THE SWEDENBORG MANUSCRIPTS *

A Forgotten Introduction to Cerebral Physiology

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In the middle of the 18th century, while medical students were taught that motion and sensation derive from the ventricular system, a versatile Swedish philosopher composed a series of manuscripts in which he anticipated by decades and centuries several of the basic concepts of contemporary cerebral physiology. These writings were forgotten immediately following their appearance; with very few exceptions,[1] later investigators seem to have been unaware of their existence. Although several Swedish writers and at least one medical historian [2] have subsequently discussed Swedenborg's manuscripts, current monographs on the history of neurology [3-5] contain no reference to his concepts, and the names of Gall, Jackson, and others are attached to some of his ideas. Such remarkable neglect becomes comprehensible only in the light of the curious circumstances surrounding his life and work.

Emanuel Swedenborg was born in Sweden in 1688 and received his basic education in mathematics and mining in Uppsala and London.[6] His writings in the natural sciences, which included anticipations of the nebular hypothesis and the airplane, as well as various mechanical inventions,[6] gained him much recognition in Sweden. But in 1736 he decided to undertake the study of anatomy and medicine. He left his position as director of Swedish mines and for many years journeyed from one European medical center to another. From this period date his contributions to neurophysiology. Yet even this career was suddenly terminated in 1744, when, at the age of 56, he began to experience a series of visions that continued until his death, almost 30 years later.[6] These visions were the basis for his reinterpretation of Christianity, which rapidly became a focus of controversy that lasted for more than a century, involving Immanuel Kant and Ralph Waldo Emerson among others. His theological position is maintained today by the

* Reprinted from the *Archives of Neurology,* April 1960, Vol. 2, pp. 407–409. published under the Auspices of the Board of Trustees.

[1] References are listed at the end of the article.

(Swedenborgian) Church of the New Jerusalem, which was founded in London shortly after his death there in 1772. It is not surprising, therefore, that his renown as a mystic philosopher and prophet has eclipsed his name as a scientist.

In order to evaluate Swedenborg's contributions to neurology, one must realize that in the medical schools at the beginning of the 18th century there was widespread confusion concerning the function of the brain in human physiology. Dissection, rudimentary microscopy, and occasional primitive animal experimentation by such men as Willis (1621–1675), Malpighi (1628–1694), Boerhaave (1668–1738), and Morgagni (1682–1772) had provided an adequate description of gross brain structure. In terms of function, however, very little of value had been added since Galen, when Swedenborg began his studies in Paris. He wrote copiously, but published only two fragments of neurophysiology, which appeared in "Oeconomia regni animalis" [7] and in "Regnum animale." [8] The remainder, in manuscript form, lay forgotten in the Royal Swedish Archives for a century, until discovered by a Swedenborgian clergyman, Rudolf Tafel. During the last 75 years, these have been translated into English by Tafel and others and published as "The Brain," [9] "The Cerebrum" [10] and "Psychological Transactions." [11] The scheme of these papers is quite uniform, consisting first of quotations from the pertinent literature of the time, followed by an attempt at reconciling conflicting data and constructing a plausible hypothesis as to the function of portions of the nervous system. The language is florid and replete with circumlocutions, metaphors, and metaphysical asides. Swedenborg freely admitted that the data were primarily derived from others,[7] and hence he shared in some of the errors and hairsplitting of his predecessors. Nevertheless, scattered throughout these manuscripts are insights and concepts that were not to find their way into the body of scientific thought until long after his death. These relate especially to the integrative action of the nervous system and to the localization of functions within it.

On the Integrative Function of the Nervous System

Swedenborg followed Galen [4] and Willis [5] in stating that the cerebrum

is the general animatory and regulating organ of the body, its general organ of voluntary motion and also its general sensorium.[9]

He carried their scheme a step further, however, by postulating, almost in terms of Jacksonian levels:

The sphere of effects is . . . the viscera, the organs of motion and of external sensation. The sphere of causes is the cerebrum, the cerebellum, the medulla oblongata and the spinal cord. The sphere of principles, finally, is the cortical, or gray, substance.[9]

The forgotten discovery by Malpighi of cortical "glands" (probably Betz cells) led him to propose a neuron theory:

From each cortical gland proceeds a single nerve fiber; this is carried down into the body in order that it may take hold of a sensation, or produce some part of an action. One and the same fiber cannot perform a double office at its extremities. For this reason there is the same luxuriance of cortical glands in the cerebrum, cerebellum, medulla oblongata and medulla spinalis as there is of motor fibers in the body.[11]

Another concept is one that Jackson was to propose again, more than a century later[12]:

Thought . . . is internal action. This presupposes a change of state of the cortical gland and its fibers. This change of state cannot be conceived of without the idea of motion.[11]

Elsewhere, in discussing habit, the idea of the conditioned reflex is invoked:

When harmony between medullary (or spinal) fibers becomes established by frequent use, then at the first sign given by the cerebrum, the medullas (oblongata and spinalis) rush into . . . acts, just as though the cerebrum were commanding each separate act.[11]

Integration by reciprocal motor action is foreshadowed in another passage:

The general animation of the cerebrum and cerebellum causes the muscles of the whole body, except the muscles of the lung and heart, even though in perpetual action, to be nevertheless maintained in equilibrum by means of antagonistic muscles.[11]

On Localization of Function

Although some Greeks and Romans speculated that psychic and somatic functions have specific representation in the brain,[3, 4] Franz Joseph Gall (1758–1828) is generally credited with being

the first modern proponent of this idea. Yet this concept is another cornerstone of Swedenborg's physiology, and he did not make the mistake of Gall in arbitrarily categorizing and localizing psychic "faculties." These hypotheses were derived primarily from clinical-pathological data:

> If this anterior portion of the cerebrum is wounded, then imagination, memory, thought suffer; the very will is weakened and the power of its determination blunted.[9]

He correctly localized motor representation:

> The muscles and actions which are in the ultimates of the body, or in the soles of the feet, depend upon the highest part (of cerebrum) . . . and upon the third lobe, those which belong to the face and head.[9]

but he cautioned:

> Experience and time are necessary to enable us to trace out what particular gyrus respects a given muscle as its correspondent in the body.[7]

Even more striking is the statement: "The pituitary gland is the gland of life, or the arch-gland," and its actions can only be observed by its effects on other glands, a concept which appears in an elaborate discussion of this organ,[9] which was not again to be credited with such importance until the present century.[18]

In addition to these quotations, the manuscripts in general present perhaps the most comprehensive and rational model of the nervous system to appear before Jackson. Yet it is doubtful whether even the published Swedenborg works were read by the medical investigators of his century. Haller, the "father of physiology," for example, in his textbook [14] written shortly after Swedenborg's manuscripts, denies the possibility of cerebral localization and generally belittles the role of the brain in the physiology of the organism. Certainly, few of the hypotheses quoted above were presented again until their verification by the experimental physiology of another era.

Undoubtedly, the fact that Swedenborg did not hold an academic appointment, his failure to supply experimental verification for his hypotheses, and his later reputation as a mystic have been sufficient to discourage the medical world from reading his works or subscribing to his theories. He has certainly had little or no influence on the subsequent development of neurophysiology. Nevertheless, from the perspective of today, Swedenborg's success in intuitively

synthesizing the isolated and conflicting observations of others into a remarkably correct vision of nervous function would appear to be an achievement worthy of notice.

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