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THE SOURCES OF SWEDENBORG'S EARLY PHILOSOPHY OF NATURE

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The Cartesian Controversy which raged at the University of Upsala from 1663 to 1689 forms the proper historical background for SWEDENBORG's early investigations in the field of the natural sciences. It will therefore be best in the present discussion of the sources of SWEDENBORG's early philosophy of nature, in the course of which the relation of his investigations to those of DESCARTES, NEWTON and POLHEM will be considered, first briefly to describe the course of the Cartesian Controversy at Upsala and its influence upon the founders of that scientific movement at the University which in 1710 was organized as the *Collegium Curiosorum* and subsequently developed into the Royal Society of Sciences of Upsala.

The Cartesian Controversy at Upsala University, 1663—1689, and its influence upon the founders of the Royal Society of Sciences of Upsala, first organized in 1710.[1]

The inner history of Sweden after the Thirty Years' War exhibits a series of changes affecting in a fundamental manner the politics, social

[1] See an address on »The Cartesian Controversy at Upsala, 1663--1689, and its connection with Swedenborg's nebular hypothesis», in *Verhandlungen des III. Internationalen Kongresses für Philosophie, Heidelberg, 1908*», pp 248--255. The same volume also contains, pp. 241—246, a contribution entitled »Relics of Descartes' visit to Sweden,

order and intellectual standards of the whole people. Queen CHRISTINA, the gifted daughter of the great GUSTAVUS ADOLPHUS, adorned her court by inviting to it many learned and talented men from the Continent, among them the philosopher DESCARTES. But for the premature death of DESCARTES, the Queen would have established an Academy of Sciences at Stockholm, which might have ameliorated the severity of the intellectual changes whose advent during the latter half of the seventeenth century was accompanied by so much controversy and animosity at the University of Upsala. The final outcome was the establishment of philosophical freedom and of untrammeled scientific research. Strangely enough, CHARLES XI., whose political power was well nigh absolute, a power built upon the ruins of the authority of the nobles, exercised a determining influence upon the great controversy at Upsala in the direction of increased freedom of discussion and liberty of teaching. The occasion of the difficulty was the entering of Cartesianism into the Faculty of Medicine, but as the discussion proceeded its scope extended, involving the remaining Faculties of Philosophy, Law and Theology in a general controversy concerning the relationship of theology, philosophy and the sciences.

It appears improbable that the short residence of DESCARTES at the Swedish capital was accompanied by any events which were directly connected with the subsequent controversy at Upsala, although it is known that the learned were opposed to the foreigner DESCARTES, just as they were opposed to the other foreigners at the court. Queen CHRISTINA was so much affected by the philosophy and personal history of DESCARTES that not long after his death she ordered that no priest should be granted a professorship in the Faculty of Philosophy at Upsala; DESCARTES had recently suffered from persecution in Holland.

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especially a newly discovered portrait by David Beck». The account of the Cartesian Controversy and its influence upon the founders of the Scientific Society at Upsala and upon SWEDENBORG, furnished in the present Introduction, is based in part upon the author's investigations and in part upon the admirable works of Dr. CLAES ANNERSTEDT, former librarian of Upsala University. See his »Bref af Olof Rudbeck den äldre», Upsala, 1893—1905, and »Upsala Universitets Historia», Vol. II., 1908—1909. The valuable article of SVEDELIUS in the periodical »Frey», 1842, as also BAILLET'S »La Vie de M. Descartes», besides many other sources, have been consulted. More detailed information, with full references to the literature illustrating the Cartesian Controversy and its effect upon the intellectual atmosphere at Upsala will, it is hoped, appear in a monograph to be published at Stockholm.

The University of Upsala was founded in 1477 and was naturally saturated with the theology and scholastic philosophy which then prevailed. ARISTOTLE reigned supreme in the philosophical camp except for the inroad which had been made by the anti-Aristotelian doctrine of RAMUS. The Cartesian Controversy began in the Faculty of Medicine, where the first Cartesian in Sweden, OLAUS MARTINI STENIUS, had been Professor. He was the teacher and predecessor of the famous anatomist and author of »Atlantica», OLOF RUDBECK. Professors RUDBECK and HOFFWENIUS, both of the Faculty of Medicine, had studied in Holland, where DESCARTES had spent twenty years of his life and acquired a great influence. In 1663, in connection with a disputation of HOFFWENIUS, the rumor began to be spread that Cartesianism had entered Upsala, which led to complaint on the part of the priests, in session at Stockholm. That the Cartesian movement met with opposition is also shown by some lines which a teacher in Linköping sent to Upsala by the hands of some departing students. He wrote: »Would that the atoms, pores, and effluvia of the sun might not obtain too great a dominion in your academy, so that the young men are drawn away by the desire for novelty from the useful and ancient manner of philosophizing, so that when returning to their parents they cause more pain than honor, not knowing anything else but how to prattle about atoms, etc.» Although there was not lacking sympathy in the Consistory with this complaint, it was nevertheless felt that such an admonition was rather strong and that it was produced by »*imbeccilitas animi*», so the Rector was instructed to give the author, ANDREAS AJALINUS, a »scrape». The discussion concerning Cartesianism might not have become so acute during the early period of the controversy had not some of the professors been prepared to welcome an opportunity for revenging themselves upon OLOF RUDBECK, who had shown himself to be an unflinching enemy of laxity and incompetence.

All the prominent representatives of the revolutionary Cartesianism were professors in the Faculty of Medicine, and when Professor HOFFWENIUS in a disputation gave evidence that Cartesianism had entered the University, the House of Priests took up the question in the Parliament of 1664. The proposal that the lectors of physics in the gymnasia should also be medical men was rejected, and for the reason that most of them were Cartesians. A deputation of priests was sent to the Chancellor, MAGNUS GABRIEL DE LA GARDIE, to prevail upon him to pre-

vent the youth at Upsala from promiscuously hearing »subtilities, even perhaps such as they do not understand, like the Cartesian philosophy, whose authors say that things of faith are probably set forth by the Holy Spirit, but not so matters in physics, chronology, etc., which are determined by the opinion of the multitude». The Chancellor was not pleased by this advice, practically a criticism of his government of the University, where the news of the proceedings against Cartesianism was received with much displeasure, RUDBECK saying that but few had read DESCARTES' philosophy and that none of the students understood it. But not long after one of the students, URBAN HJÄRNE, later known as an enlightened scientist, and the chief of a chemical institute, defended another disputation by HOFFWENIUS, the Cartesian tendencies of which were found to be so obnoxious to the theologians that a long discussion followed, which, however, did not lead to a decisive victory for either party. HOFFWENIUS refused to have his disputation altered, the theologian STIGZELIUS and his supporters refused to have it ventilated unless altered, and finally both parties rested on their arms, although personal friction continued. One of RUDBECK's disputations had also been found too Cartesian and the attacks against him for this and other reasons did not cease.

After a truce, extending from 1668 to 1686, during which Cartesianism made steady progress at Upsala among the teachers, the controversy broke out anew. The House of Priests, influenced by the Upsala theologians, approached the King, CHARLES XI., with a written application, the spirit of which was to prevent the study and dissemination of DESCARTES' teachings at the University. Among the means proposed to accomplish this purpose the following sufficiently indicate what drastic steps were resolved upon. It was advised that the Theological Faculty should be placed in a position of censorship over the whole University, and not only that the Cartesian philosophy should be forbidden, but that the study of the Aristotelian philosophy should be encouraged by special support, and that no stipends should be granted except to those who accepted ARISTOTLE'S philosophy. All disputations, as well as the authors in philosophy to be lectured upon, were to be passed upon by the theologians. Finally, all disputations, and also all books from foreign countries, were to be admitted only after having been passed upon by a censor. In order to crush Cartesianism in its former stronghold, the Faculty of Medicine, it was proposed that the professorship

of physics, which had been placed in that department by the Constitution of 1655, should be removed therefrom, and placed in the Faculty of Philosophy, and the chair occupied by a loyal Aristotelian.

The discussion was not so much concerning the principles of DESCARTES' philosophy as concerning the limitations to be imposed upon the leaders of the dawning natural sciences, who, basing themselves upon experiments and the principles of DESCARTES were demonstrating the laws of nature from its own phenomena, thus destroying the structure of Aristotelian Scholasticism not only in the field of the natural sciences, but even in that of theology itself, thus endangering religion.

If CHARLES XI. thought to pour oil upon the troubled waters by sending the accusations of the priests to the accused party, the University, the results were certainly discouraging. The Theological Faculty was opposed by all the remaining Faculties. RUDBECK's influence in the Medical Faculty was strongly in support of Cartesianism, which had also found a powerful supporter in the Faculty of Philosophy in the person of JOHANNES BILBERG, Professor of Mathematics. The King had sent the accusations to the University in January, 1687; all the Faculties had replied by May. The King permitted the matter to rest for two years, possibly to await the assembling of the next Diet, which met in 1689. The whole question was then placed in the hands of a committee of five statesmen, who, after hearing the evidence, recommended what was in form a compromise, but in actuality a rejection of the accusations against Cartesianism. On the 17th of April, 1689, the King rendered a formal decision that the doctrines of the Christian faith might not be subjected to philosophical criticism, but as for the rest philosophy should be free in practice and discussion. The controversy at Upsala continued for years after the decision, but the crisis had passed. BILBERG was removed from the Faculty of Philosophy, and, that peace might be restored, was appointed Professor of Theology! The appointment, however, failed to restore peace. Not only was further fault found with his philosophical position as set forth in two theological disputations, but another Cartesian, ERIC CASTOVIUS, was also subjected to severe criticism on account of a disputation, which had been passed upon by BILBERG. But the fundamental question of freedom of discussion and teaching had been answered by the King's decision [1].

[1] After further friction BILBERG was finally appointed to a pastorate at Örebro and died as the well beloved Bishop of Strengnäs diocese. One of his students, who

The general results of the controversy were greater freedom of thought and a direct stimulus to unfettered philosophical and scientific research. In 1710 the Royal Society of Sciences of Upsala was organized and counted among its members during the century such men as SWEDENBORG, CELSIUS and LINNÆUS. The direct influence of the Cartesian philosophy upon the founders of the Society will be discussed below.

In the case of SWEDENBORG the influence of the Cartesian Controversy soon appears upon examining his early scientific writings. He also refers favorably to DESCARTES in connection with some remarkable theories in physiological psychology, and even in his later theological works, in a treatise »De Commercio Animae et Corporis», (1769), which reports a discussion in the spiritual world by the followers of ARISTOTLE, LEIBNIZ, and DESCARTES, the Cartesians are victorious. We must, however, here confine the discussion to the early scientific works of SWEDENBORG, which are chiefly of geological, physical and cosmological content.

Beginning with mathematical, physical, chemical and mechanical researches, partly published in the »Daedalus Hyperboreus», the earliest scientific magazine of Sweden, edited by SWEDENBORG at Upsala, 1716—1617 [1], the young investigator applies himself to geological questions at a time when geology as a science did not exist, and makes a number of remarkable discoveries which have been discussed in detail by A. G. NATHORST in the Introduction to Vol. I. of this series. SWEDENBORG was also deeply interested in astronomy, and when his early studies had been reported in a series of publications which appeared from 1716 to 1722, we find him turning his attention during the next decade to general cosmological problems. At the same time he was collecting information concerning the metals and smelting processes, in connection with his duties as an assessor in the Royal College of Mines. The results of his work were published in 1734 at Dresden and Leipsic in three folio volumes entitled »Opera Philosophica et Mineralia», printed in handsome style by the munificence of the Duke of Brunswick-Lüneburg. The first volume contains the »Principia Rerum Naturalium», the second and third are works on »Iron» and »Copper» [2].

followed him to Örebro, the Cartesian psychologist ANDREAS RHYDELIUS, subsequently professor at the University of Lund, kept alive the flame which his teacher had so zealously guarded. RHYDELIUS was the uncle and educator of NILS RETZIUS, the father of ANDERS JAHAN RETZIUS.

[1] The DÆDALUS will be published in Vol. IV. of this series.

[2] The three volumes of the »Opera Philosophica et Mineralia» will be included in the present series.

The »Principia» has been the subject of some discussion by astronomers and cosmologists, most recently by S. ARRHENIUS in the Introduction to Vol. II. of this series. The early physical philosophy of SWEDENBORG gradually developed into more and more abstract theories of the origin of matter, its composition and motions, culminating in the philosophical and metaphysical introductory chapters of the »Principia» and in the »Prodromus de Infinito».

Among the evidences which indicate the influence of the Cartesian Controversy upon scientific and philosophical investigations at Upsala is the fact that most if not all of the founders of the Scientific Society, first established in 1710 as the *Collegium Curiosorum*, were Cartesians. We have certain knowledge that this is true of nearly all of the founders, of LARS ROBERG, PEHR ELVIUS, HARALD WALLERIUS, and of his son JOHAN WALLERIUS; and probably his brother GÖRAN, as also OLOF RUDBECK, Jr., should be included in the list of Cartesians. On account of the pest at Upsala in 1710, SWEDENBORG's brother-in-law, ERIC BENZELIUS, Jr., invited several of the professors of the Faculties of Philosophy and Medicine, in which it will be remembered the principles of DESCARTES had found their most ardent supporters, to meet at the University Library once or twice a week in order to discuss literary and scientific subjects. BENZELIUS, the chief founder of the Society, was at that time the University librarian. His influence upon SWEDENBORG will be discussed below [1].

Some of the interesting information illustrating the early history of the Society is summarized by one of its secretaries, ERIK PROSPERIN, the professor of astronomy at Upsala, in an »Address concerning the Royal Scientific Society of Upsala», [2] delivered before a meeting of the Royal

[1] In later years BENZELIUS became bishop of Linköping and shortly before his death Archbishop of Sweden, an office which had been filled by several members of the talented BENZELIUS family. A brilliant and versatile scholar, and the greatest librarian Upsala University had known since its foundation in 1477, BENZELIUS played a most important rôle in the intellectual history of Sweden during the early decades of the eighteenth century. The Diocesan Library at Linköping, greatly enriched by the activity of BENZELIUS, contains some twenty volumes of the family correspondence and most of SWEDENBORG's earliest manuscripts and letters, as well as other manuscript matter illustrating the history of the *Collegium Curiosorum*.

[2] »Tal, om Kongliga Vetenskaps Societeten i Upsala; hållet för Kongliga Vetenskaps Academien, vid Praesidii Nedläggande den 18 November 1789, af Erik Prospe-

Swedish Academy of Sciences at Stockholm on the occasion of his leaving the presidency of that body in 1789. PROSPERIN says: »The pest in 1710 had driven the youth from the seat of learning at Upsala, on account of which the customary lectures for a time ceased. In order to be able, in this idleness, to forget, at least for some moments, the lamentable objects which met the eyes and thoughts on all sides, Dr. Erik Benzelius, Jr., who was then Librarian of Upsala Academy, persuaded some of the most famous men of the place to meet once or twice a week in the Royal Academy's library in order to discuss literary matters and to correspond with Christopher Polhem and Emanuel Swedberg, both of whom are among the most renowned men our country has ever produced. Everyone knows that the former was without a rival in his subject. The latter was in younger years one of those who worked with the greatest diligence and the best success in spreading useful sciences. . . . The persons in Upsala who constituted this Society were especially the Professors Harald Wallerius, Johan Uppmarck, Pehr Elvius, Olof Rudbeck, Jr., Lars Roberg, and the brothers Johan and Göran Wallerius. They called their society *Collegium Curiosorum*. It is not known whether they had determined upon special activities or adopted any rules. No complete record has preserved to our time what was considered at their meetings. It is only known that the *Dædalus Hyberboreus*, which was published by Herr Swedberg during the years 1716, 1717, 1718, is a fruit of their labors, and should therefore be regarded as the Royal Scientific Society's first »Proceedings». From the subjects which are there found treated, and from other considerations, it may be concluded that mathematics, physics, economy, and astronomy were the main subjects of the investigations of this Society».

When the University Constitution of 1655 was adopted, the formation of »nations», or clubs of students from the various provinces of the country, was strictly forbidden, but they were nevertheless formed some

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rin, Kongl. Astronom. Observator, Kongl. Vet. Societetens i Upsala Ledamot och Secreterare.» Stockholm, 1791.

Besides the above the student should consult the following publications: »Kongl. Vetenskaps-Societeten i Upsala. Dess stiftelse, utbildning och verksamhet», by J. H. SCHRÖDER, Upsala, 1845; the »Essai sur la Société Royale des Sciences d'Upsal et ses rapports avec l'Université d'Upsal», by O. GLAS. Upsala, 1877, and the recently issued festival publication of the Society, edited by its perpetual Secreterary NILS DUNÉR: »Kongliga Vetenskaps Societetens i Upsala Tvåhundraårsminne MCMX.»

years later. The first inspector of the Westmanland-Dala nation was OLOF RUDBECK, Sr., the professor in the Faculty of Medicine who had defended the revolutionary Cartesian philosophy. Since OLOF RUDBECK lived until after the great fire at Upsala in 1702, and was a next-door neighbor of JESPER SWEDBERG, it is likely that SWEDENBORG received some impressions from this great scientist and investigator. We know that JESPER SWEDBERG's inclinations were not in the scientific and philosophical direction, but he himself says that he permitted his children freely to choose their own occupations. In his disputation thesis SWEDENBORG addresses his parent in terms of loving, filial respect, but they do not seem to have stood very near one another in the following years. SWEDENBORG's steps were not taken in the theological path; he himself afterwards recorded that he was kept from reading works on dogmatic theology, and his work in the Faculty of Philosophy at Upsala no doubt consisted for the most part of a thorough study of the classics and of some branches of mathematics and the natural sciences. Perhaps he also did some work in the Faculty of Medicine, for the professorship of physics, which in those days included the major part of the natural sciences, was in the Medical Faculty. More detailed information as to the professors, subjects, and text-books of the period 1699—1709 is found in the large printed folio sheets which in those days constituted the University Catalogue. It seems likely, if we may judge from certain expressions in SWEDENBORG's earliest letters, written soon after he left the University, that his teachers were among others the following professors in the Faculty of Philosophy: the professor of mathematics, HARALD WALLERIUS; the professor of astronomy, PEHR ELVIUS; and the Schyttean professor of elocution, JOHANNES UPMARK, afterwards ennobled with the name ROSENADLER. He also praises the professor of theoretical and practical medicine, LARS ROBERG. In passing it may be mentioned that there is an oil portrait of Professor WALLERIUS at Upsala showing him with one arm resting upon a volume of DESCARTES; and that the works of that philosopher were still studied during SWEDENBORG's stay at the University appears from the catalogue of 1708, which records that the professor of theoretical philosophy, Magister FABIANUS TOERNER, under whose presidency SWEDENBORG disputed the following year, lectured on ARISTOTLE's Logic compared with DESCARTES'.

SWEDENBORG was a student at the University of Upsala from 1699 to 1709. He then spent a few months at the episcopal residence, Brunsbo,

near Scara, with his father, Bishop JESPER SWEDBERG, before leaving Sweden in 1710 on a journey to England. After a four years' visit in England and on the Continent, SWEDENBORG arrived in Swedish Pomerania in 1714 and returned to Sweden in 1715. He seeks in vain a secretaryship at Upsala[1], but is introduced by POLHEM to CHARLES XII., at Lund, and is appointed extraordinary assessor in the Royal College of Mines. SWEDENBORG is now fairly established; he discusses mathematical and scientific subjects with the King, assists POLHEM in various engineering enterprises at Trollhettan and Carlskrona, and continues the scientific studies which he had begun before returning to Sweden. Beginning with mathematical, mechanical, and astronomical studies, he proceeded with physics, chemistry and geology, and then after writing and partly publishing a series of most remarkable works on those subjects, the last of which were the »Precursor of the Principles of Natural Things»,[1] 1721, and the »Miscellaneous Observations,» 1722, he devoted himself for twelve years to metallurgy and cosmology, publishing, in 1734, the three magnificent folios entitled »Opera Philosophica et Mineralia.» An analysis of SWEDENBORG's later philosophical, psychological, physiological and anatomical studies, based upon a comparison of his works of the period 1734—1745, whith the earlier series of the period 1716—1734, shows most clearly that the fundamental principles of his philosophy were worked out during the earlier period. The »Principia» is justly admired on account of the new cosmology it expounds, but many of the principles there laid down are found in the works published before 1722, although a close comparative study shows that great modifications were made from time to time and that some positions were gradually abandoned as the system developed.

The Relation of Swedenborg's Philosophy of Nature to the philosophies of Descartes, Newton and Polhem.[2]

It is certain that SWEDENBORG's interest in the natural sciences and philosophy had been powerfully excited before he left his Alma Mater

[1] Dr. CLAES ANNERSTEDT, the former librarian of Upsala University, has kindly furnished me with a copy of SWEDENBORG's application to the Rector and Consistory, preserved among the »Acta» of the Consistory for the year 1716.

[2] Much of the material employed in the previous sections, and in the remainder of this Introduction, has been submitted to the annual meetings of the Swedenborg Scientific Association of Philadelphia, U. S. A., and published in the quarterly of that body, »The New Philosophy», since 1901.

in 1709, and that it was his brother-in-law, ERIC BENZELIUS, who advised him to apply himself to those subjects, is proved by SWEDENBORG's remarks in his earliest letters to BENZELIUS, and in the dedication of the work »On the Infinite.» [1]

We shall not, at present, concern ourselves with an analysis of SWEDENBORG's early treatises on a variety of mathematical and scientific subjects, written and partly published before the year 1722, but rather attempt further to define with some precision the sources and development of his general philosophy of nature during this early period. An abundance of evidence shows that SWEDENBORG had great confidence in the work of ERIC BENZELIUS and CHRISTOPHER POLHEM, and that he admired and studied the works of DESCARTES, NEWTON, PUFFENDORF and RUDBECK. In the earliest work published by SWEDENBORG after leaving Upsala, — a »Festive Applause», printed at Greifswald in 1714 in commemoration of the return of Charles XII. from Turkey to Swedish Pomerania, — SWEDENBORG begins by referring to a doctrine of the Pythagoreans that all things develope in cycles, proceeding and then returning to the point of departure. The student of SWEDENBORG's works will find this doctrine developed from time to time, especially in the »Principia» and »Worship and Love of God». Again, in a short paper »On the Causes of Things», [229] — whether it be by SWEDENBORG or POLHEM we cannot be certain, perhaps it is the result of joint labor, the doctrines of a series of particles, differing in size and variously compounded, derived from the Infinite, and in vortices, may be traced quite clearly. These doctrines, greatly developed, reappear in the »Precursor» [1] of 1721 and

[1] In his first letter to BENZELIUS, written at Brunsbo, July 13th, 1709, thus only a few weeks after having defended his thesis at Upsala, and as we would term it today »graduated», SWEDENBORG mentions his plans for the journey to England, which had evidently been discussed before he left Upsala. He also refers to his plans for future study, proposing to choose a certain subject which might in time be completed. He has always desired to derive use and improvement from »the studies, which I selected with your advice and approval, my dear Brother». He shows his interest in Physics and »Natural History,» which in those days meant natural science and philosophy in general, and declares his intention to collect mathematical knowledge, also expressing his desire to have access to the mechanical inventions of POLHEM, before anything mortal happen to him. All these early dreams of SWEDENBORG were afterwards fulfilled, and in later years, after the publication of his »Opera Philosophica et Mineralia», he dedicates to his adviser BENZELIUS the »Prodromus de Infinito», referring gratefully to the valuable counsel of his early guide.

in the »Miscellaneous Observations» of 1722, and the culmination of their development, the theory of motion becoming more and more prominent, is recorded in the Second or Lesser »Principia», 1729, and in the »Principia» of 1734.

Among the theories which SWEDENBORG began developing as early as during his first visit to London, is that of finding the longitude at sea by means of lunar observations. His interest in this subject never waned, and we find him reprinting and circulating his early work on the subject even during the latter portion of his theological period, as late as 1766, when he was 78 years old. At the time when SWEDENBORG was first developing this theory in London he was studying the works of NEWTON, and discussing astronomical subjects with HALLEY and FLAMSTEED. Now if SWEDENBORG had accepted NEWTON's results, taken as a whole, he would have rejected the theory of vortices taught by DESCARTES, for NEWTON is opposed to the vortical theory and accepts a vacuum. SWEDENBORG, however, although he very early formulated a theory of round particles which differs from that of DESCARTES, never gave up the theory of various kinds of particles and vortices which DESCARTES had introduced into modern physics and cosmology, and which was in those days received everywhere, except in England, where the philosophy of NEWTON won the day long before it was accepted on the Continent and in Sweden. The condition in Sweden is well illustrated by the following question in a letter, dated the 28th of July, 1711, written by the astronomer, PEHR ELVIUS, to his former student, SWEDENBORG, during his visit in England. ELVIUS inquires as to »what the learned mathematicians think about NEWTON's principles of the motions of the planets, since they appear to be pure abstraction and not physical, namely, how one planetary body can gravitate towards another, etc., which seems to be absurd». Of this question SWEDENBORG says in a contemporary letter to BENZELIUS: »P. S. Prof. Elvius asks what is the opinion of Englishmen with regard to Newton's 'Principia,' but in this matter no Englishman ought to be consulted, because he is blind about his own (*quia caecutit in suis*); and it would be a crime to call them into doubt».

SWEDENBORG not only retained DESCARTES' theory of vortices, but also denied NEWTON's corpuscular theory of light and doctrine of the vacuum. DESCARTES also denied a vacuum, and it is well known that SWEDENBORG formulated a wonderful undulatory theory of light, very early ranking himself on the side of those who hold light to be a motion, namely,

HUYGHENS, HOOKE, and others. As every student of the subject knows, the mechanical explanation of the law of gravitation presents great difficulties even today. I think it likely that SWEDENBORG came to the doctrines of the natural point and first element, set forth in his »Principia», as a result of these early studies during which he became thoroughly aware of the fundamental opposition between the philosophies of DESCARTES and NEWTON.

Another stream of thought into which SWEDENBORG was led during the first decade of his researches, that of the subdivision of matter into particles of various sizes, was derived from the theories of the ancient atomists, DEMOCRITUS, LEUCIPPUS and EPICURUS, and was introduced into modern chemistry and physics by PIERRE GASSENDI and ROBERT BOYLE. But there are many proofs that SWEDENBORG also inherited much from the alchemists, and indeed chemistry was in his day far less advanced than were physics and astronomy.

SWEDENBORG's early standpoint with regard to the streams of thought to which we have just referred, namely, the Cartesian theory of vortices, the Newtonian conception of gravity and the vacuum, and the subdivision of matter into particles of various sizes, all combined to determine his future physical philosophy as developed in the »Principia» from 1721 to 1734. We find him in 1719, in the little work on the »Motion and Rest of the Earth and Planets»,[303] projecting a *Theoria Telluris*, with which he says the theories of DESCARTES and NEWTON must be compared. And still earlier, in 1718, in a letter to his brother-in-law, ERIC BENZELIUS, Jr., SWEDENBORG had begun to develope his theory of round particles, subsequently presented in full as the »bullular hypothesis», in the »Precursor» and »Miscellaneous Observations,» and again with many additions and some modifications in the two »Principia» of 1729 and 1734. In the letter to BENZELIUS, dated January 30th, 1718, SWEDENBORG writes:

»Most honored and dear brother.

»I send you something new in Physics, upon the particles of air and water, proving them to be round, which may militate against the philosophy of many; but as I base my theory upon proofs and geometry, I hope that no one will be able to advance reasons for denying it. Preconceived ideas received from Descartes and others will probably furnish the greatest obstacles and objections. Dr. Roberg, who in everything that is minute and subtle is himself subtle, is best able to judge re-

specting it: if you would therefore be kind enough to leave this with him, I should like to hear his opinion. If Prof. Vallerius would lay aside a little his own and his dear father's Descartes, I would also like to have his opinion. This is a subject with which I might produce a large book, as is done by the learned abroad with their speculations, but as we have no appliances here for so large a publication I must cut my coat according to the cloth, and introduce only the most general views. The use of this seems to me to enable us more thoroughly to investigate the nature of air and water in all its parts: for if the true shape of the particles is once discovered, we obtain with it all the properties which belong to such a shape.» [1]

SWEDENBORG here opposes the Cartesian theory with regard to the *shape* of the particles, and incidentally indicates how faithfully HARALD WALLERIUS and his son JOHAN adhered to the Cartesian philosophy. But that SWEDENBORG had by no means become an opponent of the »Cartesian» theory of vortices is evident not only from the numerous references to vortical theories with which his later »Principia» abounds, but also from his three little works on the »Earth and Planets». [269—320] SWEDENBORG's conception of the earth's revolution around the sun in the planetary vortex is further shown by the following quotation from his letter to ERIC BENZELIUS, Jr., dated November 3rd, 1719:[2]

»Most honored and dear brother.

»A few days ago I arrived here in Stockholm, when I was at once informed by various persons that a new discovery had been made in France affecting the inhabitants of this earth, viz. that our earth had approached about 35,000 miles nearer the sun, and that they had written on this subject to the learned Academies. I should like very much, for better information, to obtain more particular knowledge respecting it, viz. whether observations have been made of the sun's diameter, and its visible increase, or of the parallaxes of the planets and their supposed

[1] See the original Swedish letter in Vol. I., p. 281, of this series. The version above is a revised form of the English translation in Vol. I., pp. 296—297 of the »Documents concerning Swedenborg», edited by the Dr. R. L. TAFEL, London, 1875—1877.

[2] The original Swedish letter from which we have quoted is printed in Vol. I., p. 290, of this series. The translation below is revised from Dr. R. L. TAFEL'S »Documents», Vol. I., pp. 307—309.

displacement, which would be noticed, in case we approached nearer to our centre; for this could only show itself within our solar vortex, outside of which there is no possibility of any indications nor of any parallax with the sun showing itself, unless one should appear which could not be distinguished before. The greatest matter of surprise is, that such a leap should have been made within one or two years, when yet no comet has hurled itself into our larger vortex, nor has any other planet, so far as I know, approached so near to our terrestrial vortex, that it could have forced us inwards. In case there have been some such violent cause, we may presume that our planet will again recede to its proper distance, inasmuch as this always adapts itself to the speed and to the right track. It does not seem reasonable that this should have taken place in a natural manner in so short a time, unless it is deduced from observations made for some 100 years. I am glad, however, that I treated publicly a similar subject about a year ago in my treatise »On the Earth's Motion and Rest», in which I maintain that the earth moves more and more slowly both in its annual and diurnal revolution, from which it must necessarily follow, that it approaches nearer and nearer to our sun; for the more rapid the motion and revolution of the planets within the solar vortex, the greater is the distance to which they are carried from the centre; but the slower the motion, the more they are drawn inwards; moreover, it is known in what proportion the centrifugal force increases according to the velocity with which a body either tends outwards or inwards. Isaac Newton's »Principia» treats of this subject. The case with the planets is, also, as if a long arm were made, with a ball upon it, which was free, and could slide either forward or backward on the arm, and thus could move either out or in by the least force; if, now, this ball should be spun round very rapidly — especially under water — then the centrifugal force would be increased to such a degree, that the ball would run far out on the arm, away from its centre; but if the motion (*primum mobile*) should decrease, the ball would be drawn inward. Exactly so it is with the planets; if the first moving cause (*primum mobile*) decreases, the planet approaches nearer to its centre; but if the motion is increased, the planet is thrown far out; or what is the same thing, the slower the revolution the nearer its approach to the sun, which is the theory I discuss in the above-named treatise, which I shall show you when there is a good opportunity. That this, however, should take place within two or

three years, I cannot yet get into my head; although even our atmosphere itself seems to indicate a change in the temperature in respect to summer and winter, and also in respect to the unusual north winds we now have. With regard to the nature of motions, if an examination is made of the degree in which they either increase or decrease, they are no doubt in duplicate ratio, and it appears that toward the end motion decreases more in one moment than before in 20; for instance, if anything be whirled around, the revolution towards the end diminishes more in one moment, than it did before in 20; yet this cannot, it would seem, be applied to our planet. I should therefore like very much to obtain more exact knowledge about this matter.»

We see from the above, and from many other places in SWEDENBORG's early works and letters, that although a student of NEWTON's »Principia», and a great admirer of his discoveries, SWEDENBORG did not go further and also accept NEWTON's doctrine of the vacuum. In agreement with the older Cartesian philosophy, SWEDENBORG found vortices of atmospheric particles necessary, and all his later explanations of the planetary and lunar motions involve the vortical theory.

In still another direction SWEDENBORG is in agreement with DESCARTES rather than with NEWTON. We refer to the general conceptions of the origin, composition and interrelations of substantial and material particles. While DESCARTES derives his series of particles from the Infinite, and NEWTON also holds that God in the beginning created small, impenetrable particles, by whose composition everything was formed, they differ in that DESCARTES accepts no creation of particles in a vacuum, while for NEWTON the vacuum is a postulate, even if he later on began to speculate as to the necessity of a communicating ether. In his *Principia Philosophiae* DESCARTES expressly opposes the idea of a vacuum, but NEWTON was possibly led to construct his impossible corpuscular theory of light and colors just because he did accept a vacuum in his earlier work the *Principia,* 1686, the *Opticks* not appearing until many years later, in 1704.

Since the fundamental differences between those philosophies which accept the principle of discrete spatial substances without postulating a vacuum, and those which suppose that atoms occupying space are contained and move in an infinite vacuum of which space is also predicated, are very well illustrated by the various theories of light and color, it will throw further light on SWEDENBORG's relation to DESCARTES and NEW-

TON briefly to recount the history of investigations concerning light and color up to SWEDENBORG's times.

GOETHE has well said:[1] »From time immemorial it has been dangerous to treat of color, so much so, that one of our predecessors ventured on a certain occasion to say, 'The ox becomes furious if a red cloth is shown to him; but the philosopher, who speaks of color only in a general way, begins to rave.'». Since ancient times the phenomena of light and colors have received the attention of philosophers, and many are the theories of their causes which have been presented. PYTHAGORAS taught that vision was caused by particles continually projected from the surfaces of objects into the eye, while EMPEDOCLES and PLATO ascribed the excitation of the sense of sight both to emanations proceeding from the objects seen and also from the eye itself. ARISTOTLE opposed the doctrine of visual rays and emission theories in general, maintaining that light is not a material emission in any sense, but an action of a pellucid medium, thus anticipating in a general way some of the best results of modern times. EPICURUS, LUCRETIUS, and others had a confused notion that the eye sees bodies at a distance in a similar way that we feel them by means of a rod, and this strange idea was accepted for many centuries until the Arabian astronomer ALHAZEN showed in the eleventh century A. D. that the cause of vision proceeds from the objects and not from the eye.

The ancients were acquainted with some of the fundamental laws of optics, among which may be mentioned these: that light travels in straight lines, that the angle of incidence is equal to the angle of reflection, that water and air refract light, and that transparent balls of glass or crystal, or glass globes filled with water, may be used as burning glasses.

ALHAZEN made great progress in the explanation of reflection and refraction, and also entered into anatomical examination of the eye. VITELLIO, a native of Poland, still further extended the knowledge of refraction and reflection, drawing up some improved tables concerning them. That universal genius, ROGER BACON, if we are to accept certain statements in his works as authentic, appears to have discovered the underlying principles of both the telescope and microscope, and to him also has been

[1] »*Zur Farbenlehre*», 2 vols., Tübingen, 1810. There is a later edition and a translation of the first volume by CHARLES LOCK EASTLAKE R. A., F. R. S., London, 1840, entitled »Goethe's Theory of Colors.»

attributed the invention of the magic lantern. The first telescope, however, was, according to one version of the story, constructed by a Dutchman named JANSEN, whose children while playing in their father's workshop accidentally placed a convex and concave spectacle glass at a short distance from each other and noticed the apparent increase in magnitude of what they saw through the glasses. They drew their father's attention to the phenomenon, and he fixed such glasses in a tube and sold the instrument. It is certain that the principle of the telescope was discovered in Holland, although it is not quite clear who the discoverer was. But whoever he was, GALILEO, having heard of the instrument, made one himself, and with it discovered a satellite of Jupiter. Great progress was now made in the study of light and colors. KEPLER, PORTA, DE DOMINIS, SNELLIUS, DESCARTES, and GRIMALDI both enlarged the field of discovery and corrected previous results, preparing the way for NEWTON, who in 1704 published his »Opticks», containing experiments of the utmost importance and presenting his theory of light and colors, which, although rejected as to its corpuscular philosophy, is still accepted by the scientific world in many other respects.[1]

NEWTON's theory briefly stated is as follows: Lights consists of material particles or luminous corpuscles sent forth from a luminous body in straight lines which by their mechanical action on the retina produce sight. He says:[2]

»Are not the Rays of Light very Small Bodies emitted from Shining Substances? For such Bodies will pass through uniform Mediums in right Lines without bending into the Shadow, which is the nature of the Rays of Light. They will also be capable of Several Properties and be able to conserve their Properties in passing through several Mediums, which is another Condition of the Rays of Light.»

NEWTON also attributes the heat of substances to the agitation of their parts caused by the action of the rays.

NEWTON's theory of light, according to the above quotation, is therefore an »emission» or »corpuscular» theory, its fundamental features being similar to those combated ages before by ARISTOTLE. NEWTON was well aware of the »undulatory» theory, which considers light to be due

[1] For a condensed history of theory and experiment on light and color see PRESTON's »Theory of Light,» Macmillan & Co., 1890, of which the present account is for the most part an abridgement. For original documents see GOETHE, *Op. Cit.*, Vol. II.

[2] »Opticks», Bk. III., Qu. 29.

to the periodic motion of a medium between the luminous source and the retina, but he thought that a ray of light could travel only longitudinally in a manner analogous to sound vibrations, and therefore, as PRESTON says, he »fell back upon the emission theory, and developed it with a genius more than mortal.»[1]

NEWTON'S theory of color may be stated as follows: Every color is simply a kind of light. Thus when a ray of white light from the sun is passed through a prism, the various kinds of light composing the ray are separated from each other, and when one of these kinds of light is again passed through a prism it remains unaltered as to color. He thus taught that there were seven fundamental lights: violet, indigo, blue, green, yellow, orange, red, the combination of which produced white light, and he considered this proved by collecting all the refractions of his spectrum by means of a lens and again producing white light. NEWTON not only thought that sunlight was composed of several different kinds of light, but in the first sentence of his »Opticks» emphasizes his opposition to all such conceptions as those held by SWEDENBORG and other receivers of vibratory and undulatory theories in the following language:

»The Phenomena of Colours in refracted or reflected Light are not caused by new Modifications of the Light variously impressed, according to the various Terminations of the Light and Shadow.»[2]

NEWTON'S corpuscular theory of light was opposed by ROBERT HOOKE, and even long before, DESCARTES, LIONARDO DA VINCI, GALILEO and GRIMALDI had written in favor of the idea that light is an instantaneous pressure of an elastic medium or a vibratile movement there of. Butthe undulatory theory was first definitely stated by HUYGHENS in 1678, and after remaining lifeless for almost a century, was revived by YOUNG, the discoverer of the principle of interference. It was still further strengthened by FRESNEL, who introduced the idea of transverse vibrations guessed at by HOOKE in 1672. The undulatory theory teaches that the propagation of light is due to the periodic wave motion of a postulated medium called the ether, that there are millions of kinds of waves differing in length, that only a short range of these may be perceived in the spectrum from violet to red, and that above the violet are many waves decreasing in length and noticeable in fluorescence and chemical

[1] *Op. Cit.*, p. 21.

[2] Book I, Prop. I, Theor. I.

action, while below the red are many waves increasing in length and noticeable in thermal action or calorescence.

It should be noted that NEWTON also postulated an ether in which his luminous corpuscles travelled, and in which they were capable of exciting undulations.

»He also attempted to account for gravitation in an ether, but he published little of this theory, because he was not able from experiment and observation to give a satisfactory account of the medium and the manner of its operation in producing the chief phenomena of nature.»[1]

SWEDENBORG'S theories of light and colors are radically different from those of NEWTON. The whole scheme of his bullular hypothesis would at once prevent the formation of any theory involving the shooting of corpuscles from the sun to the earth and thus impinging on the retina, for he considers all space to the filled with degrees of matter and natural substances, differing in degree of density of composition and inertia. From the very beginning he taught that light is produced by the undulatory motion of an elastic ether, and that colors are produced by the modification of this motion in the material objects receiving it. He developed and modified the theory from time to time, but that it was originally derived from the older workers, from DESCARTES, HUYGHENS or HOOKE, is clear from SWEDENBORG'S earliest works.

Up to the present point we have seen that SWEDENBORG retained the Cartesian theory of vortices and without accepting the Newtonian vacuum nevertheless employed NEWTON'S discovery of the mathematical relation of masses in space which is commonly called the law of gravitation. With regard to the question of the constitution of matter, GASSENDI and BOYLE had introduced the atomic theory of DEMOCRITUS, who also postulates a vacuum, into modern chemistry and physics, but SWEDENBORG, who studied BOYLE'S works, and was in general much influenced by the English experimental school of thought, nevertheless differs with all those advocates of the subdivisibility of matter whose reasoning ends

[1] Preston, *Op. Cit.*, p. 26: — The student of SWEDENBORG'S cosmology may be interested in the following note, quoted from the same work, pp. 25—26: »To Descartes the bare existence of bodies apparently at a distance was proof of the existence of a continuous medium between them, for he regarded extension as the sole essential property of matter, and matter a necessary condition of extension. 'Ethers were invented for the planets to swim in, to constitute the electric atmospheres and magnetic effluvia, to convey sensations from one part of our body to another, till all space was filled several times over with ethers' (J. C. Maxwell).»

in ultimate atoms which, while occupying space, cannot be further divided, but move in a vacuum. SWEDENBORG, while differing from DESCARTES as to the shapes and properties of his particles, still agrees with that philosopher in accepting a series of discrete substantial forms whose origin is the Infinite, and which move, not in a vacuum, that is, a great empty space, but whose relationship to one another first produces space. He would therefore maintain that space is not a vacuum in which the particles move, but that it is a relationship of the extended particles. Every student of the history of philosophy and the sciences is aware of what confusion and obscurity have prevailed concerning these prime questions, and that even today both physicists and metaphysicians accept theories which are in utter disagreement with each other. We cannot, however, here enter upon a detailed discussion of these profound questions, but must content ourselves with having defined SWEDENBORG's position and its relation to DESCARTES and NEWTON.

If, now, we enquire as to how SWEDENBORG placed himself with regard to the problems of the divisibility of matter and its properties, and endeavor to see his exact position in history, we find that his earliest statements date from a period when he was intimately associated with the Swedish ARCHIMEDES, CHRISTOPHER POLHEM, and that whether POLHEM was or was not the author of the chemical and physical theories which will now be referred to, SWEDENBORG in any case developed his own theories upon a basis which was supplied by POLHEM. The evidence for this is the following.

POLHEM, whose mechanical genius and numerous inventions won the admiration of his age, has left behind him masses of unpublished matter, preserved in the Royal Library at Stockholm, among which there are many dialogues and discussions which set forth his conceptions of mechanics, physics, chemistry and dietetics. Among these manuscripts is a »Dialogue between Mechanica and Chymia on the Constitution of Nature»,[243] which is in the handwriting of SWEDENBORG, but in the same package the latter portion of the »Dialogue» exists as a first draft in the handwriting of POLHEM. We know that SWEDENBORG for a time acted as POLHEM's amanuensis, and he appears to have done so in the present instance. The remarkable thing is that several of the positions of the »Dialogue» which have by students of SWEDENBORG been considered to be original with him in his »Precursor» and »Miscellaneous Observations», are clearly stated in the little work we are discussing.[243] Thus we observe that the »Dialogue» mentions the salt particles smaller

than the water particles, which salt particles are formed at the bottom of the sea by pressure. There is also a remarkable similarity between the positions of this work with regard to the flood, the origin of the mountains, strata, sand and clay, and the statements of SWEDENBORG on the same subjects. We observe further that BOYLE and the Swedish chemist HJÄRNE are mentioned. SWEDENBORG was personally acquainted with HJÄRNE and probably derived several ideas from him. As for the authorship of the »Dialogue», there can be no doubt that POLHEM drafted the work, but it may be that SWEDENBORG collaborated.

Still another question of a similar kind arises when we notice the resemblance of many expressions in the »Dialogue» to those in the little paper in SWEDENBORG's handwriting »On the Causes of Things».[220] Both of these papers refer to the floating of a hollow bullet on water and to the part which flowing glass played in the original development of the earth, an idea probably derived from the presence of quartz and other glassy looking minerals occuring in the crust of the earth. The paper »On the Causes of Things» has always been ascribed to SWEDENBORG, and various students have with the learned editor of the »Documents concerning Swedenborg» seen how in this early manucript »are contained the germs of some theories which SWEDENBORG subsequently treated more fully and established at greater length».[1] If, however, we examine the manuscripts of POLHEM we find a little work »De Causis Rerum», which has contents similar to those contained in the paper written by SWEDENBORG's hand. POLHEM's paper is much longer than SWEDENBORG's, but contains the same headings and treats of the same subjects. The discovery of this evidence shows that if we are ever to obtain clear and satisfactory ideas concerning the sources and development of SWEDENBORG's philosophy of nature, and we may add of the Swedish natural science and philosophy of the eighteenth century, a much deeper investigation and historical analysis than has been attempted in the past must be undertaken. The literature is very meagre, and students must therefore, in discussing the development of SWEDENBORG's early philosophy of nature and »Principia», rely very largely upon the internal evidence of his own works and letters, although fully admitting the probability that the publication of the extensive material left behind by the Swedish scientists of the seventeenth and eighteenth centuries which still lies buried in the public and private archives of Sweden would throw a powerful light upon the subject.

[1] Dr. R. L. TAFEL's »Documents», Vol. II., p. 890.

NOTES

ON THE

DEVELOPMENT AND TEXTS OF SWEDENBORG'S EARLY PHILOSOPHY OF NATURE AND »PRINCIPIA».

Since the publication of Vols. I. and II. of SWEDENBORG's scientific texts the literature has been greatly enriched by a number of festival publications issued at Stockholm and Upsala during the past year, and also by the contributions published in the *Transactions* of the International Swedenborg Congress held in London, July, 1910. The festival publications which bear upon SWEDENBORG's scientific works will be referred to in the *Notes* below, in which the reader will find a résumé of the latest results obtained in Sweden on the development and texts of SWEDENBORG's early philosophy of nature and »Principia».

Stockholm, March, 1911.

EDITOR.

An interval of three years has elapsed since the publication of Vol. II., and as considerable progress has since been made in the interpretation of SWEDENBORG's physical philosophy it seems advisable that the »Notes on the history and texts of SWEDENBORG's contributions to cosmology», published in 1908 (Vol. II., pp. 369—373), should here be revised and amplified.

In our former *Notes* the Cartesian Controversy, which played so important a rôle at Upsala University during the latter half of the seventeenth century, was referred to only in passing, but in the Introduction to

the present volume the reader will find some account of that important revolution in the intellectual life of Sweden. Viewed in connection with the historical background furnished by the Cartesian Controversy and its influence upon SWEDENBORG's teachers and early associates, his earliest scientific and philosophical contributions fall into relationships which permit our obtaining that perspective which is so necessary for a just view of their significance. The streams of doctrine and speculation arising from the works of ARISTOTLE, DESCARTES and NEWTON, to mention only the main sources, were all active at Upsala just before and after SWEDENBORG'S residence at the University (1699—1709), and could not fail to influence the course of a young investigator's thoughts. In the Introduction we have attempted, even at this early stage of these historical researches, briefly to define the conditions by which SWEDENBORG was surrounded, when in early manhood he decided to devote himself to the study of nature.

After preliminary theological, classical, and scientific studies at Upsala University, SWEDENBORG defended a classical disputation in 1709. About a year later he departed for London, and, according to his earliest letters, the journey had been determined upon before his leaving the University. Bishop JESPER SWEDBERG, SWEDENBORG's father, and ERIC BENZELIUS, Jr., his brother-in-law, had visited England and been greatly influenced by English learning. Before leaving the paternal roof in 1710, SWEDENBORG sent to Upsala from Skara the skeleton of what he at the time referred to as a »giant». Subsequently the bones were found by Professor LARS ROBERG to be those of an extinct species of whale. Although surrounded by the rich geological treasures of Vestrogothia, SWEDENBORG does not appear at this early stage of his work to have perceived the significance of the stories buried in the rocks. Probably he was so confined to the neighborhood of the episcopal residence, Brunsbo, that the wonders of Kinnekulle, about which he published an important work ten years later, were beyond his reach, although but a few miles distant. That he chafed in his confinement at Brunsbo and longed to set forth upon his journey to England appears from his first letters to BENZELIUS. (Vol. I., p. 201 *et seqq.*)

Arrived in England, SWEDENBORG devoted his attention chiefly to astronomical subjects, studied NEWTON, and laid the foundations for his future many-sided activities in the field of the natural sciences, as may be seen from his letters to BENZELIUS. On the way back to Sweden, during a stay at Greifswald in Swedish Pomerania, SWEDENBORG began to arrange his results into order and published a number of poems and fables, as also

a »Festive Applause» on the return of Charles XII. from Turkey. In the opening words of the »Applause» he refers to a doctrine of the Pythagoreans that all things proceed and return in cycles, making it a leading idéa in the little work, a harbinger of doctrines which were in later works again and again elaborated by SWEDENBORG, forming as important a component of his later philosophy as the doctrine of perpetual flux in HERACLITUS. Just before returning to his native country SWEDENBORG sent to BENZELIUS a letter (Vol. I., p. 225) in which he furnishes a list of the inventions then in hand. From the letter referred to it may be seen how his mind at that time teemed with ideas which were in part elaborated and printed in the *Daedalus Hyperboreus*[1] and which in several respects foreshadowed the subsequent course of discovery.

Without attempting to analyze SWEDENBORG's numerous papers of this period, dealing with very diverse mechanical, physical, chemical, mathematical, geological and metallurgical questions, let us turn our attention to his earliest contributions to a philosophy of nature, subsequently developed in his »Principia». In our former *Notes* special emphasis was laid upon the fact that SWEDENBORG in reality wrote three »Principia», and that the second work was evidently not from the period *prior* to the *Prodromus Principiorum Rerum Naturalium*, but of much later date. The second »*Principia*» probably dates from about 1729, thus only five years before the publication (in 1734) of the third »*Principia*». We shall return to this question below, and merely refer to it here in order to again draw

[1] The *Daedalus Hyperboreus* has been reproduced in a photolithographic *facsimile* which will be included in Vol. IV. of the present series, and a separate edition of the reproduction has already appeared in »*Kungliga Vetenskaps Societetens i Upsala Tvåhundraårsminne, Upsala*, 1910, edited by the Society's perpetual secretary, Professor Dr. NILS DUNÉR, and containing much historical information of interest to students of SWEDENBORG'S earliest scientific works. This »Tvåhundraårsminne», published on November 19th, 1910, in celebration of the bicentenary of the Royal Society of Sciences of Upsala, forms one of the twelve festival publications which appeared at Stockholm and Upsala in July and November, 1910. Without here referring to the whole series of festival publications, several of which are editions of SWEDENBORG's early works, and all of which will be noted in the »Chronological List» to be included in the *Appendix* to Vol. I. of this series, we desire to call the special attention of the student of SWEDENBORG's scientific works to the festival publication dedicated by the University of Upsala *Till Kungl. Vetenskapssocieteten i Upsala 1910*, in which is contained a remarkably thorough discussion of »EMANUEL SWEDENBORG's investigations in natural science and the basis for his statements concerning the functions of the brain,» by MARTIN RAMSTRÖM, M. D., Professor of Anatomy at the University of Upsala.

attention to the *very gradual development of Swedenborg's principles of nature from 1721 to 1734*, a longer period by two years than that in which he produced (from 1734 to 1745) his great works on the human body and mind, in the analysis of which the principles previously developed were constantly applied. Now, an interesting result of recent investigations in Sweden is that *even before 1721 the »Principia» were expressed in some of their most striking aspects in a number of short Swedish works dating from about the year 1718.*[269–320] In these Swedish works, several of which are printed in the present volume, we therefore find the original conceptions which were later expanded in the three Latin »Principia».

In the Introduction we have discussed the relation of SWEDENBORG's philosophy of nature to the philosophies of DESCARTES, NEWTON, and POLHEM, and pointed out that the manuscripts »*De Causis Rerum*»[229] and »*Discours omellan Mechaniquen och Chymien om naturens väsende*»,[243] although in SWEDENBORG's handwriting, were probably more the result of POLHEM's authorship than SWEDENBORG's. The relationship of these texts, now first published, is, however, confined for the most part to SWEDENBORG's chemical, geological and physical theories as recorded in the treatise *Om Watnens Högd* and in the *Prodromus* and *Miscellanea observata*. When we come to the cosmological theories of SWEDENBORG, the historical lines lead us partly to the ancient classical writers of Greece and Rome, partly to DESCARTES and NEWTON, as pointed out in the Introduction. Whether SWEDENBORG received the first hints of his »nebular hypothesis» from OVID's *Metamorphoses*, or from some other source than his own original speculations, has not yet been made clear. Certain it is that he did not express the theory in the fragment *En ny theorie om jordens afstammande*,[269] although it may have been in his mind then, for in discussing the decreasing motion of the earth and planets (a theory developed in our times by G. H. DARWIN), the question of the original planetary and solar chaos of course lay near at hand. Be that as it may, in a work of considerably later date, to judge from the pronounced difference in the handwriting, the theory of the origin of the earth and planets from their »first lump» is clearly expressed in the opening words of the preface.[285]

In the printed work,[299] which, after some revision and expansion, was published at Skara in 1718, the »lump» has become a »Chaos», reminding us of the chapter in the *Principia* of 1734 *De Chao universali solis et planetarum*. In this theory SWEDENBORG separates himself from the cosmological theories existing before his time and establishes the »nebular hypothesis»,

thereby anticipating BUFFON, KANT, WRIGHT, LAPLACE and other writers. In so far as the doctrine of vortices is concerned, SWEDENBORG probably derived it from DESCARTES, but he differs with DESCARTES as to the origin of the planets, for whereas DESCARTES derives them from outer space, SWEDENBORG derives them from the original chaos of the sun and planets. So far as BUFFON is concerned, he had SWEDENBORG's work in his library two years after it was published, and did not publish his own theory of the origin of the planets by the crashing of an enormous meteor into the sun, the matter of the planets being thus splashed out into space, until many years later. Of this theory it must be admitted that it crudely resembles SWEDENBORG's in so far as the solar origin of the planets is concerned, and it also reminds us of the theories of certain modern writers who hold that masses in space may crash into one another and produce nebulae. As for the theories of KANT and LAPLACE, and their relation to SWEDENBORG's »Principia» theory, we may here quote the remarks of NYRÉN, who wrote on the question many years ago.[1]

»It cannot be denied that the essential part of the nebular hypothesis, namely, that the whole solar system has been formed out of a single chaotic mass, which first rolled itself together into a colossal ball and subsequently by rotation separated a ring from itself, which then during the continued rotation broke up into several parts, and finally contracted into the planetary masses, was first expressed by SWEDENBORG. The work of KANT here in question, *Allgemeine Naturgeschichte und Theorie des Himmels*, was published in 1755, that is 21 years later; LAPLACE did not publish his hypothesis until 62 years later. It should further be observed that SWEDENBORG has in all probability given his hypothesis the more correct form, that, namely, as LAPLACE also later on supposed, the planets were formed out of broken up rings, (on the basis of the vortical theory SWEDENBORG found but one ring necessary) not, as KANT supposed, immediately out of conglomerations formed from the original mass of vapor.»

If we examine SWEDENBORG's earliest works in their chronological order we find that the three component parts of his early philosophy of nature, namely, 1) the theory of vortices, 2) the origin of the earth and planets, and 3) the constitution of matter out of grades of particles, — that these

[1] *Vierteljahrschrift der Astronomischen Gesellschaft*, Vol. 14, 1879. See recent discussions in the Introduction to Vol. II. of the present series, Stockholm, 1908, by Professor Dr. S. ARRHENIUS, and in the *Transactions* of the International Swedenborg Congress, London, 1910, by Professor I. TANSLEY.

three streams of thought, which we have briefly discussed in the Introduction, follow one another during the second decade of the seventeenth century. It will be observed that their order indicates how SWEDENBORG passed from more general to more specific questions, from the universe to the particles of which it is composed, and, probably under the guidance of that ancient doctrine that in the microcosm we see the macrocosm, and *vice versa*, he was led to formulate his early philosophy in such a way as to accept the same laws as governing the least parts of nature which are operative in the grand universe. SWEDENBORG, so far as his works record, accepted the theory of vortices without question, but applied it successively in two new ways, 1) to the origin and motions of the planets, and 2) to the origin and motions of the grades of »particles» in nature. The first application is recorded in the three little Swedish works on the earth and planets published in this volume, and in the three Latin »Principia». The second application is first found in the »bullular hypothesis» of the *Prodromus* and *Miscellanea observata*, and later, in greatly extended form, in the second and third *Principia* and in other works written after 1730. Prior to 1721 we find very little concerning »particles», but something of the future »bullular hypothesis» may be discerned in the *De Causis Rerum*,[229] in *Om eldens och fergornas natur*,[235] in the *Discours*,[243] and in SWEDENBORG's early letters, while in the *Philosophia corpuscularis in compendio*,[265] dating from a period long after the *Principia*, the corpuscular philosophy is once more briefly summarized. As for the doctrine of the mathematical or natural points, which plays so prominent a rôle in the second and third »Principia», it is barely referred to in the earlier works, although it is defended and its future treatment promised in the *Miscellanea observata*.

A feature of SWEDENBORG's early works on the »Earth and Planets» which will no doubt impress itself upon the reader's mind, is the constant reference to the biblical statements concerning creation. That SWEDENBORG at that time, 1717—1718, followed the literal account in *Genesis* is indisputable, and he attempts all kinds of explanations and reconciliations of the account of creation in *Genesis* and of the ages of the patriarchs, etc., with the natural science of his time. This he also continued to do in the two editions of »*Om watnens högd*», published in 1719, in which he still accepts NOAH's flood literally. But if we compare the works of this period with one another, and with the later Latin works, we find that SWEDENBORG refers less and less to the biblical accounts, and in the beginning of the second *Principia* the absence of reference to the *Genesis* account is very striking. He evidently became

less and less literal as he abstracted his philosophy from its first matrix, although remaining a devout believer in the Deity (*Numen*), identical with the Infinite of the *Principia*. In his later theological works the accounts in *Genesis* are continually referred to as being not literally, but spiritually, true. In his Latin *Principia* SWEDENBORG had already so far separated himself from the Lutheran theology that his *De Infinito*, 1734, was criticized as being materialistic, which it certainly is not; and that there must have been a very considerable freedom in Sweden with regard to such questions would seem to be indicated by the fact that the *De Infinito* was dedicated to ERIC BENZELIUS, who had become Bishop of Linköping and who later became Archbishop of the Swedish Church. The Roman Church was, however, less complacent and honored the *Principia* of 1734 by placing in on the *Index Expurgatorius*.

The Texts and Translations.

The texts of the *Prodromus* and other short treatises[1–227] were published at Amsterdam in 1721, and the *Index*[140] shows that they were all in hand and possibly in the press at the same time. No trace has ever been found of the *Principia* referred to in the *Prodromus*, although it seems certain from the references that SWEDENBORG had actually committed it to writing, or at least drafted it. The *Principia* references of the *Prodromus* evidently have no connection with the second *Principia*, as some have supposed. (See R. L. TAFEL'S *Documents concerning Swedenborg*, London, 1875–1877, Vol. II., p. 899). In a monumental work published in 1906 by the late Rev. JAMES HYDE, *A Bibliography of the Works of Emanuel Swedenborg* London, 1906, the second *Principia* is still dated 1720 (p. 32). But immediately after the publication of *An Abridged Chronological List of the Works of Emanuel Swedenborg*, Stockholm, 1910, I had an opportunity of thoroughly discussing this question with Mr. HYDE, when we agreed that the true date is much later, probably about 1729. The evidence for this is contained in SWEDENBORG'S letter to ANDERS CELSIUS, the secretary of the Royal Society of Sciences of Upsala, (Vol. I., p. 321).

SWEDENBORG'S reference to »*ex priori et posteriori principia Naturae*» reminds one strongly of the title of the second *Principia*, and the reference to magnetism indicates that the questions treated of in Part II. and other portions of the »Principia» of 1734 were in the author's mind as early as 1729.

Several of the short Latin treatises published simultaneously with the *Prodromus* had previously appeared in Sweden in the Swedish language, and were in their Latin dress reproductions and extensions of the Swedish originals. (See the *Chronological List*, Stockholm, 1910, which will appear in extended form in the *Appendix* to Vol. I. of this series and will contain not only references to all printed editions of Swedenborgs texts, but also to the numerous *facsimile* reproductions of MSS. published at Stockholm, 1869—70, and subsequently.)

The manuscript of *De Causis Rerum* is preserved in the »Benzelius Collection» of the Linköping Diocesan Library, Codex 14 A, No. 30, and in the same volume No. 43 is preserved the manuscript of *Om eldens och fergornas natur*.

The manuscript of the *Discours emellan Mechaniquen och Chymien om naturens wäsende* is preserved in the Royal Library, Stockholm, among the manuscripts of POLHEM, where it was found by the editor in 1903.

The manuscript of *Philosophia corpuscularis in compendio* is contained in SWEDENBORG's MS., Codex 57, preserved in the Library of the Royal Swedish Academy of Sciences, Stockholm.

The manuscript of *En ny theorie om jordens afstannande* is preserved in the »Benzelius Collection» of the Linköping Diocesan Library, Codex 14 A, No. 34.

The manuscript of *En ny mening om jordens och planeternas Gång och Ständ eller några Bewis at jorden löper alt sachtare och sachtare: at winter och sommar, dagar och dygn til tiden blifwa lengre och lengre in til werldsens sista tid*, is in the possession of JARL ERNBERG, Esq., Stockholm, and has been in his family for many years, having originally come into its possession through Secretary VON KOCKEN, an official of the time of CHARLES XII.

The little Swedish work *J. N. D: Om jordenes och planeternas Gång och Ständ: thet är några Bewisliga skiäl at Jorden aftager i sitt lopp och nu går långsammare än tillförene: giörande winter och sommar, dagar och nätter lengre i anseende till tiden nu än förr*, appeared at Skara in 1718 and is evidently the final form in which SWEDENBORG produced his work on the »Earth and Planets», the two manuscript preparations for which are printed on pages 269—298.

In conclusion, the attention of the reader is especially directed to the *Appendix* to Vol. I. of this series in which the revised *Chronological List of Swedenborg's Works* is to appear, together with other information respecting the manuscripts and printed works of SWEDENBORG. In the final volume of the series the *Notae Criticae* for the texts and other critical matter will appear, together with an Index.