedenborg attributed the primary cause of this to the injury to the cortex of the brain. He also drew the correct conclusion that loss of feeling in connection with a blow to the head could be due to injury to the cerebral cortex, and that the cerebral cortex rather than the *corpus pineale* should be the seat of the life of the soul.

Swedenborg himself has described his observations as follows: "A woman, aged 70, after having displayed signs of a stroke (*apolexi*) suddenly lost her ability to speak for several months and had to lie in bed, losing her sense of touch and the ability to move as well. When an investigation was made after death a large depression of the cortex was

found in this woman." Another case Swedenborg cited was from Pacchioni: "A young man died after symptoms of fever, severe headache, and muscle cramps. When the cranium was opened it was found that the *dura* (the hard portion of the cerebral cortex) had loosened from the bone at the top of the skull and that here there had been a strong pressure on the underlying brain tissue."

Another case from Pacchioni was more convincing still for Swedenborg: "A youth was brought to the hospital almost unconscious. He spoke disconnectedly, moved his arms and legs uncontrollably, etc., and his lips were somewhat overdrawn to the left." At the autopsy no injuries to the head were found either on the exterior or interior of the skull, but in the brain was found a depression in the cerebral cortex that showed a cyst or "bubble" in the surrounding hard cerebral cortex that lay just over the depressed region.

Clinical Connections

Swedenborg cited cases that he expressed as *"phalanges observationum idem testificatum"* (an array of observations testifying the same things). He himself had clearly observed several patients suffering from stroke and paralysis that—in the instances that they involved the cerebral cortex—strengthened him in the idea that the gray substance was of the greatest significance. He understood also that pressure from without on the cerebral cortex was significant, just as is the worsened circulation that arises in connection with bleeding. Swedenborg was of the opinion that in these cases the common denominator was worsened flow of blood to the cerebral cortex, and that this was the reason for the loss of feeling and movement. At the beginning of 1992 the causal connection between symptoms and circulatory disorders are still subjects of intensive research at, among other places, the neurological clinic at the Karolinska Institute in Stockholm.

Animal Experiments and Observations on the Brain After Death

Swedenborg was led to the same conclusion by other observations he made on experiments on animals carried out by the Italian anatomist Giorgio Baglivi (1668–1707), who was known for his "brain-dedication."

This scientist did not conduct experiments for the purpose of investigating the function of the cerebral cortex, but to investigate the brain's pulsation and other things. When he had chanced to damage the cerebral cortex of a laboratory animal, certain muscle groups then contracted—a happening that Baglivi described only in passing. Swedenborg, however, was able to understand how to couple this observation to injuries to the brain's cortex. This experiment gave him further support in the thesis that physical phenomena had their seat and their origin in the cerebral cortex. These clinical and experimental discoveries led him all the more definitely to this conclusion.

Using the anatomic observations published at that time by, among others, Leeuwenhoek (1632–1723) and Malpighi (1628–1694), Swedenborg could not, on the other hand, draw the conclusion that the fibers in the white substance were in constant contact with the cerebral cortex's bubble-like elements and their processes. Nevertheless, in a way corresponding to that in which he drew the conclusion that the cerebral cortex was significant to the function of the life of the soul, Swedenborg did now take a further step: he assumed that there was an actual connection between the white substance and the cerebral cortex. "These effects (conscious perception), he says, "could never have been born . . . if there were not a connection and perceptual communication between the white substance and the fibrils."

Concerning the connection of the motor fibers with the cerebral cortex, Swedenborg reasons in the following way: "If we study the cerebral cortex under a microscope, it is clear that the nerve fibers come forth from it like streams from a fountain. This is confirmed also by the observation that diseases that attack the brain when the brain has been injured—which one can be sure of when an autopsy is done—that these injuries can spread through the fibers that lead from the cerebral cortex to the muscles and that damage arises in the muscle movements thereby." By assuming that such a connection existed, Swedenborg succeeded in finding an explanation of the connection between the clinical symptoms and the previously mentioned damage in the cerebral cortex. Taken all together, this strengthened Swedenborg in his thought that it is in the cerebral cortex that sense impressions become conscious, and that it is in the cerebral cortex that the impulses to conscious muscle movement start.

Swedenborg Attributes Higher Functions of the Soul to the Cerebral Cortex

The attempted goal of Swedenborg's research on the brain was obviously to find the soul and the soul's actual seat, and to this end he continued his investigations all the more intensely. He could himself now state that physical phenomena could be localized in the cerebral cortex. He also knew from the work of previous authors that the cerebral cortex was for the most part constituted of substance surrounded by small blood vessels, and that it was in this unit that the nervous fluid *spiritus animalis* was generated and carried further in the nerves, and that it was this phenomenon that was the basis of the nervous system's activity. From these observations he drew the conclusion that it was in these small cortical units that physical activity had its seat:

> Because these small units are located at the nerve endings, if one follows the nerves' path into the brain, they come out from the central part of the brain itself all the way to the brain's peripheral membrane. It must therefore be in the unit constituting the cerebral cortex that the soul receives sense impressions, transforms them to ideas, makes its judgments and comes to conclusions, and it is therefrom that the soul sends out its responses. And the part of the cerebral cortex that is best suited to perform the necessary and changing tasks the soul's life requires is the unit of the cerebral cortex, to which the life-giving powers of the blood have such direct access and in which the most sublime nervous fluid appears to start, and whose task it is to communicate changes in the soul's manifestations.

Swedenborg had come far in his conception of *"spherula"* and *"cerebellula,"* which we now identify as nerve cells with their branchings; and he explained that the soul's life is the sum of the brain's activity, when the activity in all the cells is combined.

The cerebral cortex with its "spheres" formed a whole that transformed sense impressions to thoughts and determinations; but not all the parts of the cerebral cortex had the same significance. Some of the regions controlled higher—and lower—functions, some received inflow from the

senses, and others sent out motor impulses of the different kinds. This meant that different areas of the cerebral cortex controlled physical activity localized in different parts of the cerebral cortex.

Swedenborg had the Englishman Thomas Willis's (1622–1775) picture of the brain at his disposal. A picture of Willis's from 1681 gave a good conception of the brain's fissures, its basal parts with the cerebellum, medulla oblongata, spinal nerves, and blood vessels. The white inner substance there is shown enclosed by the gray substance—the cerebral cortex. In the white substance there are a number of gray areas, among them the *corpus striatum*, on which Swedenborg placed great importance in his localization theory. The branchings of the nerves from the *corpus striatum*, for example, the branchings of fibers to the cerebral cortex and to the *medulla oblongata*, had been described by Raymond Vieussens (1641–1716), a French anatomist just before Swedenborg's time. In *Neurographia universalis* Vieussens had described in detail not only the *corpus striatum*, but also the *nucleus caudatus* and the *thalamus opticus*, and even the nucleus lentiformis.

Brain studies in Paris and Two Volumes on the Brain

That Swedenborg himself actually studied the brain's anatomy and its diseases is evident from his journal while in France. Swedenborg says that on Friday 2 October he rented a room near the École de Chirurgie in Paris. He wanted to come in contact with the anatomical studies of the brain that were going on there. In order to be able to rest and concentrate on writing his great, two volume work on the brain, *De Cerebro*, he traveled to Italy. That he wrote diligently while visiting in Venice from 15 May to 9 August can be understood from the fact that there was a period of silence in his journal during this period. The idea of the localization of different functions in the brain was not new, but what *was* new was that Swedenborg localized the physical functions to just the cerebral cortex. Swedenborg regarded the most significant parts of the brain as being the frontal lobes and the cortex areas of the parietal lobes. "It is from the frontal lobes that all the [nerve] fibers go to the body's 'kingdom.' All perception affects the forward parts of the brain and conscious movements begin in this region."

Therefore Swedenborg adds that "if these parts of the brain are injured, then functions such as imagination, memory, and thought will suffer; the life of the will itself will be weakened, and the ability to make decisions will be diminished—which is not the case if the injury strikes the rear part of the brain."

When one attempts to enter into Swedenborg's view of the brain, one asks: When and how did Swedenborg come into all this knowledge? On what ground did Swedenborg base his claims? Swedenborg himself has told how he came to his view of the brain. His observations were based to a large extent on the clinical results described above—brain injuries followed by speech disturbances and paralysis. Swedenborg writes in the introduction to his great anatomical work *The Economy of the Animal Kingdom* (two parts, 1740–1741) as follows:

> Here and there I have taken the liberty to throw in the results from my own experience; but this only sparingly, for on deeply considering the matter, I deemed it best to make use of the facts supplied by others. Indeed, there are some that seem born for experimental observation and endowed with a sharper insight than others, as if they naturally possessed an inner acumen; such are Eustachius, Ruysch, Leeuwenhoek, Lancisi, and others. There are others again who enjoy a natural faculty for contemplating facts already discovered and eliciting their causes. Both are peculiar gifts, and are seldom united in the same person. Besides, I found that when intently occupied in exploring the secrets of the human body, as soon as I discovered anything that had not been observed before, I began (probably seduced by my ego) to grow blind to the most acute lucubrations and researches of others, and to originate the whole series of inductive arguments from my discovery alone; and consequently to be incapacitated to view and comprehend the idea of universals in individual cases, and the individual case under the universal aspect . . . . I therefore laid my instruments aside and, restraining my desire for making my own observations, determined to rely on the researches of others rather than to trust to my own.

Many have puzzled over what sources Swedenborg could have used in his research on the brain. Professor Max Neuberger proposed the

following in 1901: "Working from informative material that had been overlooked [Swedenborg] had the ability to draw conclusions that lead to essential knowledge and that penetrate more deeply than reached by a number of the representatives of exact science."

Professor Gustav Retzius at the Karolinska Institute maintained in 1903 that Swedenborg was indeed a sharp observer and thinker, but that he also must have carried out experiments, because, "These statements have been put forth with such precision by Swedenborg that they must rest on experimental work and dissections. Swedenborg was not only a learned anatomist and sharp observer, but also in many passages an unbiased anatomical thinker." Swedenborg wove together information contained in many areas of anatomical, physiological, experimental, clinical and pathological discovery, and from this complicated system drew the discoveries essential to giving a picture of the shifting manifestations of the soul's life.

Every Brain Unique

The motor and sensory functions do not act as the mere 'stimulus' Descartes envisioned, as a nerve reflex; and even today's hypotheses about thinking, memory, and learning are based on complex and incomplete models of the nervous system's function. One of the problems can be expressed thus: If the brain were so simple that we grasped how it functioned, we would be unable to use it to attempt to understand the brain. Considering the many strange and erroneous ideas that were published and taught in the eighteenth century, one must admire Swedenborg's ability to bring out essential, new, and correct concepts about the brain's function. And as he did so, he maintained that every human being was unique. "Each and every one has his understanding of the world around him and has his special experiences that characterize the brain's development and structure." ❑