SWEDENBORG AND THE INTERNATIONAL GEOPHYSICAL YEAR

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I. INTRODUCTION

Swedenborg was born in 1688. He died in 1772. His writings on science and philosophy were done before the middle of the Eighteenth Century. Thus over 200 years separate these works from the International Geophysical year of 1957–1958.

What is the connection between the studies of a man whose work in physical science took place over two hundred years ago and the studies of the present geophysical year?

In order to answer this question it would be necessary to gain a perspective on two developments. Although this would require more space than is possible in this short treatment, yet brief outlines will be presented as a partial answer. First: we need a perspective on Swedenborg's own development during his lifetime. Second: we need a perspective on the history of science from about 1700 up to the present day.

Having presented these two brief outlines, these remarks will conclude with a section referring to those problems Swedenborg studied that may be called geophysical; or rather, more in particular those that are of the kind studied in an international geophysical year, when scientists and volunteer observers all over the world are trying to obtain data that can be synthesized with reference to world-wide phenomena.

II. SWEDENBORG'S DEVELOPMENT

As Swedenborg's mind developed in youth and early manhood we note its application to inner contemplation in his poems; to studies related to his native Sweden—concern for its scientific, economic and national welfare; and other practical matters of an immediate nature. At the same time there was the beginning of studies that later became applied to creation as a whole, that is, concern with cosmological and metaphysical problems. Thus, although he was interested indeed in the geology of his native

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country for the possible benefits the results of such interests might have in mining and hence upon the economy of Sweden, he was also interested in the geology of neighboring and distant countries for less practical but more scientific reasons of understanding the structure of the whole earth and how it came to be the way it is now. If he was interested in the commerce of Sweden for its economic welfare among nations, he was also interested in some of the tools of travel for their more scientific value. The location of ships on the seas was a very serious problem in those days to every master of a vessel. The problem of the longitude was attacked by Swedenborg for this reason. Again, if Swedenborg was interested in textbooks in mathematics and physical science to be written in his native Swedish, and in scientific instruments for his own Upsala, he was also interested in world-wide application of mathematics and instruments, for example, to the measurement of the magnetic declination of the compass needle. Yet even this had a more general application. For in his *Principia* it was necessary that his cosmology be subjected to experimental test; and in particular his theory of a magnetic aura was to be tested by the magnetic experiments of his day. Yet even the *Principia* theories were themselves but preliminary to the idea that God is Creator.

To gain some perspective on Swedenborg's relation to the kind of problems proper to geophysical studies it is necessary to realize that his scientific studies, in so far as they were concerned with the physical sciences, were largely brought to an end in 1734 with the *Principia,* 38 years before his death. Those things in particular that will be referred to as relating to geophysical studies were largely the work of a very young man. After 1734 Swedenborg devoted about ten years to anatomical studies, after which he devoted the rest of his life to theology.

III. Science 1700–1957

We ought really to say here, physical science, because although the scientific studies in the International Geophysical Year will no doubt soon have results also in the life sciences, yet at present the larger emphasis is upon physical measurements.

Newton's works were published just before 1700. The full significance of his dynamics as a unifying principle in physics alone was just being comprehended by the learned world during the

time of Swedenborg's scientific studies. Also, Newton's law of gravitation extended the application of his dynamics outside physics into astronomy. The realization that all the details of Archimedes, Kepler and Galileo were being unified under one set of principles must have been a startling thought to those able to understand this during the first half of the Eighteenth Century. But once this was comprehended, for 150 years, up until the beginning of our own century, science was not science unless it was Newtonian; and this idea went far beyond application to the physical sciences alone.

At the beginning of the Twentieth Century it became evident, however, that Newtonian principles could not account for certain physical phenomena, and the first quarter of this century witnessed the development of relativity and of wave mechanics, each based upon axioms which were non-Newtonian. The subsequent developments in physics have accelerated scientific discovery to an extent far beyond anything like it in the history of mankind.

The placing of the International Geophysical Year in the 1957–58 period is itself a commentary upon this rapid development. There was an International Polar Year in 1882, and fifty years later in 1932. There had been talk of one in 1982, that is, in another fifty years from 1932. But scientific developments were progressing at too rapid a pace to wait so long, and also were too broad to be limited to polar studies. The International Geophysical Year of 1957–58 was the result.

IV. Geophysical Problems

Although Swedenborg during the latter third of his life was theologian and revelator, his earlier life was one continual development from an interest in the details of scientific observation and the tools of the scientist to more general reflections on the results of such studies, not only his own but those of others—mostly of others.

We say "mostly of others." That is really the theme of an international geophysical year. Each student can observe only within the limits of a very small geophysical area over a short duration of time. World-wide phenomena in terrestrial magnetism, aurora, cosmic rays, etc., require many observations all over the world. And so it was with Swedenborg. He could and

did make limited measurements with the magnetic needle, for example. But mainly he used the data collected by Halley, insofar as it was then available, from limited portions of the earth.

Of all the problems that Swedenborg worked on, those that have been selected for discussion here as related to international geophysical studies are:

A. The problem of the longitude.
B. The problem of the primordial ocean.
C. The internal fire of the earth.
D. Terrestrial Magnetism.

A. The Problem of the Longitude. Fortunately there is available an excellent paper entitled "Swedenborg's Work on Longitude," by Wertha Pendleton Cole, published in the NEW PHILOSOPHY for April 1933. However, for the benefit of those readers for whom that paper is not immediately available a few comments based on it will be added here.

The finding of the longitude at sea was such an important problem, especially to the nations that depended much upon shipping, that the several governments had offered prizes for the solution of the problem; Philip III of Spain, early in the Seventeenth Century, and again Charles II of Great Britain later in the same century.

Swedenborg's method depended upon astronomical measurements on the moon and stars. He produced four different treatises on his solution, the latest of which was the 1721 edition published again in 1766. The prize offered by the British Government was awarded in 1736 to John Harrison for his invention of the chronometer.

Of course the problem has now been solved by time pieces, yet when Swedenborg worked on it, it was nevertheless a problem that was of concern to all nations; and had there been a geophysical year then, it most certainly would have been an important problem for scientists the world over.

As Mrs. Cole says: ". . . for about two hundred years [i.e., prior to 1720], furnishing the observations which could be used in determining the longitude was the most important of practical astronomical problems." And later: "since the invention of radio, determining time differences at sea has been no problem at all. . . ."

B. The Primordial Ocean. In a letter to Jacob A. Melle, published in the *Miscellaneous Observations,* Swedenborg discusses the subject of the primeval ocean. He says, quite in the spirit of an international geophysicist:

"I am rejoiced to find that the researches of the learned are everywhere bringing to light at the present day so many indubitable evidences of the existence of the primeval ocean."

He discusses some of the details of geological formations, not only in his native Sweden, but in other countries as well. Already—the letter was written in 1721—he seems to have left the Biblical literalists, for he says with reference to the enormous changes wrought by this hypothetical primeval ocean:

"These circumstances might have taken place in a deluge; but it may perhaps be doubted whether they all happened during the Deluge of Noah, which lasted only one year. For in many places which are, at present, forty or fifty ells above the level of our sea, the timbers and ribs of large vessels are yet found; and in the very mountains there are hooks, rings, mooring places, and many other signs proving that the ancient inhabitants possessed a port in that spot; and it is certain that towards the north the level of the Baltic is still gradually subsiding at the rate of four or five ells in depth within seventy years" (*Miscellaneous Observations,* p. 152).

Not in the spirit of dogma but in that of scientific investigation he says:

"These facts tend to show, that all such changes did not take place in the universal Deluge; but that for a long time afterwards, the lands, towards the north in particular, were buried under a deep ocean, whence they gradually emerged as the sea subsided towards the north; or, in other words, its bed became habitable. If this view should derive additional confirmation from other discoveries, similar to your researches in the vicinity of Lubeck, we shall have grounds for believing, though not yet for asserting, that, 1. The horizontal pressure of our world is liable to change; which necessarily follows, if the seas are depressed towards the poles, and raised, as reported, towards the equator. 2. Consequently the distances of latitude vary. 3. Certain lands, at present continents, may formerly have been islands, which have united in course of time as the sea subsided. There are many other points, which I do not venture to publish until I am furnished with additional proofs, and thus enabled to proceed on a firmer foundation" (*ibid.* pp. 152–153).

C. The Earth's Interior. Modern knowledge of the structure of the earth below a depth of five miles is very scanty. Someone has said that we know more about the interior of stars than we

do of our earth. But be this as it may, the earth physicists are still well aware in 1958 of many unsolved problems.

Swedenborg's interest in this subject is illustrated by a brief note entitled "The Notion of a Central Fire." He says:

"The opinion has been very prevalent that the nucleus or interior of the earth is hollow, and filled with a peculiar fire; and this has been attempted to be proved by the following arguments. 1. The earth appears to have been at first a star, which in process of time was encrusted, and formed a planet. 2. The earth is balanced in the solar vortex, which seems to be owing to an internal vacuum, whereby the crust might be balanced like a hollow globe of metal. 3. There are many volcanoes in existence at the present day, and formerly they were still more numerous: furthermore, there are thermal springs and boiling waters gushing from the bowels of the earth. 4. Minerals are formed, and metals, and many substances undergo various changes in the bosom of the earth; moreover flowers spring up, and the earth's crust becomes covered with vegetation. 5. And many mountains have been converted into lime, and seem to have been burnt up by fire. All these circumstances appear to prove the existence of a central fire, which in particular places bursts through the crust that encloses it" (*ibid.* pp. 100–101).

But Swedenborg is not satisfied with this idea, popular in his day, for he says:

"I admit that it is undeniable that a certain subterranean fire really exists; that is to say, that in some parts of the earth's crust a degree of heat is perceptible, which causes thermal springs, volcanic eruptions, and many other phenomena: but whether this heat proceeds from the earth's center, and whether there be a cavity full of fire, or an igneous void—this is to the last degree questionable, and for the following reasons. 1. Because fire cannot live, unless it be enclosed in hard bodies, as in carbonaceous matter already mentioned as shut up with the fire in a furnace. 2. But if the furnace contain no solid fuel, although it be full of flames, no sooner is it closed, than the fire dies out, lasting in fact no longer than the heat remains in the hard bodies. Consequently fire cannot be kept in a cavity unless solid substances be present. If, therefore, there be any heat in the center (supposing a central vacuum to exist), such heat must come from the substances of the crust, instead of the crustal heat proceeding from the center. 3. Hence we may conclude that heat exists in many parts of the earth's crust, and not in others; but as for its source, and the manner in which it is kept up, see the preceding observations on Thermal Springs" (*ibid.* pp. 101).

Among the other things discussed in the article is the remarkable suggestion "that the more fire a body contains, the heavier it is . . . that the addition of fire is not the way to obtain levity."

Swedenborg's use of "fire" is more aptly called in modern terminology "energy." Under this assumption, there is a remarkable resemblance of Swedenborg's ideas in this respect to a "central fire" not in a void, as then popularly thought of, but in the densest matter, and to certain modern cosmological ideas.

D. Terrestrial Magnetism. By 1722, Swedenborg had completed a digest of what had been written by others on the subject of the magnet. Added to the manuscript entitled *De Magnete* were observations of his own. He is particularly interested in the declination of the compass. This work seems to be preliminary to the treatment of magnetism in the *Principia,* published in 1734.

Two things are important in connection with these studies for our present purpose. First: Swedenborg's explicit acknowledgment of the importance of world-wide observations. Second: The survey of the magnetic declination he was so interested in for cosmological purposes is today just as important a problem as it was in his day.

With respect to the first point, Swedenborg says: "I am willing to travel over the whole globe, and explore these declinations, if God grant life for it." (*Documents Concerning Swedenborg,* R. L. Tafel, p. 869.) In the *Principia* he included data taken all over the world at land stations and on ships at sea (see Part II, Chap. XIV). He advanced a theory for the cause of magnetic declination, and developed a method for predicting its value. By this method he calculated the declination at Paris for every year up to 1920. Swedenborg had great faith in the validity of these computations. Yet he says: "I am not indeed vain enough to put forth these speculations, without the sanction and consent of experience; for unless experience impart her light to theory, the latter will only blind the understanding, and cause it to wander in the mazes of error."

Had there been a geophysical year in Swedenborg's time it most certainly would have had on its program the task of adding to the known data on magnetic declination. Its immediate purpose would have been to improve or add to Halley's map of 1700, which was a source of data to Swedenborg. But since that time the famous mathematician Gauss worked on the same problem early in the Nineteenth Century; and so did the magnetician Weber, and later Schuster. By the turn of this century various governments

had independently recognized the practical and scientific importance of magnetic data—not only of declination but of intensity. In the United States the Department of Terrestrial Magnetism was set up; several magnetic observatories were established, and non-magnetic ships sailed the seas gathering data. A journal published by this agency is devoted entirely to the subject of terrestrial magnetism, which now includes studies in the outer spheres of the earth's atmosphere, cosmic rays and nuclear physics. Two hundred and seventy years after Swedenborg's birth the collection of data and the increase in knowledge has been considerable. Yet from the perspective of history he was a pioneer in this field.

SWEDENBORG THE MATHEMATICIAN

MARGARET JACKSON *

It is not my aim to introduce you to the technicalities of mathematics, nor to indicate, except in a very general way, in which of these technicalities Swedenborg was versed; but rather to tell you something of the effects which I believe the study of the discipline of mathematics had on Swedenborg—how it may have influenced his thought, his philosophy and his style.

There is plenty of evidence that Swedenborg had made a fairly wide study of the mathematics of his day, that he felt himself to be at home in this field of inquiry, and that he enjoyed the pursuit of mathematics; furthermore, that he realized the uses which mathematics can serve. In the *Diary Minimus* he describes mathematics as "one of the useful sciences, by which as means each one can become rational"; and in the *Spiritual Diary* he describes mathematics as "a means for acquiring understanding."

The mathematics of Swedenborg's day was considerably less in content than is present day mathematics, although it had recently been considerably swollen by the work of such mathematical giants as Leibnitz and Newton. In reading Swedenborg's *Algebra and Geometry*—something of a misnomer, for the book includes work

* The substance of an extemporaneous address by Dr. Margaret Jackson, M.Sc., Ph.D., at the Swedenborg Birthday Meeting of the Swedenborg Society, London, 1958.