

SWEDENBORG AND HIS SCIENTIFIC REVIEWERS*

XXVII

Miscellaneous Observations, Part IV

Pars Quarta *Miscellaneous Observationum circa Res Naturales et praecipue circa Mineralia, Ferrum, et Stallactitas in Cavernis Baumannianis, etc. Naupotami, vulgo Schiffbeck bey Hamburg, 1722. 8vo, pp. 51.*

Note. This work was dedicated to Ludwig Rudolph, Duke of Braunschweig-Lüneburg, who not only had facilitated Swedenborg's examination of the caves of Bauman but had also shown him many other favors. See *Documents conc. Swedenborg, II, 5.*

Acta Eruditorum

Miscellaneous Observations respecting Natural Things, and especially respecting Minerals, Iron, and the Stalactites found in the Caves of Bauman. Part IV. Schiffbeck near Hamburg. Herm. Heinr. Hollius, 1722, 8vo. 3.5 sheets.

We reviewed the earlier parts of these Observations in the *Acta* of last year, p. 263, where, for the use of our readers, we extracted from them a number of things worthy of note. It will, therefore, be our purpose to bring out the noteworthy things contained in the present Part also.

The beginning consists of a new sexagenary calculus, with newly invented characters and numerical denominations, the invention of which is attributed by the illustrious author: to King Charles XII of Sweden, of pious memory. In respect to the decimal calculus; the king felt that it did not satisfactorily meet the divisions of measures, weights, and numbers; and he contended that the progression of the simple numbers ought to stop at a number which was both a cube and a square, and which, by division would return to unity without a fraction. For the rest, the illustrious author, content with this historical recital, delays presenting the actual form of the new calculus to a more suitable occasion. At the end, he adds that when living in exile in Bender, the king composed an entire volume on military exercises which is much esteemed by those skilled in that art;

* Continued from this journal vol. CVI (July–Dec., 2003), 574. Reprinted from *The New Philosophy* vol. XXI (Jan.–Oct. §§ 1–4, 1929), 109–140.

and also that sometimes the king used to say that *the man who could not calculate was scarcely half a man*.

The second Observation comprises the reasons which induce the author to believe that mineral effluvia or particles flow into their matrices and, by the medium of water, impregnate them with metal. These reasons are as follows: (1) Because there exist waters which are impregnated with the effluvia of various kinds of metals, and which, for the most part, emanate from the fissures of mountains rich in metallic veins; moreover, they are found to be imbued with saline particles of every kind, and even with sulphurous and oily particles. (2) Because water penetrates into the pores of stones, as witnessed in the case of stones which have lain for a long time submerged on river beds; nay, it is evident that it penetrates also into the pores of metals and is driven even into the pores of gold. (3) Because in many mines the hardest rocks give off sweat; and the walls and roofs, moisture, though no fissure is anywhere visible; in some cases, the water is seen to be imbued with vitriol; in mines which consist of strata, there is ocular evidence that water now flows or has formerly flowed in the confines of a stratum of rock, etc.

The third Observation concerns stalactites and the crystallizations arising from stones. Here the author calls special attention to the phenomena observed in the Caves of Bauman. He compares stones which have their origin in petrifying water, with frozen water.

In the fourth Observation he describes the phenomena observed in the Caves of Bauman, in respect to the dropping water which seems to turn to stone. He contends that in penetrating the rock, and during its abode there, the water becomes impregnated with stony particles; and this he proves by the fact that the water which produces stalactites is different from that fluid which turns vegetables and animals into stone.

In the fifth Observation, the author endeavors to prove that the kind of stone commonly called *quartz* and *spar*, wherein for the most part is found a metallic ore, originated after the Noachic flood.

Finally, in the place of an appendix, he makes, some general observations on furnaces for iron smelting, observations which he is convinced include an improvement in such furnaces; and he outlines the plan of a new furnace which his mind has conceived. He promises that many advantages would result from the making of such a furnace. Such im-

provements can, at any rate, be hoped for from its use (*Acta Erud.*, March, 1723, pp. 96–97).

Neue Zeitungen Von Gelehrten Sachen

The March number of the *Acta Eruditorum* contains the following : . . . ,
 (2) *Pars Quarta Miscellaneorum Observationum circa res naturales, et praecipue circa mineralia, ferrum et stallactitas in Cavernis Baumannianas. Naupotami, near Hamburg, 1722. 8vo, 3.5 sheets.*

In this volume the author brings forward some noteworthy things, such as the sexagenary calculus invented by Charles XII, King of Sweden, who also, when he was at Bender, composed a complete book on military exercises which is very highly esteemed by those experienced in war; and who was often accustomed to say that a man who could not reckon, is hardly half a man (*Neue Zeit.*, March 29, 1723, p. 235).

Note. An English translation of Swedenborg's letter to Nordberg was published in *The Gentleman's Magazine* for September, 1754, pp. 423–24, entitled "A Curious Memoir of M. Emanuel Swedenborg concerning Charles XII of Sweden." At the end of the translation, the Editor writes "We should esteem it as a great favour if this ingenious gentleman would communicate a copy of his Swedish Majesty's scheme [namely, his new system of numbering, using 64 as the turning point instead of 10], for some future Magazine."

Julius Bernard Von Rohr⁹⁴

Emanuel Swedenborg, Assessor of the Royal Swedish College of Mines, printed in Leipzig, in several Parts, *Miscellaneous Observations* in respect to natural things, and especially in respect to mineral, fire, and the strata of mountains. In this work are contained many physical, mathematical, and mechanical demonstrations (*Phys. Biol.* 1. On Natural Philosophy in General, p. 54).

XXVIII

Metamorphosis of Urania

Ad . . . Regni Sueciae Senatorem celsissimum Comitem, Comitem de Wellink Musarum Patronum. Naupotami vulgo Schiffbeck. 1722. Sm. 4to,

pp. 8. *Fabula de Amore et Metamorphosi Uranies in virum et in famulam Apollinis.*

Note. The title page contains merely the dedication, the title of the poem itself occurring on page 3. The only evidence of its authorship is given in the closing signature “Your most humble servant E. S. Brunswick, April 27, 1722.” At that time, Count Wellink was the Swedish Plenipotentiary to the Congress of Brunswick, and was at the zenith of his power. The poem was published a little later in Schiffbeck, at the same time as Part IV of the *Miscellaneous Observations*. In it the poet allegorizes his own devotion to Count Wellink, and his readiness to serve him.

Acta Literaria Sueciae

By Emanuel Swedenborg, *A Fable concerning the Love of Uraria, and her metamorphosis into a man and into the servant of Apollo*. Dedicated to the most illustrious and highly placed Royal Senator Count Maurice Wellink. Schiffbeck, Herm. Henr. Hollius, 1722. 4to. An elegaic poem (*Acta Lit. Suec.*, Oct.–Dec., 1724 p. 589).

Note. The above note is one in a list of anonymous publications appended to a review of A.A. Stiernman’s *A Century of Svea-Gothic Anonymous Writers*, as additions, which the reviewer notes “in the order in which they come to our memory.”

XXIX

The Genuine Treatment of Metals

De Genuina Metallorum Tractatione

Note. This is a 4to prospectus of four pages, published presumably by Swedenborg himself in the latter half of 1722.

*Nova Literaria*⁹⁵

Since a book on *The Genuine Treatment of Metals* by Emanuel Swedenborg, Assessor in the Swedish College of Mines, is to be given to the press; which book will be printed in the latter part of next year, 1723; therefore, if any person wishes to pay something in advance, he will

obtain a copy which will cast him hardly one-half of what it will cost otherwise.

The contents of the book are as follows:

On minerals in general:

(1) On *Copper* ore, and the art of knowing its differences, qualities, and signs.

The methods of treating this ore, as used in Germany, Hungary, Sweden, etc.; also the smelting of it into copper-stone; the different ways of calcining it; the re-smelting of it into copper, and the purification of the latter; together with a delineation of the furnaces.

The proving of copper ore in small quantities. Here are presented the different ways used by workmen and by the author. A judgment as to the excellence and the defects of the processes both on a large scale and on a small.

The improvement of the processes and of the furnaces both large and small.⁹⁶

(2) On *Silver* and its Ore; the usual ways of calcining, smelting, and proving it; also their defects and excellence; the improvement of the processes and of the furnaces—treated in the same way as stated above, when speaking of copper.

(3) Also on *Lead*, treated in the same way.

(4) On *Gold* in the same way.

(5) On the ways of separating silver and gold from lead, copper, and other metals, both in large operations and in small, together with a delineation of the furnaces, and the improvement of the processes.

(6) On *Mercury*, etc.

(7) On *Iron*, etc.

(8) On *Tin*, etc.

(9) On *Zinc* and *Calamine Stone*, etc.

The conversion of copper into bronze, etc.

(10) On *Bismuth*, *Cobalt*, *Antimony*, etc.

(11) On the methods of separating ores which contain metals of various kinds, sulphur, arsenic, stones, etc., both in small operations and in large.

(12) On the ways of crushing metals into powder, and separating them by means of water, commonly called Bokwerk and Waskwerk.⁹⁷ There is

added a disquisition on an improved application of these works to ores of different kinds, etc.

(13) On *Vitriol*, etc.

(14) On *Alum*, etc.

(15) On *Saltpetre*, etc.

(16) On *Common Salt*, etc.

(17) On *Furnaces* of different kinds, both for smelting and proving, and for domestic uses, etc.

(18) An inquiry into the nature of *Fire* and *Wind*, so far as these pertain to the treatment of metals and salts, deduced from experiments observed in processes on a large scale and on a small.

(19) On the *Menstrua* commonly called “Flux”; and on the *Matrices* of minerals.

Since this work not only contains the particular operations obtaining in the methods used throughout Europe, but also discloses their good points and their defects; besides containing many things, as yet entirely unknown, which relate to the knowledge of metals and their improved treatment, it is to be supposed that it will be of the greatest use to the metallic world. Since it exceeds 150 large folio sheets, or 1,200 pages quarto, and will be adorned with more than 40 large copperplates, therefore, any person who asks for it in advance, will pay only 3 Dutch florins up to the end of the present year, 1722, and 3 more florins when the work is furnished to him; but he who has not subscribed will pay 10 florins.

The above mentioned 3 florins may be deposited with the following:

In, Amsterdam, Joh. Osterwik, bookseller; in Stockholm, the Royal Printer Werner; in Hamburg, Herman Hollius, printer; in Leipzig, the royal bookseller Weidman (*Nov. Lit.* n, viii, August, 1722, pp. 126–28).

Note. The *Nova Literaria* reprinted Swedenborg’s *Prospectus verbatim et literatim*. Thus, in effect the above is a translation of the original *Prospectus*. Swedenborg arrived in Sweden in July, and in Stockholm in August, 1722; and the fact that this *Prospectus* is reprinted in the *Nova Literaria* for August of that year, would indicate that it was printed before Swedenborg returned to Sweden, probably in Schiffbeck. In view of the fact that the text of this *Prospectus* has never since been printed, we here reproduce it:

Quia typis vulgandus est Liber, de Genuina Metallorum Tractatione, Autore Emanuele Swedenborg, Assess. Colleg Metall. Svec. qui Liber ad finem sequentis anni scil. 1723, impressus erit; hinc si cui placeat aliquid praenumerare, exemplar habebit, quod vix ultra dimidium quam alias ei constabit.

Libri illius contenta sunt.

De Mineralibus in genere

- (1) De Miners *Cupri* & de illius differentia, qualitate & signs cognoscendi.
 —De methodis illam tractandi Germaniae, Hungariae, Sveciae &c. in usu receptis; ut & de fusione ejus in lapidem Cupreum, et modis illam calcinandi diversis; de iterata fusione in Cuprum, & de hujus purificatione; una cum delineatione Caminorum.
 —De probatione illius in parvis; ubi sistuntur differentes modi ab Artificibus & ab Autore usitati.
 —Judicium de praestantia & vitiis processuum tam majorum. quam minorum.
 —De melioratione Processuum & Caminorum tam majorum quam minorum.
- (2) De *Argento* ejusq; minera; de modis illam calcinandi, fundendi, probandi, usitatis: ut & de vitiis & praestantia; & de processuum & Caminorum melioratione, pari modo quo dictum est de cupro.
- (3) Sic etiam de *Plumbo*.
- (4) De *Auro* pariter.
- (5) De modis separandi a plumbo, Cupro, aliisq; metallis Argentum & Aurum; tam in magnis operibus quam in parvis; una cum delineatione Caminorum & melioratione processuum.
- (6) De *Mercurio*, &c.
- (7) De *Ferro*, &c.
- (8) De *Stanno*, &c.
- (9) De *Zinco* & de *Lapide Calaminari*, &c.
 —De conversione cupri in *Orichalcum*, &c.
- (10) De *Bismutho*, *Cobolto*, *Antimonio*, &c.

- (11) De methodis separandi mineras, quae varii generis metalla, sulphura, arsenica, lapides, &c. possident, tam in parvis, quam in magnis.
- (12) De modis in pulverem contundendi & per aquam separandi metalla, vulgo Bokwerk & Waskwerk dictis; adjuncta disquisitione de meliore illorum applicatione ad diversi generis mineras, &c.
- (13) De *vitriolo*, &c.
- (14) De *Alumine*, &c.
- (15) De *Salpetra*, &c.
- (16) De *Sale communi*, &c.
- (17) De diversi generis *Camini*s tam metallicis, probatoriis, quam Oeconomicis; &c.
- (18) Inquisitio in naturam *Ignis & Venti*; quatenus ad tractationem metallorum & salium pertineant, ab experimentis circa processus majores & minores observatis deducta.
- (19) De Menstruis, vulgo (Fluss) dictis: & de *Matricibus* minerarum.

In quo opere, cum non tantum illa, quae in usitatis per Europam methodis occurrunt, exponantur; sed etiam detegantur virtutes & vitia, & plurima adhuc plane incognita, quae ad notitiam & meliorem tractationem Metallorum pertinent, hinc illud Orbi Metallico utilissimum fore putandum est. Quod quia excedet 150 Folia majora, sive 1200 pag. in forma quadrata, & ornabitur plus quam 40 figuris aeneis majoribus, hinc si quis in antecessum illud expetat, pendet modo 3 Floren. Hollandicos intra finem hujus anni 1722. & cum exemplar praestabitur adhuc 3 Flor. sed qui nihil praenumeravit, expendet 10 Floren.

Praedicti 3 Floreni H. deponantur.

Amstaelodami, apud Librarium Joh. Osterwik.

Stockholmiae, apud Typograph. Regium Werner.

Hamburgi, apud Typograph. Hols: Hermannum Hollium.

Lipsiae, apud Librarium Reg. Weidman.

Neue Zeitungen Von Gelehrten Sachen

The eighth number of the Latin Journal, *Nova Literaria*, contains the following : . . .

(4) An Outline of Herr Emanuel Swedenborg's work On the Genuine Treatment of Metals (*Neue Zeit.*, December 21, 1722, p. 1008).

Conserving Heat*Novae Regulae de Caloris Conservatione in Conclavibus*

Note. This appeared in the *Acta Literaria Sueciae* for April–June, 1722, pp. 282–85, being printed from a letter sent by Swedenborg from Liege, November 29, 1721. It belongs to the series of the *Miscellaneous Observations*. Like the letter to à Melle, it was translated into English and printed in *Acta Germanica*, London, 1742, pp 122–24, and reprinted in 1743 and 1759. See n. XXII.

Neue Zeitungen Von Gelehrten Sachen

The second Trimestre of the *Acta Literaria Sueciae* contains the following: . . .

(4) From the Letter of Herr Emanuel Swedenborg, Assessor of the Royal College of Mines, dated Liege, November 29, 1721, *Novae Regulae de Caloris Conservatione in Conclavibus* (New Rules for Preserving the Heat in rooms).

Herr Swedenborg wishes in this article to give some rules as to how warmth can be retained in rooms. He observes that wooden walls are warmer than stone, because stones give off cold without intermission, while wood, as soon as any warmth comes to it, at once emanates an imperceptible warmth and continues to do so for some time. The more wood a room contains, such as walls, tables, chairs, etc., the warmer will be the room. Wainscotted or papered walls impede the emanation from stone; and the same is the case if the walls are heavily covered with lime.

The thicker the stones, the more do they give rise to cold, as may be seen in churches. Bricks are not so cold as masonry. In the case of both stone and wood, the lighter and more porous they are, the better will they retain the warmth. A thin wall retains heat better than a thick one, because the latter gives off more cold. Thus, a wall of the thickness of one brick will be much warmer than if it consisted of the thickest stones. The greater the extent of wooden wall in a small room, the greater will be the warmth flowing out of it. Therefore, a square room is warmer than a round one; but an oblong room is still warmer, and the longer the better. Long rooms are better than high ones, since the warmth can affect a greater extent of

wall. Cracks in the upper parts of a room are much worse than lower down, because heat rises up and flows outside like a stream; but lower down, hardly any warmth can escape from a crack. Therefore, the more closed the upper part of the room is, the better; and the nearer the windows are to the ceilings, the cooler will be the room (*Neue Zeit.*, November 25, 1723 pp. 924–25).

XXXI

Answer to Quensel

Amicum Responsum ad Objectionem factam a Celeberr. Dn. Profess. C. Quensel contra Nobiliss. Dn. Assessor E. Swedenborgii Novam Methodum Longitudinis inveniendae, datum in absentia Auctoris ab Amico.

Acta Literaria Sueciae

A friendly answer to an objection made by the illustrious Herr Professor C. Quensel against the noble Herr Assessor E. Swedenborg's new Method of finding the Longitude. (See *Acta Liter. Suec.*, p. 270). Given, in the author's absence, by a friend.

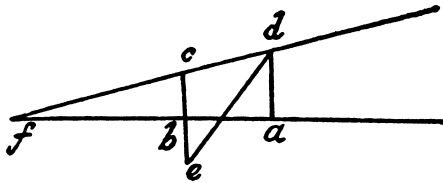
The matter in question is concerning the accurate finding of the parallax; and the objection is raised that in the new Method an ignoring of minutes is allowed, the objection being that thus the parallax in longitude is held to be equal to the difference between the observed and the true position of the moon. But, if it may be allowed, in the author's absence, to give in a friendly way an answer to this objection, it should not be unknown:

1. That the author was not unaware of this objection. On the other hand, it was well known to him; for in his former edition, which was written in Swedish, he not only took it up but in many respects he also satisfied it (see pp. 26, 27⁹⁸). This objection, together with other matters, was omitted in the second edition, perhaps in order that minute details "might not obscure a matter which otherwise could be seen clearly.

2. So far, then as can be gathered from the author's words, in the Swedish treatise just referred to, and so far as we can examine into the matter itself, it follows that in this Method the question is not concerning the true parallax in longitude in the nodes; "nor can any sensible objection

arise at any slight distance from the nodes, or when the parallax in longitude is very slight or none at all; as for instance, in the nonagesimal. But the matter treated of is the true position of the moon when at some distance from the ecliptic, that is to say, in positions midway between the two nodes.

3. Suppose that we are merely seeking for the parallax according to longitude. In that case, I see no error of minutes; nor the difference of a single minute. There is indeed an error of seconds, but these the author did not wish to take into consideration, lest, as I have already said, by minute details he obscure a matter which otherwise is dear. True, if we would find the true position of the moon by means of all three parallaxes, namely, the parallaxes of altitude, latitude, and longitude, as is done in other places in the case of eclipses, the occultation of stars by the moon, then certainly an error of seconds may give rise to an error of minutes. In the present case, however, since the facility of the new Method consists mainly in the fact that only one parallax, the parallax in longitude, is desired, seconds are ignored, but not minutes.



4. Take an example in straight lines. In the figure, (f) represents a small angle of 5 degrees; (e) the observed position of the moon; (b) its position in the ecliptic, and (c) in the zodiac; (e d) the parallax of altitude. The true position of the moon in its zodiac will therefore be at the point (d), while its true position in the ecliptic will be at (a), it being reduced to this position because this is what is required. But since the angle (f) is so small, the parallax of longitude, the parallel lines (c b) and (d a), the rightangles (a) and (b) being also small, I do not see that any material difference can result between (d c) and (a b), or any neglect of minutes; though I do grant a variation of seconds. (It should be observed that here and elsewhere the

delineation is near the nodes.) Merely take a few examples for calculation, and we shall plainly see how extremely slight are the differences. As I have said, it is another matter if all three parallaxes are necessary in order to obtain the position of the moon's centre.

5. It seems to have been for this reason, moreover, that in their calculations when dealing solely with the parallax of longitude, many of the most experienced astronomers have omitted this difference.

6. In this new Method, I do not admit the necessity of seconds. I am not speaking of the equator, when the course lies there, and where they are of the greatest moment. Such is not the case, however, in regions mediate between the poles and the equator. And, if so much importance is to be attached to seconds, then, if I mistake not, the author can tell us of a way whereby this difference also be ascertained, at the same time that we are finding the difference of parallax. See page 27 of the Swedish edition of the treatise on Longitude. But these are small matters to deserve much notice (*Act. Lit. Suec.*, July–Sept., 1722, pp. 315–17).

Note. The above "Friendly Answer" was written by Swedenborg himself, who, in a letter to Eric Benzelius, dated Stockholm, August, 1722, refers to it as follows: "What I have hastily written, namely, my Friendly Answer, if it is found worthy, is left in my brother's hands to be inserted in the *Acta*, at his pleasure" (*Op. Quaed.* I, 309).—the "brother" was of course Benzelius himself. On August 17, the latter brought it before the Upsala Society of Sciences as Swedenborg's answer to Quensel, and it was referred to the editor of the *Acta* to see whether it should be printed. The original MS of the "Answer" is preserved in Linköping, Sweden.

Neue Zeitungen Von Gelehrten Sachen

The third Trimestre of last year's *Acta Literaria Sueciae* contains the following: . . .

(8) *Amicum Responsum ad Objectionem factam a Celeberr. Dn. Professor C. Quensel contra Nobiliss. Dn. Assessor Em. Swedenborgii Novam Methodum Longitudinis Inveniendae, datum in absentia Auctoris ab Amico.*

The author is of the opinion that Herr Quensel, had no ground for reproaching Herr Swedenborg because of his omission of minutes, since in the Swedish edition of his work on the Longitude, Swedenborg had himself seen this objection, and removed it; in the Latin edition, however, he had passed it by as a small matter. The question here is not concerning the parallax in longitude, since the new Method is to be used only in the nodes; but even if it were, still no error of minutes would be made. This he demonstrates by an example (*Neue Zeit.*, December 27, 1723, p. 1012).

XXXII

Swedish Money

Oförgräpelige Tancker om Svenska Myntets Förnedring och Förhöjning (Inoffensive thoughts on the debasement and rise of Swedish Money). Stockholm, 1722; sm. 4to. [Pp. 20] Reprinted, Stockholm, 1771.

Note. This work, and also the reprint, was published anonymously; but it is referred to by Swedenborg in a letter to Eric Benzelius, dated Stockholm, November 7, 1722, where he writes: "Here in Stockholm I have printed something which concerns Swedish money, and certain reasons why it should not be lowered. It has made considerable stir here" (*Op. Quaed. I*, 310–11).

Anders Chydenius⁹⁹

In the beginning of our freedom¹⁰⁰ much thought was given to the debasement of valuation, which, in, 1715, became raised; but in the year 1722, in a solid treatise entitled *Inoffensive Thoughts on the Debasement and Rise of Swedish Money*, printed in Stockholm by Joh. Henry Werner, an anonymous writer showed how extremely dangerous any such devaluation would be. He brings the matter out with such clearness and force that his work can hardly be improved on, and needs no more than to be adapted to the crisis in which we now are.

He shows first how that, in six years, the rise which took place in the coinage raised the price of the commodities and products of the kingdom 100 and 150 per cent. He proves this in the case of copper and iron, and says that "since by the raising of the coinage together with the small value

of the tokens, they have now left their former excellent condition and have been brought to another, they stand in peril and danger, if a single further movement should be made in the coinage" [p. 5].

He goes into the movements of manufacturing, and brings to light how that all its branches underwent changes in accordance with the coinage; cast iron, ore; charcoal, transport and freight, etc., rose in price. He then thoughtfully observes: "Should there now be a disturbance in the coinage, upon the valuation of which this whole industry is grounded, then the very foundation of the iron industry will be disturbed. One pictures, for example, those works at which iron cannot be manufactured under 35, 40, 45 dalers; and, that through a depreciation of a coinage, it should fall to 30 or 35 must not the works that are so circumstanced, go under, and the others continue without profit until in time they fall on the rocks? What consideration then for the welfare of the kingdom would they have (he continues), who hold depreciation of the coinage to be a gain to the country; when, like that industry which is the kingdom's foremost treasure, it is thereby subjected to such great peril?" [pp. 5–6].

He says further that a change in the coinage and in the value of goods, from whatsoever cause it may arise, becomes in the same way more and more permanent, and finally inescapable. It is not so easy to change that which has been raised for so many years, and because of so many opportunities. To restore all that has been mentioned above to its former condition by law and compulsion, is easier said than done. All such products rise in price in accordance with a coinage, more easily than they become lower. It is easier for those to make difficulties, who are necessary for the carrying on of the works, and who with little harm can leave the work in abeyance or even the materials unsold, than it is for the owner to therefore let the whole works stand idle" [p. 6].

Finally, he takes up all the disturbances which would result from a raising of the coinage; and shows how the main disturbances had already been removed, and the remaining ones might easily be remedied, without setting the welfare and stability of the kingdom and the citizen in the utmost peril by a devaluation [pp. 9–10] . . .

In respect to the salaried man in particular, the anonymous author previously cited by me says : "Those who receive their pay in seed, etc.,

can to some extent reckon an increase in valuation as a benefit. On the other hand, this is not the case with the rest; for everything used for food and sustenance must be paid for according to the higher valuation, and this is clearly equivalent to a reduction in salary proportionate to the rise of the coinage. And if this disturbance came to be allayed, then on the other hand, it would be the equivalent of setting aside the general and private welfare of the whole kingdom, in order to regain for the country's servants a better value in their salary, and this is no more reasonable than it would be to give them the enjoyment of the same salary in a currency of higher value as in one of lower" [pp. 10–11] (*Rikets Hjelp*, pp. 22–24, 29).

Note. It was perhaps owing to the efforts of Anders Chydenius, the writer of the above review, that Swedenborg's work on the debasement and rise of Swedish money was republished in 1771. At that time it was still unknown who was the author of this work, indeed it is known not merely because of Swedenborg's letter to Benzelius cited above, and the title-page of the new edition merely mentions that it was "published in the yeax 1722, but now at the request of many persons, is printed anew." The reprint, which occupied 14.5 pages, was followed by 53 pages of anonymous "Reflections on the state of the Coinage in earlier and later times, together with the cause of the rise in exchange; and in what way the consequent loss, both to the crown and to the private citizen, might be remedied and righted without any further change in the coinage," etc.

XXXIII

Hydrostatic Law

Emanuelis Swedenborgii Expositio *Legis Hydrostaticae* qua demonstrari potest effectus et vis aquae diluvianae altissimae in saxa et materias fundi sui.

Note. This was published in the *Acta Literaria Sueciae* for October–December, 1722. The immediate cause that led to its writing was the criticism that had been directed against the author's theory in the *Historie der Gelehrsamkeit* (see n. XXVI). Swedenborg's article closed with the passage we have already translated at the end of n. XXVI.

Neue Zeitungen Von Gelehrten Sachen

The fourth Trimestre of the *Acta Literaria Suecuae* contains the following: . . .

(6) Exposition of the *Hydrostatic Law* whereby the effects and the force of flood waters of great depth upon the stones and materials at their bottom, can be demonstrated.

In a work which he wrote in Swedish, Herr Swedenborg sought to prove from the rules of hydrostatics, that the flood could have moved great rocks such as are found here and there in the fields in northern lands. In the present article also, he shows from hydrostatics, that water, if deep, can move great stones by its flow; for its power increases in the ratio of its depth. He likewise appeals to the experience gained from moles and ore-crushing works.¹⁰¹ At the end he reminds the reader that in the *Historie der Gelehrsamkeit* his *Miscellaneous Observations* were attacked because of the misprints, the above mentioned hydrostatic laws, and his mathematical points, on which latter he will explain himself at another time; and that, since the Editors themselves announce in their preface that they have no director, no head, no laws, and do not know each other—moreover, they could thus the more easily attack anybody—it would not be taken ill on his part if he did not consider it either becoming or advisable to enter into an issue with them (*Neue Zeit.*, February 28, 1724, pp. 167–8).

Note. Three weeks later the *Neue Zeitungen* again reviewed Swedenborg's *Hydrostatic Law*. The author of this later review was also the author of the review of *Miscellaneous Observations* in the *Historie der Gelehrsamkeit*. He writes as follows:

The author of the review of Swedenborg's *Miscellaneous Observations* which appeared in the *Historie der Gelehrsamkeit Unserer Zeiten*, desires to announce in the pages of the *Neue Zeitungen*, that he is not at all surprised that Herr Swedenborg, in the *Acta Literaria Sueciae*, desires to make it appear as though he did not wish to enter into any issue with him; though at the same, time, to some, he has given the impression that by his Article he wished to justify himself as against the *Historie der Gelehrsamkeit*. This trick is entirely too common that one should wonder at it. But it might possibly bring wonder to some that even now, after so many reminders

have been given him, he makes no due distinction between the natural pressure of water and its violent onset. The pressure of water does indeed increase in ratio with the altitude, but the force of its onset can be estimated only according to the swiftness and density of the water. The latter is a living, the former a dead force, and they can by no means be compared with each other. If, then, the flood not only had moved immense rocks but had also been able to heap them one above the other, this must be ascribed, not to any natural pressure according to altitude, but to a violent and entirely unnatural motion of the water.

As to what is written in the preface to the *Historie der Gelehrsamkeit*, this was never entirely approved of by the author of the review; moreover, no one of them in particular can be made responsible for it. But if one did not wish to bind himself to any special laws, it was because he believed that even in this case the rules of decorum and fairness were already sufficient to remind each one of his duty. These rules, moreover, have not been transgressed as against Herr Swedenborg, to whom his opponent would make himself known without hesitation if there were any occasion for so doing; just as, on other occasions, he has already shown that he does not fear to stand before the eyes of opponents without a mask (*Neue Zeit.*, March 23, 1724, PP. 230–31).

Note. Swedenborg evidently heard about this criticism on his position, perhaps from his brother-in-law the librarian, before he saw the criticism itself; for on May 26, 1724, he writes to Eric Benzelius: "As concerns my antagonist's severe answer, I would like to see it; for words will not move me, and, as I promised in my printed article, no answer whatever will be made to it, for it would be a most ignoble strife, one with a mask and the other without a mask. Probably it is one of the canaille of the multitude, etc., that I have to do with, since he lays the greatest stress on words; for he seems to have no understanding of the matter itself, and barely an adequate one of my position, seeing that he represents that position as being that a mountain must have been moved. He does not know that in Sweden great rocks are found on flat ground and that many ridges and mountains consist solely of stones piled together. Therefore, to please the learned in Sweden, I will compose right soon a simple proposition, bringing

forward the data, together with experiments from hydrostatics and hydraulics set over against them, and will add thereto geometry; and so will make a clear conclusion without any mention of the canaille who seeks glory by dragging someone in an ignoble fashion into a dispute from which he himself can lose no honor, seeing that he is unknown, but the other can, since he is known. This demonstration I will afterwards send to Councillor of Commerce Polhem, and when he has given his judgment, my brother might send a copy to Wolff¹⁰² in Halle, and Julius in Leipzig. For I presume that with their judgment, my brother and other learned men will be content which is quite enough" (*Op. Quaed.*, I, 313–14).

It does not appear that Swedenborg ever wrote this projected explanation of his position; but from the early Minutes of the Upsala Society of Sciences, we learn that on August 14, 1724, at a meeting of the Society which he attended, he "promised to write something in answer to the criticism of his article made in the *Neue Zeitungen*, n. 24 [March 23]."

For a comment on Swedenborg's *Hydrostatic Law* by von Rohr, see n. XIX *ad fin.*

XXXIV

Opera Philosophica et Mineralia

Emanuelis Swedenborgii Opera Philosophica et Mineralia. Dresden and Leipzig 1724 Three volumes folio.

Note. Of these three volumes, the first was dedicated to Ludwig Rudolph, Duke of Brunswick-Lüneburg, the second to Wilhelm, Landgrave of Hesse-Cassel, and the third to Frederick I, King of Sweden.

On its publication, Swedenborg sent copies to various learned societies in Europe, and we learn from the records of the Russian Academy of Sciences of St. Petersburg, that a copy which was sent from Sweden was received by the Academy early in November, 1734. On November 11, the Academy appointed a committee of three professors and a Councillor of Mines to examine the work with a view to seeing what therein might be of use to the Russian Kingdom which

was then beginning to introduce her minerals to the European market. From the draft of a letter sent to Swedenborg December 28, 1734, now preserved in the archives of the Académie des Sciences de l'Union des Républiques Soviétiques Socialistes, it appears that Swedenborg was informed of this action. The letter continues: "Meanwhile, since some of the members of our Academy have read through your work wherein, with happy genius and praiseworthy diligence, you investigate the secrets of nature, with the purpose of communicating to you their judgment concerning so important a work, it is certainly not a matter of indifference to me that, in the name of the whole Society, I give you the utmost thanks for the fine gift which you have bestowed on us, and would invite you to enter into a literary correspondence with the Society."

Mr. Kratchkovsky, the Secretary of the present Académie des Sciences at Leningrad, to whose courtesy we are indebted for a copy of the records and letter above referred to, informs us that the Academy has no other documents bearing on Swedenborg. It would appear, therefore, that Swedenborg did not accept the invitation to become a corresponding member of the Russian Academy. Moreover, M. Kratchovsky informs us that his name does not appear on the Society's lists of members.

Some further light on this matter is afforded us by Dr. Georg Schauman, the learned Director of the University Library in Helsingfors, Finland. Dr. Schauman quotes the following passage from the Proceedings of the Russian Academy for 1734, December 2, p. 123: "Mr. Goldbach read the following letters, of which he had made a rough draft, to Messrs. Sloane, Polenius and Michelotti, informing them that they had been received by the Academy as honorary members and to Messrs. Swedenborg and Teubner, thanking them for books sent to the Academy." Dr. Schauman then judiciously observes that the connection in which Swedenborg's name is here mentioned "may have been the cause of the statement that Swedenborg had been called to be a corresponding member of the Academy."

"Some chapters" of the volume on Iron (pp. 1966–213) were translated into French, and constitute about one-half (56 pages) of a small work entitled *Traité sur l'Acier d'Alsace*, Strasbourg, 1737. Fifteen years

later, these drafts were translated from French into Swedish and published under the title *Utdrag af några Herr Asses. Swedenborgs Anmärkningar om Ståhl; ofwersätte från Fransöskatt*. (Extracts from some Notes on Steel, by Herr. Asses. Swedenborg; translated from the French). Stockholm, 1753.

The original volume on *Iron* was also translated into French by M. Bouchu, and constitutes, with plates, the fourth section of *Art des Forges et Fourneaux* by Courtivron and Bouchu, a magnificent volume in imperial folio, published in 1762 by the Académie Royale des Sciences of Paris.

On April 13, 1739, the *Principia* was put on the *Index Expurgatorius* by order of Pope Benedict XIV, and, so far as we know, is still listed there.

Deutsche Acta Eruditorum¹⁰³

Emanuelis Swedenborgii Opera Philosophica et Mineralia

that is

Philosophical and Mineralogical Works by Emanuel Swedenborg, Assessor of the Royal College of Mines of the Kingdom of Sweden. Dresden and Leipzig, 1734, folio; 16 Alph. with X40 copperplates. In three Parts.

The author, who by some small works on the natural sciences has long made himself of service to the learned world, has been inspired by the praiseworthy desire of showing, that he is a useful member of that world, to submit to the judgment of its other members the fruits of his studies during twelve years devoted to the contemplation of philosophy. These fruits are contained in the first main division of this costly and magnificent work,—a work in which nothing whatever has been neglected which could in anyway contribute to its adornment and embellishment. So clear is the print, and so fine the paper, that the most magnificent books of Holland and other countries show nothing superior.

The whole work consists of three main Parts, the first of which contains the fundamental principles of natural philosophy, and the second and third, the treatment of the subjects of the mineral kingdom, iron, steel, copper and brass.

As regards the first main Part, its principles of natural philosophy are of a construction which is entirely new and singular, and which is based on mechanism. Seeing that neither Descartes nor Newton nor any other of the famous natural philosophers had obtained general approbation for their theories, the author wished to make the attempt to see whether he perhaps might be able to attain this end and to discover the right and true way to reach solidity and correctness in natural philosophy. And since his principles of natural philosophy come nearest to the opinion of Herr. Councillor Wolff, Swedenborg by no means denies that he was signally confirmed in his thoughts by reading the *Ontology* and *Cosmology* of this famous philosopher two years after he himself had completed the composition and design of his own *Principia*. For the rest, in this whole first Part he has not brought forward one single philosopher, not even by name, for it was not his purpose to attack the opinions of others, much less to detract aught from their fame. For this reason also, he promises himself that he will be spared from bitter and quarrelsome controversies; and should one wish to enter into a dispute with him, he declares that he will not answer. Should it happen, however, that one would desire from him in a serious way further explanations of his principles, to this, as being only fair, he pledges himself. For in the degree that he has written the truth, so there will be no need of any dispute; the truth will be sufficient to defend itself. If, however, he has propounded what is erroneous and false, it would not be reasonable stubbornly to maintain it. He says further that he has not written in order thereby to gain fame or a great name in the learned world; and it would not concern him whether he obtained acclaim or not. If he did obtain it, it would bring him pleasure only as it was a sign that he had come upon the truth [*Principia* Appendix] .

But in order that the reader at the very commencement, may obtain an idea of these new principles of natural philosophy, we will here quote the following few words from the Preface, wherein the author has himself briefly sketched their substance; and we have the less hesitation in quoting them in that they will show also the author's style.¹⁰⁴ He says:

I desire, therefore, in a few words to set forth the sum of our whole philosophy. Let us begin then from the first simple. I say (1) that in the

simple there is an internal state tending to a spiral motion; consequently, that there is a like conatus. (2) That in the first finite arising therefrom, there is a spiral motion of the parts; likewise, in the other finites; so that it is the same in all elementary finites. (3) That hence, that is to say, from this cause alone, there arises in each finite a progressive motion of the parts, an axillary motion of the whole, and, if nothing hinders, a local motion. (4) That if there is a local motion, an active arises, the one being like the other so that they differ only in degree and dimension.

From the above it can be evident: That I acknowledge here entities of a threefold kind only, namely, finites and actives; and, from these two, compounds or elementaries. As concerns finites, I say that one is generated by the other; and that all finites of the class thus arising are utterly similar, and differ only as to degrees and dimensions; thus, that the fifth finite is similar to the fourth finite, the fourth to the third, the third to the second, the second to the first, and the first to its simple; so that he who knows the nature of one finite knows the nature of all. That in the same way actives are absolutely similar to each other; that the fifth, fourth, third, second, and first actives are of the same nature, and differ only in dimension and degree, just like the finites. That elementaries also are similar, in that they are compounded from the finite and the active, finites occupying the surface and actives the interiors; hence the first, second, third, fourth and fifth elements are similar, and he who knows one knows all.

The motions in each finite, I say, are three in number: A progressive motion of the parts, an axillary motion, and, if nothing hinders, a local motion. Nor do I know whether naturally any other motions are possible in these merest simples; or, if entities have motions, which can be denied by none, whether any others than these are so highly suitable to nature. I also say that all these motions proceed from one fount or from one and the same cause, to wit, from the spiral motion of the parts, a motion which, being most highly mechanical, must also be most highly natural; within which, as we know, is contained all the power of nature and all mechanical force. And if it be granted that motion is the cause of things, then no other motion can be granted than one which is most mechanical and most highly geometrical; for, in space, the spiral is an entity that is perpetual from centre to circumferences, and circular in respect to all its

dimensions; which is such that it can have no property within it but what is most highly perfect, being, in motion, most highly mechanical and natural, and in situation; and likewise, in motion, most highly geometrical. In the simple, however, wherein can be nothing substantial, to be moved therein, nor any medium wherein motion may be effected, in place of mechanical and geometrical motion such as exists between parts and in a medium, we must conceive, by way of simile, of a total or pure quasi-motion, that is, a state, and of a thence arising conatus from a similar aid to a similar quasi-motion ; a conatus in which, therefore, is latent the one only cause and primitive force of all that afterwards comes into existence.

Such are the contents of these principles of natural philosophy. As to the order which the author has chosen in presenting them, he gives us in his Preface the following information:

This then is the series which you will find in the work itself:

On the means to true philosophy (I, i). The simple or natural point (ii). The first finite (iii). The second finite (iv). The third finite (vii). The fourth finite (III, iii). The fifth finite (vi). The purely material finite, or water (ix).

With respect to actives, the series is: The active of the point (I, v *ad fin.*). The active of the first finite (I, v). The active of the second and third (vii). The active of the fourth and fifth, or fire (III, viii).

Of the elements: The first or most universal element (I, vi). The second or magnetic element (ix). The third element or ether (III, v). The fourth element or air (vii). The fifth offspring, or water-vapor, which is like the elements (x).

The existence of the sun, and its vortex (I, x). On the starry heaven, that it is like the magnetic sphere (III, i). The diversity of worlds (ii). The universal chaos of the sun and planets; and the separation into planets and satellites (iv). The vortex around the earth and its progression from the sun to the circle of its orbit (xi). The paradise of the earth and the first man (xii).

The causes of magnetic forces (II, i). On the attractive forces of several magnets (ii). On the same if the poles are alternated (iii). On the

same, if the axes are parallel (iv). Their disjunctive forces when their cognominal poles are applied to each other (v). The attractive forces of the magnet and of iron (vi). The force of the magnet on ignited iron (vii). The abundance of effuvia from a magnet, and their penetration through hard bodies (viii). Chemical experiments with the magnet (ix). The communication of the force of the magnet to iron (x). The conjunctive force of the magnet and of many things made of iron¹⁰⁵ (xi). The operation of iron and the magnet on the manner's needle (xii). Other modes of rendering iron magnetic (xiii). Calculation of the declinations of the magnet (xiv). Tables of the observations of the magnetic declination made in various places and at various times (ibid.). The causes of the magnetic declination (xv). Calculations of the magnetic declination for various years at London and Paris (xvi). Table of the magnetic declinations at Paris, from 1610 to 1920 (xvi, 23). Calculations of the magnetic declinations for Rome, the Cape of Good Hope, and elsewhere (ibid., 24).

From the references to the pages¹⁰⁶ which have been added in the above list of contents, the reader can see that in the treatment of his subject, Herr Swedenborg did not bind himself exactly to the above mentioned order. He has preferred to follow the natural order; for he believes that one thing came forth from the other and that the one is most closely connected with the other. He has also been especially careful so to order his style that it shall be distinct and fluent, as indeed should be the case in a philosophical work such as the present. Despite this, however, since the things themselves are new, he has not been able altogether to avoid making use of some new words, or words not hitherto used in such a sense; as, for instance, *Finite*, *Active*, and *Element*. For the rest, in order to avoid affording the reader the least hindrance or delay in the matter of words or expressions, it has been his desire, so far as was possible, never to use either the technical words ordinarily found in metaphysics and geometry, or any algebraic calculation.

Moreover, just as the author, both on the title-page¹⁰⁷ and also elsewhere, appeals to experience, on which he has founded his principles in natural philosophy, so, in the second part of this first main division of his work he gives an excellent proof of this. In this Part, he investigates the magnet and its powers. As the basis of this investigation, he adduces the

well known proofs and experiments of Herr van Musschenbroeck; and he proves a priori that which Musschenbroeck has discovered and demonstrated a posteriori. His thought is, that the power of the magnet comes from the motion of his first and second, or magnetic element, from which also were produced the solar and planetary vortices; that magnetism itself consists in emanations which are of such a nature that they must rotate around their axis, and, if brought into motion, must draw a subtle element of this kind, and bring it into a circle; that consequently, through these motions and rotations coming into a circle, arise little vortices and likewise their colligations from one pole of the magnet or sphere to the other; that when homogeneous emanations are induced around a body in this fashion, magnetism is produced, and its conjoining force; that the magnet itself, as regards the interior arrangement of its parts, consists in the parallel or orderly situation of those parts from one polar side to the other; and hence, by mechanical necessity, there is formed on the outside a sphere connected with the axis from both sides—the emanations being merely iron-emanations; and that iron receives magnetic power if only a small part of it is brought into a rectilinear or other orderly arrangement by the friction of a magnet.

The deviation of the magnetic needle is also the result of the situation of these particles of the first and second elements, that is, of the particles from which are formed the vortices around the sun and planets; and it is from these situations that the magnet is ordinated together with its sphere, wherein stand the particles of the above mentioned element,—elementary particles which, since they likewise and at the same time make the vortex around the earth, are bent in a spiral form from one pole of the ecliptic to the other. From this come the anomalies.

The above extracts from the contents of the learned Herr author's principles of natural philosophy must be sufficient; and though, from them, one might well form for himself an idea of these principles, yet we imagine that a philosopher will not easily be found who will make shift with this summary sketch. Rather, will each one be anxious attentively to read the work itself; therefore; we have striven so much the more for brevity. And now, as to whether the author has really attained the end which he sought, namely, the building up of a natural philosophy on such irrefutable foundations that no reasonable philosopher can bring any

serious objection to it, but which must rather be accepted with general approval, this seems to us to be a question which perhaps does not give promise of being decided in the space of a year; for we are thoroughly convinced that students of natural philosophy, will here find new inducements to enter into the hidden mysteries of nature by further attempts and experiments. Meanwhile, we can be assured of this, that throughout the whole work, there shines out solicitous diligence in the search for the truth, and a rare insight into natural philosophy.

And now we will lay before the eyes of the reader a specimen of the author's diction. But since lack of space forbids this, we shall stop here and reserve for the next number, not only the promised specimen of this first and philosophical volume, but also an account of the contents of Herr Swedenborg's *Mineral Kingdom* (*Deutsche Apt. Erud.*, n. 184 [July], 1734, pp. 295–304).

Note. The continuation appears to have been crowded out of the "next number," for it appears in the number that followed.

Continuation of the review of Swedenborg's *Opera Philosophica et Mineralia*.

In the 84th number of our *Acta*, we gave some information concerning this magnificent work, and at the same time, we promised to show the reader a specimen of the diction used by the author. In order to keep our promise, we now lay before the reader the last two chapters of the third part of the *Principia*.

We select these so much the more readily because in the first, namely chapter 11 "On the Vortex around the Earth, and the Progression of the Earth from the Sun to the Circle of its Orbit," the author investigates the velocity, periodic times, and centripetal forces of the planets at various distances from their suns, and also the cause of the eccentricity of their orbits; and proves a priori and with, infinite pains, the laws which were given out by Kepler who accurately established them by tests and experiments, and which are still retained by all students of natural science. But we must be satisfied with the principles, since lack of descriptive figures prohibits us from bringing forward further explanations and deductions.¹⁰⁸ In chapter XI comes the following:

That in the solar vortex formed by reason of the spiral motion of the elements from centre to peripheries, the elementary particles are not only reduced and disposed into a regular situation and motion, but are also held in that situation and motion by the sun which is ever active in the centre. Consequently, that in this vortex there is a force or endeavor from the centre, and to the centre, according as the bodies are lighter or heavier than the volume of the element (III; xi, § 1).

That the earth, like a great finite, continually revolves round its axis, and this spontaneously, that is to say, from the nitency of its individual parts which constitute the central globe; and thus commenced to make day and night immediately on its egress from the sun; and that on its first egress from the sun, it seems to have performed these axillary circumvolutions more rapidly than later, when it was distant from the sun and a large part of it was used up in the making of ether, air, water, and terrestrial matter, after which it was somewhat bound and coerced by a crust consisting of divers entities (§ 2).

That the earth, like a great active, contributes to its own entrance into a second motion, that is to say, into a circling motion round the sun; by which circles it forms a surface, not unlike as is done by the aforementioned actives; but that yet it is carved around principally by the stream of the solar vortex. And, consequently, that from the beginning of its excursion and by means of its circles and periods, it has continually measured out and completed, winters and summers, springs and autumns, in a word, years; but these were much shorter, and passed more quickly (§ 3).

That the earth, revolving among the elementary particles of the solar vortex, has formed around itself a vortex, according to the magnitude of the globe and the celerity of its motion, in the same way as does the least magnetic corpuscle, of which we treated in Part II; and consequently, a larger vortex in the beginning of its excursion from the sun, and then a smaller vortex. Thus, that the earth, lying concealed in the centre of its vortex, is in its natural situation; that it cannot be carried out of its vortex, nor go unaccompanied by its vortex; but so long as its axillary motion remains, so long does the vortical motion of the parts endure, ever determinate and proportionate to the size and celerity of its body (§ 4).

That the vortex formed around the earth, seeks for itself equilibrium in the solar vortex; that is to say, that it occupies the place where it can be

in equilibration; and that if the vortical motion had been greater and swifter, it would have sought out another place than if it had been smaller and slower. This, however, does not militate against the fact that the elements of the solar vortex exercise pressure within the smaller vortex also, according to their altitude; and this equally on every side and in every direction; and that they continue to exercise pressure, even though smaller vortices are formed within the larger; thus, that a nitency toward the centre of the earth arises from this general pressure of the solar vortex (§ 5).

That the motion of the solar vortex is greatest around the centre, less at the peripheries, and least of all or non-existent in the last periphery; and this in the plane of its zodiac (§ 6).

That the earth, which, in its passage round the sun, was coerced to form innumerable spiral circles, progressed with a celerity ever less and less the more remote it became from the sun; and that its motion diminished in a simple ratio according to its circles, that is, according to its annual gyres; but in a duplicate ratio in respect to its diameter or to a perpendicular or straight line dropped from the sun (§ 7).

As concerns the celerities in the solar vortex at every point of its distance from the centre, I say, that, in the diameter they are in the duplicate ratio of the distances, counting from the ultimate periphery, or from that periphery where all motion ceases. So likewise, the times in the solar vortex are in the subduplicate ratio of the distances of the ultimate periphery to the centre. But if the vortex be such, that the least motion is in the centre, and that it becomes continually greater toward the peripheries, then the celerities and times would be in the duplicate ratio of the radii from the centre (§ 8).

If two planetary bodies flow in the solar vortex, each at a different distance from the centre but yet in a circle or ellipse around the sun, I say, that the squares of the periodic times of each body, would be as the squares of the radii, divided by their distances, that is, by the complements of the radii extended to the last periphery. On the other hand, if the vortex be so formed that the least motion is in the centre and the greater at the peripheries, the squares of the periodic times would be as the cubes of the distances from the centre (§ 9).

That two planetary bodies flowing at unequal distances from the centre or sun, differ from each other in celerity; and that their celerities are, as the rectangle of the radii and times reciprocally. But if the motion increased from the centre toward the peripheries, then their celerities would be reciprocally in the subduplicate ratio of the radii (§ 10).

That between two planetary bodies gyrating at unequal, distances from the solar centre, the forces of centripetency are as the distances from the last periphery divided by the radii. But in a vortex whose motion is less near the centre and greater at the peripheries, the forces of centripetency will be reciprocally as the squares of the radii (§ 11).

The twelfth or last chapter has the heading "On the Paradise of the Earth and On the First Man." The three principles there presented are:

That a crust formed itself upon the waters by the dissolution of the parts in the waters and the interjection of finites, which emerged to the surface and formed a crust over the waters; thus, this crust continually increased by the addition of parts under parts (III, xii, § 1).

That before coming to its proper orbit or set circle, the earth underwent innumerable changes; that is to say, changes equal in number to the circles which it had measured out, or to the different distances of these circles from the sun, and likewise to the different degrees of celerity in its annual and daily circumvolutions; in a word, that, in its progress from the sun even to the circle of its orbit, it underwent some new change every day and hour. That changes equally many and equally innumerable must have been undergone by the earth and its vortex before it could have been fully perfected and could consist of so many series which arose simultaneously and successively; that is to say, before it could have been enriched with so many entities, that they would suffice for all its kingdoms, the mineral, vegetable, and animal; and before it could have laid down seeds and have then unfolded and expanded them, and have been able thus to adorn its surface so delightfully and with such great variety (§ 2).

That in the state of the earth when it revolved more swiftly round its axis and gyrated more swiftly round the sun, that is, when it made shorter days and years, then, around its whole globe, there was a kind of per-

petual spring, most highly suited for the work of generation and procreation; and that without a perpetual spring, seeds could not have been born, nor could plants and animals of all sorts have been produced (§ 3).

According to the author, the position set forth in the last quotation is confirmed by the age of the patriarchs who lived before the flood, an age which, as we read in the Bible, extended to eight, or nine hundred years. He thinks that one could not well attribute to them so great an age, but rather many years; and if one would compare their years with ours, the result might amount to hardly a century. Moreover, there must once have been a time when the globe used for a year what would be only a few days of our time. We leave it to the reader to look up the rest, in the author's own work; and we turn from the philosophical Part of that work to the mineral kingdom which is treated of in volumes II and III.

In the Introduction to the second volume, and here and there elsewhere, the learned author, who is skilled in mining, promises to write on the whole subterranean or mineral kingdom, of which he here gives us some Parts, namely, on iron, steel, copper, brass, etc.; and in this writing he desires to treat not only of the remaining minerals but also of salts and species of stones; so that finally we shall have a complete work on this kingdom. The thoroughness, clarity, and fidelity with which he handles the matters contained in these two Parts now lying before the eye of the world, bear witness to a vast experience in mining affairs which he connects with the philosophy of nature. Hence we are assured in our anticipation of something comprehensive and good. That all may be seen in a more practical way, whenever the need required, he has clarified and embellished his treatise with necessary and useful copperplates.

Of his sincerity he gives some exceptional proofs, particularly when telling of the art of smelting; in which connection, he discloses with the utmost faithfulness secrets which smelters and the like have so long and so jealously concealed, even, in many cases, from dearly loved children. He cares nothing for the enmity of those who, from selfishness and jealousy, have begrudged to others their arts under the vain pretext that it was not fair to make known and general, secret arts acquired by the industry, toil, and experience of so many centuries.

Moreover, the modesty of Herr Swedenborg is so great that in this work on the mineral kingdom he does not assume to give out as his own work, more than two Parts;¹⁰⁹ on the contrary, he himself frankly states that he has assembled the third Part from other writings [*On Iron*, Pref.]. Thus, two Parts contain things entirely new and which have never been made known up to now, or have never heretofore been printed; but one part has been compiled from other works already printed; and this Part is added only in order that the Mineral Kingdom may lack nothing in completeness.

As regards the order which the author has prescribed for himself in this Mineral Kingdom and which he observes in both these volumes, it consists in the division of each volume into three Classes. In the first Class he presents the processes of smelting used in almost the whole of Europe. To those who are interested in mining and smelting, he here supplies an almost inestimable treasure; for he describes for them not only the smelting processes of other countries, but also and in particular those used in his fatherland, Sweden; and he describes them with such attention to details, such clarity, and such truthfulness that, in the reading, it almost seems as though one saw the work itself before him. This must be the more pleasing to his readers, inasmuch as they know how that in many places where men think to keep from others their methods and secret arts, such extraordinary secrecy is observed that they do their utmost both to bar strangers from entering in for the purpose of inspection, and to Lock up the buildings and tools, and also the work itself. How often must Herr Swedenborg have come to a knowledge of their secrets by way of money.¹¹⁰ He did not find these difficulties in his fatherland, though jealousy on the part of the smelters is no less prevalent there than elsewhere.

The second Class contains smelting processes on a small scale, that is, it describes the art of proving and assaying, namely, how to test a metal in the assaying furnace, and learn its component parts; so that one may know how to make a surer and more profitable use of it in the great smelting works.

The third Class tells of chemical processes and experiment instituted with metals. The author has here set forth a wise selection of these, in that he has copied only the most authentic; on the other hand, he touches

hardly at all on the fables and fictions of the alchemists. In this connection he complains that he has lacked time and opportunity accurately to test all the experiments; and thus, that the reader would not have to accept everything in this Class without proof. Those, however, who think something is lacking here, could supply the lack with little trouble.

The author adds that he had wanted to add a fourth Class, and there institute a theoretical examination of each metal; but he was obliged to postpone this until after he had described the whole mineral kingdom; afterwards, an examination of this kind, covering all the metals, would appear in a separate volume. For, he says, there is so close an affinity between all metals, sulphurs, salts, and stones, that the nature, species and quality of one can not be perceived without an understanding of all. Moreover, it would be a fruitless work to wish to search into metals if one had not previously investigated the nature of the elements.

We should also present here something of the subterranean wealth of the cold northern countries in which, according to the author's report, silver- and copper-plates are brought to the light of day larger and purer than in southern countries; and likewise, as to how he deduces the cause of this from the flood [*On Copper*, Pref.]. But we leave the reader to look up such deductions for himself. We turn now to the Table of Contents of the matters dealt with in these volumes.

(To be continued)

ENDNOTES

94. In *Physikalische Bibliothek*, Leipzig, 1754.

95. The *Nova Literaria in Supplementum Actorum Eruditorum* was issued by the publisher of the *Neue Zeitungen* as a vehicle for printing the matter crowded out of the *Neue Zeitungen* itself. This he decided to publish monthly and in Latin, as a sort of supplement to the *Acta Eruditorum*. The publication was commenced in 1718, but after 1722 it was discontinued.

96. This order of treatment was not followed in the work on Copper published in 1734.

97. Swedish words meaning *Crushing work* and *Washing work*.

98. The reference is to § 16 of the Swedish work. See above, n. XVII, under *Acta Literaria Sueciae*.

99. In *Rikets Hielp genom en Naturlig Finance—System*. Förestäld af Anders Chydenius, Riksdagsman (The Kingdom's Help by means of a Natural System of Finance. Put forward by Anders Chydenius, member of the Diet), Stockholm, 1766.

100. This era is known in Swedish history as the *frilhetstid* (time of freedom). It commenced at the end of 1718, immediately after the death of Charles XII, when the throne was deprived not only of despotic power but almost of all power.

101. *Puchwercke* were works for pounding mineral ore. The pounders were run by water which after driving a water-wheel, ran through a channel into a pit.

102. That is, the celebrated Professor, Christian Wolff.

103. *Deutsche Acta Eruditorum* oder Geschichte der Gelehrten welche den gegenwärtigen zustand der literatur in Europa begreiffer (The German Acta Eruditorum, or the History of Learning, including the present state of literature in Europe). This journal was published in Leipzig every month from 1712–1739 as a high class literary journal for the learned of Germany. Each number included an engraving of some author whose work was there reviewed. The journal was devoted wholly to reviews of selected books, for the reviews were usually very long, and its literary and scholarly standards were very high. It was continued in 1740, as *Zuverlässige Nachrichten*. See n. XXXVI.

104. Here and elsewhere in this review, all quotations from Swedenborg were made in Latin.

105. This should read “with many things made of iron.”

106. In the review Swedenborg's work is referred to by pages; these we have changed to references to chapters.

107. Presumably the reviewer refers to the Title “Principles of Natural things, i.e., of new attempts to explain philosophically the phenomena of the elementary world.”

108. In what follows, the reviewer quotes merely the headings of paragraphs, that is, the propositions, but not the demonstrations.

109. The works on *Iron* and *Copper* were each divided into 3 Parts, called “Classes.” The third Class consists solely of quotations from chemical authors.

110. It may be noted that in many cases Swedenborg visited mines with the authorization and zealous cooperation of the prince of the country; and frequently also he was accompanied by a mine inspector who was his friend. Moreover, he made his visits as the official representative of the Swedish College of Mines. But above all, he was an expert metallurgist and a close and careful observer. Still, that he did experience difficulties is evident from a letter he wrote to Eric Benzelius, dated February 14, 1724, after his first journey to the German mines. He writes: “What is sent you, now, as well as a part of the former instalment which deals with refining works, is indeed held as a secret; for a foreigner has difficulty in getting at these things and becoming in some measure advised concerning them. But, according to my simple thought, in metallurgy nothing ought to be secret; for without this knowledge no one can make any advance in the investigation of nature (*Op.* I, 312).

