SWEDENBORG'S SCIENTIFIC CONTEMPORARIES

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In dealing with the subject of Swedenborg's scientific contemporaries, the object is not so much to present potted biographies of Swedenborg's contacts in the scientific world, as to try to show something of the intellectual climate of that world. For the distinction between the eighteenth century and our own is far more than may be attributed to a mere increase in our store of knowledge. To some of us, brought up in an age dominated by scientific materialism, the pre-revelation works of Swedenborg may seem far from scientific. It is appropriate, therefore, that we should attempt to project ourselves back these brief but eventful two hundred years, lest we attempt to judge them by a totally misleading standpoint.

Science today may be likened to a conquering army. This is said, not entirely out of admiration for its conquests, but rather to draw a parallel with an occupying force, advancing into unfamiliar territory on an ever-widening front. More and more forces are required as the advance proceeds, and the individual soldiers see less and less of the over-all situation as they press forward. Now it would be churlish to suggest that this army has no officers to whom a wider view of operations is possible—it has. But those who attempt to form any sort of unified philosophy must at times cast a pensive eye on former, less complicated times, when one stood a chance of keeping abreast of developments outside one's own particular field of study. And what better time than the eighteenth century; when, to be sure, exciting discoveries were being made in plenty, but science was not yet so formalized and codified, its discipline so rigorous. It was the age of the scientist-philosopher rather than of the purely experimental scientist; an age when the boundaries between science, philosophy and revelation were ill-defined; an age, consequently, when it was still habitual for men of science to acknowledge God, and to find in their discoveries evidence of His glory. Such, at least, they professed; but we should also remember that although that age was one of increasing intellectual freedom, the darkness of preceding

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centuries could not be shaken off at one bound. Fear was still a potent force opposing the free expression of opinions. There are numerous passages in the Writings where it is described how "men at this day" hold certain views in contempt, but give lip service to them for the sake of honors and gain, or for fear of loss of reputation. While in no way suggesting that these statements are irrelevant to our own times, we may yet accept them as valid commentary on Swedenborg's contemporaries, in particular those whom he describes as "the learned."

In the introduction to his *Principia*, Swedenborg considers the means leading to a true philosophy of natural things. These, he states, are three: *experience*, *geometry* and *reason*. The terms perhaps strike oddly on our ears today, and yet here, surely, is a fair description of what we are pleased to call the *scientific method*. By *experience*, we understand the collection of observations, the conducting of experiments, the amassing of factual data. By *geometry*, or by mathematics in general, we are enabled more precisely to describe our observations, to reduce the data we have collected into some order, to suggest possible relationships. We may perhaps wonder at the emphasis on geometry, rather than, say, arithmetic or algebra. Here, possibly, we can see the influence of Descartes, whose philosophical teachings were so widely received in the learned world of Swedenborg's day. Descartes was responsible for great extensions in the scope of geometry, and for unifying it with other branches of mathematics. Both to Descartes and to Swedenborg, however, geometry meant more than a formal study of those artificial constructions beloved of the Greeks; it was more in the nature of an ultimate natural truth, for more and more of the secrets of nature were being revealed in geometrical terms.

Finally, by *reason*, Swedenborg has in mind that perceptive faculty which views the ordered facts presented before it, sees the significant relationships between them, and penetrates beyond mere relationships to something of fundamental causes.

An illustration from astronomy will serve to draw the distinction between these three stages of scientific inquiry. (I hope I may be excused, in view of my title, if I start rather earlier than Swedenborg's lifetime.)

In every recorded civilization, men have marveled at the majesty of the firmament. They have sought wisdom in following

the courses of the stars and planets, and have pondered on their origins. Many have ascribed supernatural qualities to the heavenly bodies, and have been convinced of their influence over the lives of men. But the very constancy with which times and seasons recur must have led other thinkers to look for more universal laws of order, and to explain the courses of these bodies in more logical terms. Progress was long hampered by dogmatism; not only on the part of the Church, Catholic and Protestant, which ruthlessly oppressed anything not in accordance with its understanding of Holy Writ, but also on the part of the followers of Aristotle and Ptolemy, whose writings were accorded in the universities a reverence scarcely less than that due to the Bible. Copernicus revived the notion of a universe centered on the sun, and showed that his model of the solar system explained, roughly at least, all the known motions of the stars and planets. (Since his theories were not published until he was on his deathbed, he escaped the persecution which befell his later followers.) His model of the universe was an idealized one, constructed on ideological grounds as well as on mere geometry. For were not the heavenly bodies perfect, and was not the circle the perfect curve? Wherefore it was unthinkable that the planets should behave in an imperfect way, by moving in anything but circles. We may smile, but we may well reflect to what extent we, too, accept the traditional views of our age. How many of us have seriously questioned the nature of the solar system? Have we not, in our turn, accepted on the authority of the learned what we have been told?

Now Copernicus' model could explain all the motions of the planets in a qualitative way, but it was not fully convincing. His truly revolutionary theory had, however, prepared the way for a succession of giants—Tycho Brahé, Kepler and Newton.

Tycho Brahé was a student at the University of Copenhagen, when, at the age of 14, he was first impelled towards the study of astronomy by an eclipse of the sun. This had been *predicted* for the day in question, and it was the prediction rather than the eclipse itself which fired his imagination. He commenced studies in astronomy, and soon came up against the inadequacies and inconsistencies of existing records and tables. He resolved to devote his life to improving the standard of observations, and to this end devised and constructed new instruments. After some vicis-

situdes, he secured the patronage of King Frederick II who contributed generously towards the establishment and maintenance of an observatory in northern Denmark. Year after year, Tycho Brahé took painstaking observations, being both convinced of their necessity and well content to serve this use to posterity rather than to devote his time to theoretical speculation. His mantle fell on Kepler, who had become his assistant, and whom he charged with the editing and publication of his tables. Thus Kepler, on being appointed to succeed his master, had at his disposal a vast mass of reliable observations. Tycho Brahé had supplied the *experience*; Kepler now proceeded to apply *geometry*, and started by attempting to confirm the truth of Copernicus' theory, but he was forced to admit defeat. The planets just would not conform to circular orbits. Somewhat reluctantly, he turned to other possible shapes, and eventually made his great discovery that the planets described not circles, but ellipses about the sun at one focus, and enunciated his famous laws relating to their motion. These laws were still, however, purely geometrical abstractions, for there was no reason *why* the planets should have behaved thus. It remained for Newton to infill *experience* and *geometry* with *reason*. His hypothesis of a universal gravitational force acting between all bodies in the universe, and obeying a simple mathematical form; this, together with the mechanical laws of motion investigated by Galileo, led logically to planetary orbits of an elliptical shape. Thus we may say that Newton had arrived *a priori* at the same elliptical orbit which Kepler had derived *a posteriori*.

Newton expressed himself modestly about his achievement. "If I have seen a little farther than others," he wrote, "it is because I have stood on the shoulders of giants." Truly he had; but his own contribution, fantastic as it seemed to the Cartesians, was outstanding. He had shown that physical laws were infinitely more universal than had ever been supposed, and his fame spread throughout the learned world. Not that many of the learned grasped the full implications of his work at once—or even after a generation. This may seem strange to us, who have met Newton's laws in their quintessence, formally stated in concise mathematical terminology. Newton's own explanations were, by contrast, tortuous, involved and frequently contradictory!

From one of Swedenborg's letters to his brother-in-law, we learn that he "studied Newton daily," though there is no record

of a meeting in this world. This was during Swedenborg's first visit to England as a young man of twenty-two. Newton was some forty-five years his senior. His *Principia* had been first published in 1687, a year before Swedenborg's birth—largely at the instigation, and indeed at the expense, of Halley, after whom the famous comet is named.

Dr. Halley was a great observational astronomer, and had undertaken a voyage to St. Helena with the object of cataloguing the stars of the southern hemisphere. He made another extensive voyage to investigate the variation of the earth's magnetic field at different parts of the globe. The topic of magnetism is one which occupies more than half of Swedenborg's *Principia,* and we can imagine the young Swedenborg eagerly seeking out Dr. Halley. Indeed, he studied astronomy under him in Oxford, and later dedicated to him his work on finding the longitude by means of the moon. Halley was appointed Astronomer Royal in 1720, in succession to Flamsteed, the first holder of that title. Swedenborg had several discussions with Flamsteed, who, incidentally, was rector of a Surrey village for much of his tenure of office. Greenwich Observatory had been founded by Charles II in 1675, and Flamsteed, as the King's astronomer, was charged "to apply himself with the most exact care and diligence to the Rectifying the Tables of the Motions of the Heavens and the Places of the Fixed Stars, in order to find out the so much desired longitude at Sea, for the perfecting the Art of Navigation." It was a pressing problem at that time, but as in our own century, support for basic research was forthcoming if there was a sufficient commercial or military incentive. A prize of £10,000 was offered by the Government for a solution to the problem, and Swedenborg himself submitted his method based on observation of the moon. Here, he was in competition with one William Whiston, the successor to Newton in the Chair of Geometry at Oxford, who was working on similar lines. Swedenborg feared that he started at a disadvantage against the English, who could scarcely comprehend that a foreigner could produce anything of merit. The prize was in fact won, and deservedly, by John Harrison with his marine chronometer, which fully lived up to the claims made on its behalf, and had the great advantage of continuing to work whether the moon were visible or not.

But to return to Swedenborg's philosophy. I have tried to

illustrate the processes of thought involved in scientific inquiry by a concrete example from the field of astronomy. Experience I have personified in Tycho Brahé, with his painstaking observations; Geometry in Kepler with his careful analysis; Reason in Newton, whose brilliant intuition justified all the labors of his forerunners. I have suggested that this progression of experience, geometry and reason might be equated to the scientific method as we know it today. But here we must observe that there can be a great difference in emphasis on the successive stages. This is very well brought out in the correspondence which passed between Swedenborg and Professor Celsius of Uppsala—actually the third generation of the Celsius family to occupy the chair of mathematics there, but the most eminent one, and originator of the Centigrade scale of Temperature. The occasion of the correspondence was as follows. Swedenborg had published in his *Principia*, a geometrical theory of the earth's magnetism, involving a complicated vortex theory, which claimed to predict the declination of the compass at any time and for any place on the earth's surface. He had shown good agreement over a period of years with observations in London, Paris and a few other locations. Professor Celsius had taken observations in Uppsala, and resolved to test Swedenborg's theory. He got his assistant to calculate the declination according to the rules set out by Swedenborg, and on comparison, found a large discrepancy. Reporting to the Academy of Sciences in Stockholm, he concluded, rather ponderously, "From this it is made sufficiently clear that some improvement is necessary in the Assessor's hypothesis." Swedenborg repeated the calculation himself, and having apparently committed a major error in his own method, along with several minor arithmetical errors, finished up by strange coincidence with a result almost identical with the observations of Celsius. Thus, emboldened, he wrote to the professor, prefacing his calculation with a philosophical introduction, from which I now quote.

"There are two ways by which to trace out those things in nature which lie either open before us, or are hidden from our eyes, viz. the *a priori*, which is also called the synthetical method, and the *a posteriori*, or the analytical method. Both are necessary in reflecting upon and tracing out one and the same thing: for in order to do so there is required both light *a priori*, and experience *a posteriori*. Now, while the learned among the ancients followed

the former light as remotely and profoundly as they possibly could, those at a later period were induced not to accept anything as witness, unless it was confirmed by experience. Hence also some of the learned at the present day seem to have agreed to let thought rest, and to make experiments which would appeal to the senses; yet they did so with the hope and intent that some day experience would be connected with theory: for experience deprived of an insight into the nature of things is knowledge without learning, and a foundation without a building to rest upon it. The observations of the outward senses merely furnish *data* and give information about things which the understanding ought to investigate, and concerning which it ought to form its judgments; such also is the distinctive quality of a rational being whose superiority over brute animals consists in being able to exercise its understanding in matters acquired by experience." (R. L. Tafel: *Documents* Vol. I, pp. 568–9.)

Swedenborg is seen to be violently opposed to a purely experimental approach unaided by reason. He goes on to express his opinion of those who say that insufficient data is available. These, he considers, are only finding an excuse to escape the diligent study which would be required. To those who doubt whether theory has any value other than the intellectual satisfaction obtained therein, he refers back to the question of the earth's magnetism, and pictures the real benefits to navigation and commerce which would result from a satisfactory theory.

Celsius would rather have had no theory at all than a defective one, and in his strong adherence to the experimental approach, he was more in line with today's scientists than most of his contemporaries. For the *a posteriori* approach, which denies all things until they are demonstrated to the senses, is the exclusive basis of today's scientific method, and indeed, *while confined to its proper field* is the secret of its power. But in the higher realms of study to which Swedenborg was to be called, it constitutes the *negative principle* described in *Arcana Coelestia* 2568—"the principle which leads to all folly and madness." Swedenborg's constant concern to reason *a priori* explains, on the one hand, why his works have not been widely acknowledged by succeeding generations of scientists, and on the other, how his introduction into the sciences could yet prepare him for his ultimate and greatest use. We must not think that the Lord chose as revelator someone who

happened to be a scientist and subsequently renounced his scientific inclinations; such a person could have done no more than to accept blindly what the Lord had to dictate. Swedenborg's letter to Oetinger may be quoted:

"That there is a correspondence of all spiritual things with all things of man, as well as with all things of the earth, may be seen in the work on Heaven and Hell (nos. 87–102; and nos. 103–115). For this reason I was introduced by the Lord first into the natural sciences, *and thus prepared*; and indeed, from the year 1710 to 1744, when heaven was opened to me." (Italics added.)

Swedenborg was introduced into the sciences at a time when many scientific discoveries were being made, but when the negative principle of the scientific method was not as yet fully established among his contemporaries.

Not long after Swedenborg's time, for instance, the mathematician Laplace was to send a copy of his work on cosmology to the Emperor Napoleon, who rebuked him for publishing a scheme of the universe which failed to mention God. Laplace's reply was "I do not require this hypothesis."

Had this attitude been generally accepted in Swedenborg's time, it is difficult to imagine how his intromission into the world of science could have prepared him for his later work. But among the majority of his contemporaries, an acknowledgment of God was still professed—even though it might involve an unbridgeable gulf in the mind between the things of heaven and of earth. May we not therefore see in retrospect something of the Divine Providence in the transitional state of eighteenth century thought, whereby Swedenborg's study of the sciences could form a basis for his exalted use in presenting the truths of the Second Advent.