

On the Position of Palaeontology and Historical Geology in Sweden before 1800

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With 21 figures in the text

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1. Introduction

Every scientist — the pioneer research worker as well as the worker with more modest pretentions — owes an eternal debt of gratitude to a long series of precursors, men who contributed towards assembling the fund of experience on which he, the scientist of today, draws daily and hourly. It should therefore be a matter of importance for him to acquaint himself in some measure with the history of his science, in other words, to investigate the foundations of the edifice which he himself is helping to build. It is possible that he will then find the achievements of his predecessors somewhat simple, even ridiculous, which they perhaps are if measured by the standard of our own time. But simple justice demands that every work be regarded in the light of the conditions under which it came into being. If this is done it is more probable that the scientist will understand how to appraise correctly a laboriously gained view of things which now appears obvious to us, or the interpretation of a natural phenomenon which is now considered to belong to the fund of knowledge of every educated person.

2. Opinions regarding the nature of fossils

To take an example: What a fossil is will probably be fairly clear even to a person who is but little conversant with the natural sciences. But what an age it was before the real nature of the fossils was understood.¹ According to one conception, which — originally advanced by ARISTOTLE — still persisted into the 18th century, what we now mean by a fossil was the result of a freak of nature, »*lusus naturae*», an effect of the stars or the light, or of a formative power in the earth, »*vis plastica*», »*vis formativa*», »*vis seminalis*», a conception which is reflected in the designation »figured stones» or »stone jests». What homage must then be paid to sharp-witted and open-minded observers such as RISTORO D'AREZZO, LIONARDO DA VINCI, and ALESSANDRO DEGLI ALESSANDRI, who, the former towards the end of the 13th century, the two latter about the year 1500, following a line of thought from XENOPHANES, were able to advance the explanation, which was right in principle, of the occurrence of marine animal forms in the mountains of North Italy and Calabria. Further, it must be borne in mind that, even after their organic origin had been acknowledged, fossils were declared by the foremost scientists of the time to be the remains of a vegetable and animal world which had perished miserably in the Deluge. As Swedish representatives of this conception may be mentioned M. VON BROMELL, J. G. WALLERIUS (cf. p. 48), and KILIAN STOBÆUS (note, e. g., a paper by the latter entitled »*Monumenta diluvii universalis ex historia naturali*», 1741, reprinted 1752). In justice, however, it should be emphasized that men like LINNÉ and TORBERN BERGMAN gradually adopted a different and, in certain respects, a more correct point of view (concerning this question see HÖGBOM 1921, p. 10, and concerning the conception of the nature of fossils see p. 7 et seq. in the same work; cf. also HÖGBOM 1936, p. 59 et seq., and pp. 36 and 55 below).

On several occasions DANIEL TILAS had reason to turn his attention to the fossil organisms. In his description of Osmundsberget in Dalecarlia (TILAS 1740 a) he feels dubious about them: »But how can one interpret the occurrence of these figured stones or so-called Petrifications, which are commonly credited with being evidence of the Deluge?» (p. 208; translated from the Swedish). TILAS adopts a curious point of view on the fossil problem in »*Stenrikets Historia*», the speech which he gave on the occasion of his resignation of the presidency of the Swedish Academy of Science on 14th April, 1742: »Now if these mountains are to be referred to primeval times, what are we to do with the Belemnites [by which is meant the orthoceratites] and others of their sort? The poor creatures will then be nothing but *lusus naturae* or Nature's freaks. If I dared for fear of their Patrons I should certainly entertain that belief; and I often amuse myself with the thought that when, at the Creator's command, the water and the earth should produce all kinds of living creeping things, they were not quick enough to creep out of their hiding-places, and therefore had to remain there to puzzle mankind and confuse History» (op. cit., pp. 26—27; translated from the Swedish).² In the same speech TILAS vividly describes the devastating

¹ »In mediæval times no distinction was made between minerals, rocks and fossils as these words are now understood — all were brought together into one class and were known as »Fossils» from the Latin word *fossilis*, that is, a thing dug up out of the earth. With the advance of knowledge the distinction between these three classes came to be recognized and the three sciences of mineralogy, petrography and palaeontology arose devoted to the study of these three groups respectively» (ADAMS 1938, p. 137).

² »Hänföres nu desse Berg til uråldriga tiden, hwad skole wi giöra af Belemniterne och de andre des Följeslagare? De stackars Kräken blifwa då ej annat än *lusus naturae* eller Naturens Apespel.

effects of the Deluge: »Gentlemen, we have now examined the mineral kingdom in its beauty and magnificent state, when everything in it was in unbelievable order according to the first arrangement of the Creator; now we must pass on and ascertain with dismayed minds and thoughts what grievous destruction and upheavals our mineral kingdom underwent in the well known great Deluge, which covered the whole world. When the Creator in his wrath had decided on the destruction of the earth, he bade the waters rush together both above from the firmament and from the depths, to inundate the whole world. Now, when the springs of the deep gushed forth, the crust and the rocks must necessarily be rent» (op. cit., p. 17; translated from the Swedish).¹

The first of these two quotations discloses a certain doubt as to the interpretation of fossils. TILAS expressly points out that he is strongly inclined to consider them to be »*lusus naturæ*». The following expression of opinion points in the same direction: »The limestone again brings forth an infinite number of strange things, sometimes in firm and hard substances, such as are proposed to have been found at a number of old marble-quarries, sometimes a lot of monkey-tricks and jokes to mock at the rest of Nature, with dripstones as in limestone caves and especially in the Baumanshöhle, sometimes in the fossilization of plants [this refers to fossil corals] which our fellow members LINNÆUS and ADLERHEIM² observed last year on Gotland. Quartz and white flint also contribute to the matter with innumerable crystallizations: How many heterogeneous substances do we not find in them. I have seen them grown through, not only by moss but also by hay stalks. We cannot but call such products of the mineral kingdom Petrifications, in distinction from others of its products» (TILAS 1742, p. 24; translated from the Swedish).³

In a speech hold on a similar occasion in the year 1765, TILAS appears to be more inclined to look on fossils as organisms which perished in the Deluge, for he speaks of limestones which »bear more or less petrifications or clear traces of a flood» (TILAS 1765, p. 19; translated from the Swedish).

The origin of fossils is dealt with in a special paper, »De Ortu Petrificationum», 1754, by PER KALM, Professor of Economy at Åbo, well known as a writer of books of scientific travels and botanical works. The fossil forms are explained as actually being petrified animals and plants, which have been scattered over the surface of

Om jag tordes för åtskillige deras Patroners skuld, så hade jag wisseligen den tron; och mången gång roar jag mig med den Tancken, som hade wid Skaparens befallning, at Watnet och Jordan skulle göra af sig allehanda lefwande Kråk, desse ej warit snabbe nog at krypa fram ur sine gömor, utan derföre måst blifwa qwar, at bry Folck och förwilla Historien».

¹ »Nu hafwom wi mine Herrar beskådat Stenriket i sin fägring och präktiga Tilstånd, då all ting war uti en obeskriwelig ordning bibehållit efter den första Skaparens inrättning; Nu måste wi fara vidare, och med bestörte Sinnen och Tanckar röna, hwad för en grufwelig förstöring och omstielplning Wårt Stenrike undergådt, uti den hela Jordklotet öfvergångne allmänt bekante store Floden. Sedan Skaparens wrede beslutit Jordenes förderf, böd han alle Watnen stöta tillsammans, så ofwan ifrån fästet som utur diupet, til at således öfwerswämma hela Jordklotet. När nu diupsens Källor upbrusto, måste nödwändigt Stenskorpan och Hällebergen remna».

² One of LINNÆ's companions on his journey to Öland and Gotland.

³ »Kalcken åter frambringar en oändelig hop sällsamma Saker, än i fasta och hårda ämnen, såsom wid en hop gamla Marmorbrott skal wara rönt, än i en hop apespel och gyckleri at härma den öfriga naturen, med Droppsten såsom i Kalckgrottor och serdeles Baumanshöhle, än i förstenande af Vegetabilier, som wåre Herrar Ledamöter LINNÆUS och ADLERHEIM i acht tagit förledet Åhr på Gottland. Qvarsten och Whitflintan gör ock til Saken med otalige Chrystallisationer: Hwad många Heterogenea finna wi icke uti dem. Jag har sedt dem igenomwuxne ej allenast med Måssa utan och med Höstråen. Slike Stenrikets Tilwäreckningar, kunna wi ej undgå, at til skillnad ifrån de andre des Alster, för *Stenhårdningar* kalla och nämna».

the earth by natural catastrophes, such as the Deluge and severe earthquakes, a possibility which had previously been considered by an Englishman, JOHN RAY, in his paper »Lithophylacii Britannici Ichonographia», 1699 (the title cited from ADAMS 1938, p. 258). In support of this assumption, KALM states that in the sea-drift on the Scottish coasts have been found seeds and fruits of plants from the West Indies, which have been carried by winds and currents, and adds: »Si procellae & undae vehementiores fructus hosce a locis adeo dissitis, per tot milliaria, advehere valent, tanto facilius varia genera conchyliorum hodie ignotorum ex oceani abyssos & locis peregrinis, ope diluvii universalis, abripi & longe lateque protrudi potuerunt» (KALM 1754, p. 9). KALM's view was in part put forward again by A. MODEER (1758 b; cf. below p. 44). See also below regarding the opinions held by LINNÉ, GYLLENHAAL, and others (pp. 5, 22, 36, 39, 50).

To the »Werlds-Beskrifning» (Cosmography), published by Cosmographiska Sällskapet (the Cosmographical Association) of Uppsala¹, was worked out a second part, »Physisk Beskrifning öfwer Jord-Klotet» (A Physical Description of the Globe), 1766 (2nd edition 1773—74; translated into a number of foreign languages), by TORBERN BERGMAN, prominent as a research worker in various fields and world-famous as the founder of analytical chemistry. The sixth chapter of this work deals with »Stenvandlingar». »By *Stenvandlingar* (petrifications) I understand not only stones which resemble organic bodies and their parts, but also their impressions, and all kinds of remains of animals and plants which are found in unusual places. I have mentioned such things several times previously, and in general they are accounted of great importance. They are also in reality a kind of medal, the consideration and explanation of which may shed much light on the natural history of the globe» (op. cit., p. 123; translated from the Swedish). »All that has hitherto been mentioned, is, as regards the large number of shells and sea creatures which are found buried in the earth, not to be considered anything but a little lake as compared with the great ocean. They are not only countless in number, but also of so many kinds that there has not yet been time to search for all their living counterparts. However, there is now hardly anyone who entertains any doubts as to their origin from the animal kingdom. In shape, size, ornamentation, etc., such perfect resemblances are often found between those fossilized and those met with in the sea, that the species can be determined without difficulty.» — — »It is true that divers species are found in the layers of the earth whose counterparts in the sea are not yet known; but their number decreases daily as we get deeper and deeper, and obtain more knowledge of the other parts of the world» (op. cit., pp. 128—129; translated from the Swedish).²

¹ Founded in 1758; one of the founders was TORBERN BERGMAN.

² »Med *Stenvandlingar* (petrificater) förstår jag här, icke allenast stenar, som likna Organiska kroppar och deras delar, utan äfven dylika aftryck, och allahanda djurs och växters quarlefvor, som finnas på ovanliga ställen. Jag har förut flera gånger nämt sådana, och de hållas i allmänhet af mycken betydelse. De äro ock wärkeligen ett slags skådo-pänningar, hwilckas betraktande och förklaring kan sifwa mycket ljus uti Jordklotets naturliga historia.» — — »Alt hvad hittills blifvit nämt, är emot den stora mängd snäckor och hafs-kräk, som finnas i jorden begrafne, ej annorlunda att anse, än som en liten insjö emot stora werlds-hafvet. De äro ej allenast af ett obeskriwligt antal, utan ock af så många arter, att alla deras likar ej ännu humit uppsökas lefwande. Imedlertid är nu nästan ingen, som hyser något twifvelsmål om deras härkomst från djur-riket. Man finner i skapnad, storlek, strimmor, m. m. ofta så fullkomlig likhet imellan stenvandlade och dem, som träffas i hafvet, att arten utan svårighet kan utstakas — —.» — — »Det är sant, att åtskillige arter finnas i jordvarfven, hvars likar i hafvet ännu icke äro bekante; men deras antal minskas dageligen, alt som man hinner mer på djupet, och får mera kundskap om de andra werldenes delar.»

In this presentation the historical perspective is but little pronounced, in as much as fossils are apprehended as organisms living in the seas of today, which for some reason have been transformed into »stones», a view which was also shared in part by LINNÉ and others (cf. below pp. 22, 36). The circumstance that »Sea-foetuses are met with in all the places investigated, from the top of mountains several thousand feet high to deep down in the earth» — — »seems to demand that the surface has stood under water for some considerable time, and on it these creatures could multiply, die, and at length form such considerable accumulations» (BERGMAN 1766, pp. 145—146; translated from the Swedish). Further, it is concluded »That violent floods had at some time passed over a large part, if not the whole, of the world. Bones of elephants in places which, as far as is known, have never contained, nor it seems now could have harboured these animals, and impressions of plants from other parts of the world especially give grounds for this thought» (l. c.).¹ To this is added the following remark, which is rational especially in view of the fact that the remains of mammoths were considered to derive from elephants living in warm climates: »It will be true that if the inclination of the ecliptic is changeable, the climates must also gradually change accordingly, but this is not yet quite determined» (l. c.).

BERGMAN was by no means inappreciative of the difficulties which presented themselves in the face of the first attempts to interpret palaeontological material. »The difficulty in explaining all the circumstances met with in petrifications has been so great that many have been able, against the evidence of their own eyes, to persuade themselves that Nature had formed them to produce a similarity between dry land and water, to jest with man's knowledge, and for many equally childish purposes. At the end of the 16th century an ignorant potter in Paris, BERNH. PALISSY² ventured to tell the learned to their faces, that such fossils had been animals which had been deposited by the sea where they are found now. But nevertheless the deep-seated opinion subsequently persisted for about 100 years. In our times there is hardly anyone who doubts that they have been sea creatures» (BERGMAN 1766, p. 128, note k; translated from the Swedish).³

A couple of fantastic theories as to the origin of fossils which are reproduced by BERGMAN are worth quoting here: »TANCRED ROBINSON believes that shells might have been scattered around the dry land by armies and the dwellers in the towns: an Italian makes use of pilgrims from Syria, and with regard to petrified fish, they are believed to have been thrown away by the Romans because they were not sufficiently fresh: they could also have employed monkeys, who, according to LOUBERE's

¹ »Hafs-foster finnas på alla undersökta orter, ifrån det öfversta af flera tusende fots höga berg, till djupt ned i jorden» — — »tyckes fordra, att ytan någon längre tid stådt under vatten, på hvilken dessa kräk, kunnat förökas, dö och omsider utgjöra så ansenliga samlingar.» — — »Att våldsamt öfversvämning någon gång öfvergådt en stor del, om icke hela världen. Elefant-ben på orter, som så vida bekant är, aldrig hyst, ej heller nu synas kunnat härbergera dessa djur, och aftryck på växter från andra verldsdelar, äro i synnerhet anledningar till denna tanka.»

² The work referred to is BERNARD PALISSY, »Discours admirable de la nature des eaux et fontaines, tant naturelles qu'artificielles, des métaux, des sels & salines, des pierres, des terres, du feu & des émaux». — Paris 1580.

³ »Svårigheten, att förklara alla vid stenvandlingar förekommande omständigheter, har varit så mäktig, att många kunnat, emot sina ögons intygan, inbilla sig, det naturen formerat dessa för att göra likhet imellan det tårra och våta, att gyckla med människors kunskap, och för flera lika barnsliga afsikter. En olärd påttmakare i Paris, BERNH. PALISSY, vågade i slutet af 16:e hundrade-talet säga de lärde mitt i synen, att sådana fossilier varit djur, som blifvit af hafvet lämnade der de nu finnas. Men den irritade meningen bibehöll sig sedan ändock inemot 100 år. I våra tider är föga någon, som tviflar att de varit hafskräk.»

story, carry shells from the shore at the Cape of G.[ood] H.[ope]. It is obvious that, even if all these means were relied upon at the same time, nevertheless their number cannot be ascertained therefrom; their position in layers, stones and deep down in the earth, etc.» (op. cit., pp. 145—146, note z; translated from the Swedish).¹

In this connexion it may be mentioned that even VOLTAIRE, one of the most enlightened of thinkers, allowed himself to be duped by similar conceptions, so that he formulated such an assertion as that marine shells (i. e. shell animals in general) which were found up in the mountains had probably been dropped there by Crusaders who had brought them from the Orient (NORDENSKIÖLD 1921, p. 147, note 1).

To depart from our actual subject, we may mention the peculiar interpretation of fossils embedded in rocks which GÖRAN WAHLENBERG, otherwise well known for his knowledge of the Cambro-Silurian fauna in Sweden, advances in his work »Om svenska jordens bildning», 1818. After having stated (p. 60) that »it is found that every one of our large bodies of water has within its old shores an area of petrifications, which, both in size and elevation, corresponds fairly well to the present reciprocal breadth and elevation», and (p. 62) asserts that »the petrification areas» extend mainly in a NNE-SSW direction, he summarizes (pp. 62—63) his opinion thus: »It appears to me that the largest bodies of water had been as it were points of exit for magnetic forces, combined with a capacity for petrification-formation [several times earlier W. spoke of »the capacity of various areas for petrification-formation» in what preceded], and that this outflow was concentrated particularly in certain surfaces on the basic rock situated under the masses of water, where the formation of the petrified rock became as it were a continuation of that of the primeval rock» (translated from the Swedish).

3. Opinions regarding the length of geological time

With regard to fossils, it is obvious that to no small extent dogmatic theology put a check on rational thinking. This may be said to have been the case in other respects also. The fact that the origin of the organic world had to be fitted into the biblical scheme of the Creation, and the calculation of the number of mankind's generations backwards in time dependent on it [which fixes the age of the earth — calculated from 1948 backwards — at 5 708 years according to the Old Testament, and 7 456 according to the Byzantine chronology (cf. BACKLUND 1946, p. 81)], had rendered extremely difficult even an approximately correct estimate of the length of geological time and therewith an understanding of all the phenomena connected with the history of the earth. In his »Prodromus» (1669),² the great NICOLAUS STENO says that the fossil organisms in the rocks of Tuscany were carried there by the Deluge »four thousand years, more or less, before our time» (cf. ADAMS 1938, p. 359). In his »Egenhändiga anteckningar» (Autobiographical notes) LINNÉ, who combined unusually keen natural-scientific insight with genuine piety, says that he »would

¹ »TANCRED ROBINSON tror att snäckor kunnat spridas omkring det tårra genom krigshärar och invånare i städerna: en Italienare betjenar sig härtill af pelegrimer från Syrien, och hvad förstenade fiskar angår tros de blifvit af Romarena utkastade, då de icke nog färske framkommit: man kunde ock sysselsätta apor, som efter LOUBERES berättelse, vid G.[oda] H.[opps-] udden bära snäckor från stranden. Det är påtagligt, om än alla dessa medel tillika användas, så kan derutaf ändock icke utredas deras mängd; deras läge i varf, stenar, och djupt ned i jorden, m. m.»

² NICOLAUS STENONIS de Solido intra Solidum naturaliter contento dissertationis prodromus. — Firenze 1669. (Facsimile edit. published by E. W. JUNK, Berlin 1904.)

gladly have believed the earth to be older than the Chinese themselves assert, if the Scriptures permitted» (AFZELIUS 1823, p. 213; translated from the Swedish). Even towards the end of the 18th century a glimpse is caught of the time-honoured way of thinking, as is illustrated by a quotation from GADD, a Finlander (1787 b, p. 101): »— and when one bears in mind that during the many thousands of years that the earth has stood, it has been continually filled with the mouldering remains of all these creatures» (translated from the Swedish). Something similar shows itself in the pessimistic conception of the future existence of our world which emerges in the following opinion expressed by BIÖRNER (1748, p. 210), the State translator: »But in spite of this [that the hollows in the cliff between Borgholm and Köping on Öland are considered to have been caused by the waves of the sea] it appears difficult to concur with the learned Court Chancellor DALIN in his theory as to the receding of the water, for in that manner the Baltic would finally dry up entirely if the world could last some thousands of years, which is not probable» (translated from the Swedish).¹

For the rest it may be observed that, even a century later, experienced geologists had very vague and — as we now know — extremely incorrect ideas about the length of the period during which the geological course proceeded. An example of this is found in HISINGER, 1837. After having related »Slotts-Conducteurens J. M. GRÅBERGS Berättelse om en lefwande Groda, funnen på Gothland vid Burswik uti fasta och täta stenen, inemot 8 Alnar neder i Stenbrottet» (Story of a living frog found on Gotland at Burswik in the solid rock, about 8 ells down in the quarry, by J. M. GRÅBERG, Castle Superintendent) (GRÅBERG 1741), HISINGER points out that this »phenomenon of the continuation of life for perhaps thousands of years» (translated from the Swedish), i. e., in the case in question, from the time of the formation of the Silurian Burgsvik sandstone, is by no means inexplicable (HISINGER 1837, p. 112). While the original spokesman had not found it improbable that »the creature», which was assumed to have been enclosed in the sandstone when the rock was deposited, »lived in its prison many unbelievable hundreds of years» (GRÅBERG 1741, p. 250; translated from the Swedish), HISINGER thus thinks of thousands of years. It need not be said how enormously underestimated this figure appears to a modern reader. However, this feeling recedes somewhat into the background in the face of the absurdity of the statement itself. CARL SAHLIN (1939, p. 131 et seq.) recalls the case in a paper on »Berggrodor» (Rock Frogs).

In contrast to STENO, who had been faced by this dilemma as early as the middle of the 17th century, but who, »devout Catholic that he was, abandoned geology rather than the doctrine of the church» (NORDENSKIÖLD 1921, p. 146; translated from the Swedish), about a hundred years later BUFFON advanced the conception that geological and biological development were incompatible with the biblical story of the Creation. The period he allots to the development of our world, 75 000 years, appears unreasonably short to us. And nevertheless BUFFON's repudiation of the sterile authorized conception was, in principle, a step of the greatest importance.

¹ »Men detta oagadt tyckes man swåriligen kunna hålla med den wittre Hof-Cancelleren DALIN i hans sats om wattuminskningen, ty på det sättet skulle Östersjön sluteligen alldeles ut-torka om werlden fick stå några 1000:de år till, hwilket ej är troligt».

4. Previous work. Scope of the present investigation

Thus not until the pressure of theology began to lighten did possibilities of genuine geological and palaeontological research present themselves, in place of the earlier, mostly theoretical speculations. As, in contrast to a number of other branches of natural science, geology is almost entirely without ancient traditions, the time during which geology has been studied as a science in the present-day sense, is comparatively very short, and in consequence fairly easy to survey, so much the more as the number of workers in geology and allied fields has never been overwhelmingly large. An extremely interesting and well-informed description of the history of geological science from earliest times is found in a comprehensive work by ADAMS (1938), where the material is presented in a perhaps more readily accessible manner than in ZITTEL's detailed »Geschichte der Geologie und Paläontologie» (1899).

In general the usual textbooks in geology devote some space to the historical background of the subject. A fairly complete survey of »Den geologiska forskningen i Sverige» (The study of geology in Sweden) is given by NATHORST in »Jordens historia» (1894; reprinted in »Sveriges geologi», 1894), where, however, as is natural in this connexion, attention is paid in the first place to general geology. In special studies on SWEDENBERG (1906 and 1908) and LINNÉ (1907) NATHORST gave these universal geniuses in natural science the place they deserve in the pantheon of geology also. Later authors who regarded their science from the historical point of view are A. G. HÖGBOM and N. ZENZÉN. Palaeontology and historical geology are, however, mainly outside their purview (note, however, in particular HÖGBOM 1921 and 1936; certain works by ZENZÉN will be referred to below; in the museum-historical studies by the latter author, 1920 and 1930 a, referring to mineralogical conditions, several glimpses are caught of persons who will be mentioned here).

The instruction in geology at Uppsala University in by-gone times is dealt with by v. HOFSTEN (1945, pp. 33—52) and that at Lund University by HADDING (1942).

Considerable contributions towards an understanding of the milieu from which the modern natural sciences developed are given by B. HILDEBRAND (1939) in his comprehensive description of the pre-history, foundation and earliest organization of the Swedish Academy of Science. In his far-reaching work of 1937 on C. J. THOMSEN the same author devotes a chapter to »Museiväsendet och den naturvetenskapliga empirismen» (Museums and natural scientific empirism), which is also worthy of consideration in this connexion.

The notes presented here are by no means intended to give a complete survey of the earlier development and position in Sweden¹ of historical geology and palaeontology, but should afford an idea of its main features. It has only been possible to take account of printed sources. That only the period before 1800 is dealt with here is due less to the period in question having marked any absolutely definite borderline within development in Sweden, but more to the fact that most of the geological and palaeontological literature of the 19th century, being nearer to our own time, may be supposed to be familiar to the somewhat initiated reader. From a wider point of view, however, it may be justifiable to look on the turn of the century referred to as a turning point, in that the pioneer works in stratigraphy and palaeontology by WILLIAM SMITH, LAMARCK, CUVIER, and A. BRONGNIART belong to just that period.

¹ Also includes Finland, which at the period in question was a part of the kingdom of Sweden. A concise survey of the development of geology in Finland was given by BORGSTRÖM (1941).

The discussion as to the origin and physical conditions of the earth carried on by URBAN HJÄRNE, CHRISTOPHER POLHEM, TORBERN BERGMAN, DANIEL TILAS, JOHAN GOTTSCHALK WALLERIUS, and others, will not be dealt with here, nor the lengthy discussions on the so-called receding of the waters (»vattuminskningen»), in which chiefly HJÄRNE, EMANUEL SWEDENBORG, ANDERS CELSIUS, CARL V. LINNÉ, OLOF V. DALIN, JOHAN BROWALLIUS, and BENGT FERRNER took part. Relevant questions have been dealt with in works by HÖGBOM (1920 and 1932).

In a country like Sweden, with its ancient mining activities, naturally the science of mining and mineralogy have old traditions. These subjects also are outside the scope of this paper.

The material for a survey of the earlier history of palaeontology, stratigraphy, and regional geology in Sweden cannot be said to be considerable, and it is largely in the form of brief notes interspersed in larger works. There are not many theses and papers which deal specially with any of the fields mentioned.

5. From Olaus Magnus to Swedenborg and Roberg

OLAUS MAGNUS'S »Historia de gentibus septentrionalibus» (1555) is also — according to the title — a »historia de rebus mineralibus», but it would probably be difficult to trace in it any information of importance for our subject. It may be mentioned, however, that in his presentation of the vegetable world (pp. 411—415) OLAUS MAGNUS gives an explanation — on the whole correct — of the nature of amber, even though he is naturally unconscious of the difference in age between amber and the younger resin. Nevertheless when he enumerates, *inter alia*, rats among the inclusions, he has departed somewhat from what can be considered plausible (cf. FRIES 1894).

Amber also attracted the attention of SIGFRID ARON FORSIUS, known as an astronomer and theologian, who, in his posthumously published »Minerographia», says that it »is a stone which according to general opinion grows from spruce or pine resin, which runs down into the water from the trees standing on the shores. Therefore some look upon it as a gum or resin, because it also burns, and has the smell of a resin. Some consider it a kind of ambergris, which grows from the grease in the water, or the soaked bitumen, and therefore they call it Ambram Citrinam. It is found mostly on the shores of Prussia and is thrown up there by the waves, where there is no bitumen. Amber is of many kinds, yellow, white, and brownish, or in other colours according to the other materials in it. Ants, flies or gnats are often found in the amber, which is a sign that it grows from fluid resin» (FORSIUS 1643, p. 165; translated from the Swedish).¹ As can be seen this is by no means a bad description. Incidentally it may be mentioned that even PLINY had a fairly correct understanding of the nature of amber (ADAMS 1938, p. 44). For the rest FORSIUS'S work contains nothing of palaeontological interest. A considerable part of it is taken up with an

¹ »är en steen, som växer, effter en gemeen Meening, aff Graan eller Foro kådho, som aff the Trää som stå medh Stranden, nedhflyter i watnet. Ty räkna honom en part ibland Gummi eller Kådhor, at han ock brinner, och hafwer en Kådhos lucht. Somlige hålla honom för itt slags Ambra, som aff watnens feetheet, eller the blöta Jordbeket wäxa skal, och kalla förthenskul Ambram Citrinam. Han warder mäst funnin wedh then Pryska stranden, och aff Wägen ther vpkastat, ther icke någhot Jordbeck fins. Raaffstenen är mångahanda slags, gol, hwijt, och brwnachtig, eller med andre färghor, effter som han andre Materier i sigh hafwer. Man finner ofta Myrror, Flugur eller Myggar i Raafstenen, hwilket är tekn, at han växer aff flytande Kådo.

account of the medicinal and magic properties of the »stones», dealt with in the style of the medieval »Lapidaries».¹

One of the earliest associations of the name of Sweden with a palaeontological find will be in the fifth volume of MERIAN's »Theatrum Europaeum» (1647), in which P. LOTHICHIUS describes the mortal remains of a human being of gigantic stature which had been found two years earlier by Swedes while making trenches during the siege of the town of Krems in Austria. That the large bones and cranium were not in reality part of the skeleton of a human being but of the then unknown gigantic animal, the mammoth, is obvious enough to any present-day observer of the fine drawing of a large molar which accompanies the description. No one need be surprised that it was reserved to a much later period to give the correct explanation. The fact remains that the first excavation in these loess deposits, which are so rich in fossils, was carried out under Swedish directions, even though for motives other than purely scientific (cf. ABEL 1922, p. 1 et seq., and 1939, pp. 54—55).

With the formation of scientific societies and the establishment of museums for objects of nature, the soil was prepared in Sweden at the beginning of the 18th century for the growth of natural scientific research. However, curiosities still occupied a prominent place among the objects which were collected for cabinets of objects of nature and curios, and which were described in the literature. This applied also to the palaeontological material, the remains of whales and mammoths being regarded with special interest, and having since olden times given rise to the legends about giants. Thus already during antiquity, finds of fossilized bones led to the conception of an extinct race of giants (cf. ADAMS 1938, p. 48).²

In Bokwettsgillet (the Guild of Book-learning) in Uppsala on 14th December 1772 there was shown »a good drawing of an animal, which Baron KAGG, who has now returned from his imprisonment in Russia, has sent over here from Siberia; the same animal is called by the Siberians in their language Mehemot or Mammont; which perhaps has given many the idea that it was the same as Behemoth in Job» (SCHÜCK 1918, p. 79; translated from the Swedish).³ On account of this an »Epistola ad D. ERICUM BENZELIUM de Mamontowa Kost, id est de ossibus bestiae Russis Mammont dictae», by BASILI TATISCHOW, a member of the Russian Council of Mines, was published in Acta Literaria in 1725. Further, LARS ROBERG expressed his opinion in a paper (1729) on the nature of the mammoth remains and stated that they originated from elephants living in the East Indies. The tusks had got into the

¹ FORSIUS's practical attitude finds expression also in the closing remarks on the opening of mines, where he says: »Thenne Lust och begärligheet til at byggia Bärgräwäck, skal man så ljetet försumma och tillbaka sättia, at lika som the vnga Drängers lust är til Älskogh, Och så begärligh som Bij til Rosor, at vtsugha Honing och Wax vthur: Altså willig och benägen skal Menniskian ware, doch vthan girigheet, til at sökia Malm och Bärgräwäck vthur Jorden» (This desire and eagerness to build mines one is not allowed to neglect and ignore. In the same way as the young men's desire is for love and as the desire of bees is for roses, to suck honey and wax from them: equally one shall be willing and inclined, but without covetousness, to seek ore and mines out of the earth) (FORSIUS 1643, p. 188).

² In a newspaper article (Svenska Dagbladet, 19th March, 1948) KAARLO HILDÉN called attention to the possibility that there be a connexion between the ancient giants of popular belief and the early Quaternary giant anthropoids made known by recent discoveries in East Asia.

³ »en god Riktning utaf ett Diur, hwilcken, den nu ifrån sitt Fångenskap i Ryssland utur Siberien hemkombna Baron KAGG hit öfwerskickat; blifwandes samma Diur utaf Siberiackerne på deras Spräck kallad Mehemot eller Mammont; hwilcket till Äfwentyrers gifwit mångom den Tanckan, att det wore detsamma som Behemoth hos Jobum.

ground in Siberia after roving »Scythians» had buried their stolen booty there (cf. FRIES 1912, p. 435; further, NORDENSKIÖLD 1884, and HILDEBRAND 1937, p. 68).

The fossil material, which gave rise to these declarations, was foreign in origin. But from Swedish soil also finds were revealed which it was desired to regard as a proof that a hardier race had its habitat in our latitudes. In a paper published in 1740 J. J. v. DÖBELN described certain skeleton parts found in 1730 at Falkenberg, province of Halland; later on they were determined by CUVIER as belonging to an elephant (cf. KORVENKONTIO 1914, p. 18).¹ In 1705 already in the parish of Vånga, 2 Swedish miles from Skara, had been »found a skeleton consisting of legs, bones, etc.: if the skull had been beside them it would have been thought that it was a Swedish Polyphemus or Cyclops, who had forged the weapons of Vulcan for our Mars, or some other of the Gothic heroes or wrestlers. It was taken to Upsala, and everything which could be put together was put together: but when the bones with the joints were carefully inspected, it was a whale or some other large fish» (translated from the Swedish).² The quotation is taken from SWEDENBORG's work »Om Watnens högd och Förra Werldens Starcka Ebb och Flod. Bewjs vtur Swergie» (On the height of water and the strong tides in the primeval world. Proofs from Sweden), 1719 (pp. 29—30). As is surmised there, the remains were those of a whale, which was subsequently described by LILLJEBORG under the name of *Balaena swedenborgii* (according to modern nomenclature *Eubalaena* s.; cf. also AURIVILLIUS 1888, and NYBELIN 1942 and 1947). According to NATHORST, the credit of identifying the find falls to the above-mentioned Uppsala Professor ROBERG and not to SWEDENBORG, who appears at first to have entertained the opinion that the bones actually originated from a giant.³

From the paper in which NATHORST collocated information of geological and palaeontological interest from SWEDENBORG's works (NATHORST 1906, English ed. 1908) the most important may be given here.

In a 1717 issue of the periodical published by him, »Daedalus Hyperboreus» (facsimile edit. published in »Kungliga Vetenskaps Societetens i Upsala tvåhundraårsminne». — Upsala 1910), SWEDENBORG drew — without any mention of them in the text — two fossils, which G. HOLM supposed had originated from Gotland, namely a species of *Calymene* (fig. 1) and *Atrypa reticularis* (LINNÉ) (fig. 2). His chief palaeontological observations were presented in a work of 1722, »Miscellanea observata circa res naturales & praesertim circa mineralia, ignem & montium strata». In this are found, on one plate, Cretaceous fossils, mostly molluscs, from Lousberg

¹ Note also a find of mammoth from Finland given to the Swedish Academy of Science in 1751 (LÖNNBERG 1916, p. 2; also mentioned in 1904 by G. HOLM in Geol. Fören. Stockholm Förh. 26, p. 238, and in 1945 by P. GEIJER in KULLING, »Om fynd av mammut vid Pilgrimstad i Jämtland». — Sver. Geol. Unders. Ser. C. 473, p. 9; see further O. KULLING, 1946, »En gengångare från istiden». — Ymer. 66: 1). Cf. the Addendum, p. 64 below!

² »funnit ett Benragel af leggor, knotar och mera: om hofwudskålen hade legat brede wid, så har man trodt thet warit en Swensk Polyphemus eller Cyclops, som har smidt Vulcani Wapn för wår Mars, eller någon annan af de Göthiska Hieltar eller Brätare. Blef jemwel fördt til Upsala, och alt som henga kunde tilhopa, sammansatt: men när benen med fogningarna såges noga efter, så war thet en Hwal eller annan stor Fisk».

³ According to kind information (by letter) of Professor J. NORDSTRÖM, Uppsala, the Vånga whale was mentioned already by JACOB LUDENIUS in »De Lithogenesis Macro et microcosmi». — Leyden 1713. This work, which the present author unfortunately has not had an opportunity of seeing, is also said to contain reflections concerning the nature of the fossils (MODEER, 1786, p. 118: »Pars prior Lapidum generationem & petrificationis modos exhibet»). It is quoted by BROMELL (1727, p. 307; 1729, pp. 494—495).

near Aix-la-Chapelle, several of which it has been possible to determine specifically; on another Carboniferous (Westphalian A) plants from Chartreux near Liège, and these are fairly recognizable (cf. also RENIER 1943). SWEDENBORG was the first Swede to describe plant fossils, and he also realized that they were real plants which had been embedded in silt. Another description of fossils, which is of interest because it is the first and for 175 years the only one of its kind by a Swedish author,

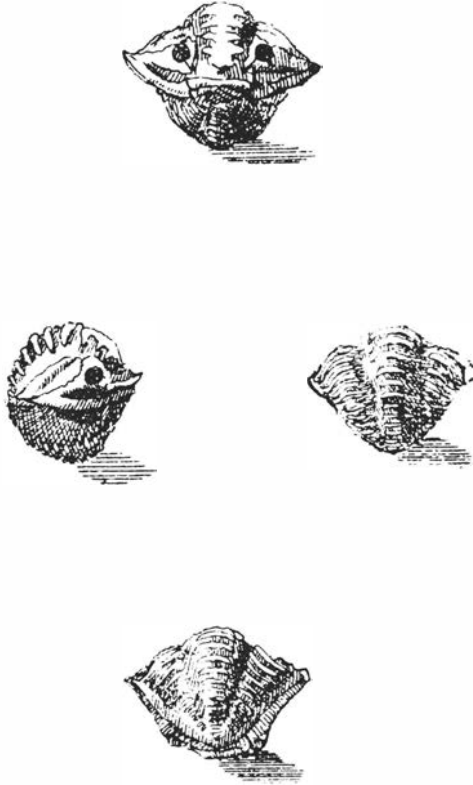


Fig. 1. Section of the plate accompanying »Dædalus Hyperboreus», 5 (1717), showing *Calymene* sp. (from Gotland?) in four different aspects. — Reproduced in the original size.

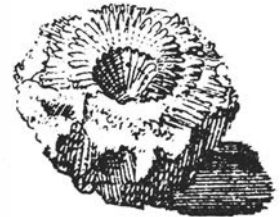


Fig. 2. Cf. the explanation of fig. 1. The present figure shows an impression of *Atrypa reticularis* (LINNÉ) (from Gotland?). — Reproduced in the original size.

was given by SWEDENBORG (1734) in the third part of the great work »Opera philosophica et mineralia». In this is given a splendid copper-plate of a skeleton of a saurian from the copper slate (Lower Zechstein) at Glücksburg in Sachsen-Meiningen. The fossil, which was subsequently described as *Protorosaurus speneri* H. MEYER, was apprehended by SWEDENBORG as a beast of prey living in the sea, »*felis marina*».

On various occasions SWEDENBORG speaks on the subject of the sedimentary rocks in Vestergötland, in which he found »In Billingen and other places, twelve miles from the sea, other marine animals, swimming creatures and strange insects, which

are entirely hidden in and transformed into stone»¹, showing that the stratum was once formed as »ooze, particles silted up, clay and sand» during a general flood (SWEDENBORG 1719; translated from the Swedish). He considered that the dolerite of the Vestergötland mountains had the same origin.² SWEDENBORG saw another proof of the supposed universal flood in the Quaternary shell beds at Uddevalla. He had no conception of the difference in age between the latter and other fossil-bearing deposits which were known to him.

In the previously mentioned work of 1719 SWEDENBORG gives the first Swedish stratigraphic description, repeated in 1722, in that within the series of strata north of Hälsingborg in Scania he distinguishes ten layers, of which, according to LUNDGREN (1878, pp. 2—3), the three uppermost belong to the Quaternary, the others to the coal-bearing (Rhaetic-Liassic) formation: »At Helsingborg there are also several layers of stone and earth; at the bottom there is brown, then red, then gray stone, above them sandstone to the thickness of a fathom; then white, brown, blue and black shales alternating with one another, a bed of coal above them, and then a blue slate-like stone, which melts in water and is full of salt» (SWEDENBORG 1719, p. 23; translated from the Swedish).³

In connexion with the Swedenborgian whale, the name was mentioned of LARS ROBERG, Professor of Anatomy and Practical Medicine at Uppsala. In an addendum to his »Dissertatio Academica de Fluviatili Astaco ejusque Usu medico» he had

¹ »i Billingen och annorstedes tolf mil ifrån Hafwet, andra Hafsiur, simmande kräk och underliga insecter, som helt gömda och förwända äro i sten».

² This conception of the nature of dolerite persisted for a long time. In 1767 HERMELIN explains (p. 23) that »Trapp är en Hälle-art, bestående af förstenad järnlera» (»Trap is a species of rock consisting of petrified iron-clay»), and still towards the end of the century HISINGER (1797, pp. 40—41) expressed an opinion in the same direction: »Hvad Vestgötha Flo-trapp angår, tyckes alla omständigheter föranleda at tro den danad på våta vägen, liksom underliggande flötshvarf, och at skapnaden bör tillskrifvas massans krympning under dess torkning» (»With regard to the bedded dolerite of Vestergötland, all circumstances seem to give us reason to believe that it was formed in water, in the same way as the underlying strata, and that its shape should be ascribed to the shrinking of the mass during drying»). Clearly influenced by HISINGER's description, WAHLENBERG (1818, pp. 12—13) described the dolerite as »Basalt or a clayey mass, which while drying split up into hexagonal pillars» (translated from the Swedish). Later on in the same paper (p. 45) is to be read the following: »The trap bed, which is the uppermost crown of the Vestergötland mountains, has» — — »like the preceding layer, a great clay content, but has so far assumed a crystalline nature that, owing, to weathering, the whole mass, under the free influence of the meteors [i. e. the agencies of the atmosphere] disintegrates into more or less coarse grains of sand, and therefore among the country people is, not without reason, called sandstone». — — »With the crystalline texture, too, all traces of living creatures have vanished from it» (translated from the Swedish).

Thus the Neptunian theory can be traced back to SWEDENBORG and already had a firm tradition in Sweden when its ideas were advanced by A. G. WERNER in Freiberg.

³ »Wid Helsingborg finnes ock åtskillige Sten- och Jord-hwarf; nederst ligger brun, sedan röd, så grå-sten, ofwanpå sandsten till en famns tioclek; ther på hwit, brun, blå och swart skifwer hwarftals, ett hwarf Stenkohl ther ofwan på, så en blå skifwerachtig sten, som smelter i watn, och är full af salt».

As early as in 1708, J. J. DÖBELIUS (v. DÖBELN), subsequently (1710) Professor at Lund, had published a »Beskrifning om Ramlösa hälo- och surbrunns uppfinnande» (On the discovery of the Ramlösa spa), but without making any real contribution to the knowledge of the geology of the district, perhaps for reasons which need no longer keep anyone from geological observations in the surroundings of Hälsingborg: »In olden times, and long before the last Scanian War, according to what is told by a peasant, SVEN NILSSON, (who lived at Ramlösa for more than 50 years), no one ventured to go there oftener, where the Spring is, than in the summer, when they wanted to cut the grass, as it was very unsafe in view of the dense forest which formerly stood there, in which a band of Robbers and Murderers had their resort, where they did great damage,

already in 1715 described and figured two trilobite pygidia found in loose stones on Vaddö in Roslagen. One of them is undoubtedly *Megalaspis limbata* (BOECK) (fig. 3), the other one is indeterminable (DALMAN 1827, p. 89, considered the specimens figured by ROBERG to belong to *Asaphus expansus*). With this little work ROBERG will probably have been the first to deal with Swedish fossil material in writing, at least pre-Quaternary one. He may be given the credit for having clearly assigned the fossils he met with among the crustaceans (cf. WIMAN 1903, p. 13 et seq.).

ROBERG's treatise »De Metallo Dannemorensi» (1716) is also of a certain interest from the Quaternary geological point of view, for in it is found a figure of varved clay from the Uppsala district. ZENZÉN (1934), who collected observations concern-

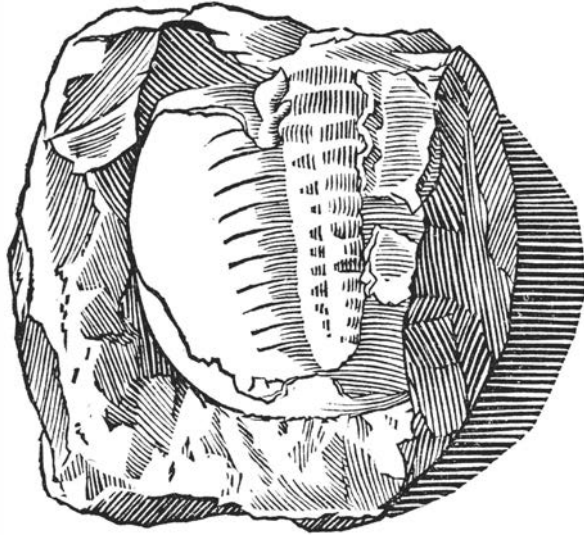


Fig. 3. *Megalaspis limbata* (BOECK) (boulder from Vaddö), fig. H on the plate accompanying ROBERG's paper of 1715. — Reproduced in the original size.

ing varved clay in the earlier Swedish literature, thinks it probable that this kind of rock attracted the attention of research workers as early as at the end of the 17th century, which is indicated by certain expressions of opinion by URBAN HJÄRNE, inter alia in his well known questionnaire »Een kort Anledning Till Åtskillige Malm- och Bergarters, Mineraliers Wäxters, och Jordeslags, samt flere sällsamme Tings effterspöriande och angifwande» (1694). Another of the oldest statements on the subject is found in the »Relatio Epistolica de Itinere suo Suecico Anno MDCCVII facta» (1720) by J. F. LEOPOLD, a doctor at Lübeck. A couple of palaeontological

not only around in the country, but also to the outgoing and incoming Ships through the Sound, for which they always lay in wait on a large hill situated opposite the Spring, where a large cave is still found with an exit on the land side, and is therefore called the Murderers' Cave by the common people still today» (DÖBELIUS 1708, pp. 2—3; translated from the Swedish).

On the other hand, certain information about the formation of the series of strata, and especially the coal seams, in the Hälsingborg district was given later by BENZELSTIERNA (1741, pp. 243—244) in his »Berättelse om åtskillige nyare Malm- och Mineral-UPfvinningar i Riket» (Report on several recent discoveries of ores and minerals in Sweden).

notes are also included in it. Thus on plate 1 is reproduced a *Terebratula*, and on plate 2 *Ostrea vesicularis* LAMARCK, both from the Cretaceous (Danian) limestone at Limhamn S. W. of Malmö¹, and on plate 8 two Silurian corals from Gotland, one of them a simple coral, the other an *Entelophyllum* or something similar.

6. Bromell

Within the earlier history of Swedish palaeontology the name of MAGNUS V. BROMELL deserves mention with special recognition, for its bearer was the first Swedish author of a work with entirely palaeontological contents. In the publication issued in Uppsala »Acta Literaria (et Scientiarum) Sveciae», volumes 2 and 3, he published during the years 1727—30 his »Lithographiae Svecanae specimen secundum». The first part of the same work, which had appeared earlier, contains a description of concretions in the bodies of man and animals.

BROMELL possessed natural history collections which were very comprehensive for the time. According to kind information from Mr. V. JAANUSSON, the palaeontological objects are now in the Palaeontological Institution of Uppsala University. The specimens are accompanied by labels with references to figures etc. On the basis of his collections BROMELL described a fairly large number of Swedish fossils. A study of his work proves to be worth the trouble.

After a short survey of the foreign and the few Swedish authors who had devoted attention to fossils, it is stated that the majority, if not all, of our fossils are remains from the Deluge, to which they themselves can bear witness according to St. Luke, Chap. 19, v. 40.² Their organic nature is expressly emphasized. The treatise consists of two parts; the first and most comprehensive, published in Acta Literaria 1727—28, is called »De vegeta[b]ilibus fossilibus & lapidefactis», the second in the volume for 1729—30, is entitled »De animalibus fossilibus, illorumque variis partibus petrifactis».

In the first part are collocated a very heterogenous collection of fossil and recent organisms from the vegetable and animal kingdoms. The first chapter, »De Lithophytis fossilibus Svecanis», consists of three parts: »De Musco incrustato & in lapide depicto», »De foliorum impressionibus & vestigiis in variis lapidibus», and »De Lithoxylis».

It is not very easy always to discover what the different descriptions refer to, especially when there are no illustrations. The »mosses» of the first part appear to consist of *Dictyonema flabelliforme* (according to the interpretation of TULLBERG 1882, pp. 3—4) in stinkstone from Skänninge in Östergötland, bryozoans in flint from the parish of Kropp in Scania, and real mosses preserved in post-Glacial fresh-water limestone from Mösseberg and from Nygården near Visby. In the second part about leaf impressions a tufaceous limestone is also included, with — as it is expressed — »Cerasi foliorum vestigia», perhaps to be identified rather with imprints of leaves

¹ Some years earlier DÖBELIUS (1706, p. 218) indicates »Liemhaffen» (i. e. Limhamn) as the finest limestone deposit in Scania. The rocks which were utilized for lime-burning are briefly described. Other geological conditions and fossil contents are not touched upon.

² »Sufficit, me» — — »credere & affirmare, quod pleraque, si non omnia, petrificata nostra, heic memoranda, sint ipsius diluvii universalis reliquiae ac rudera, quae jubente Salvatore nostro apud Lucam Cap. 19 v. 40 sacrum literarum veritatem testari possunt ac debent» (pp. 308—309). The place in the Bible referred to runs: »But he answered and said: I tell you that if these should hold their peace, the stones would immediately cry out».

belonging to some species of *Salix*. The specimen which, like several others, was obtained from KILIAN STOBÆUS, was taken from church ruins in Lund, probably from the old All Saints' Church, which was partly built of freshwater limestone, presumed to have been brought from Benestad (cf. KURCK 1901, pp. 4—5). BROMELL states that the specimens originate from the cathedral (»pantheon Lundense»), which can hardly have been the case, however, as in the following sentence mention is made of the ruins (»rudera») of that church.¹ Other supposed plant impressions in a black, fissile species of rock from Dala in Vestergötland are assumed by TULLBERG (1882, p. 4) to be graptolites. In the last part of the first chapter, about petrified wood, a description is given i. a. of a piece of wood impregnated with blue vitriol from the Falu copper mine, and in connexion with it is mentioned that not only plants have become as hard as stone from the effect of the mine water, but that parts of human bodies have been preserved in the same way. Incidentally, as the best known example of this may be recalled the so-called Fet-Mats (Fat Mats), the miner MATS ISRAËLSSON, who lost his life in the Falu mine in 1677, and whose body was found forty-two years later without any trace of decomposition. After various vicissitudes his mortal remains found a peaceful resting-place in the churchyard at Stora Kopparberg in 1930. An exhaustive account of the find, accompanied by an expressive illustration, is included in the first volume of *Acta Literaria Sveciae* (1722, p. 250 et seq.). Its author was ADAM LEYEL. The last time Fat Mats is mentioned in scientific literature is in a paper by WIMAN (1940). The miner of eternal youth has also afforded material for literary works. The motif was borrowed, i. a., by the German romanticists ARNIM and E. T. A. HOFFMAN and by PER HALLSTRÖM. This is only mentioned as a cultural-historical curiosity.

To return to BROMELL's »Lithographia Svecana». The second chapter (1728) bears the heading »De vegetabilibus marinis lapideis ex terra efossis», and the first part of it »De coralliis fossilibus». Fossil corals are said to be found more numerous in Sweden, especially in Gotland, than elsewhere.

Some of the forms described here appear impossible to interpret; in the case of others one can only venture a guess. Thus it appears as though the material in question had included a recent hydrozoan, possibly *Sertularia* (entered as no. 1), and bryozoans, fossil and recent, i. a. from Lomma in Scania. From Övedskloster or, as

¹ Cf. RETZIUS (1776, p. 86): »Efter jag nämt Allhelgona Kyrka, torde jag få lof, äfven något tala om det besynnerliga Murbruk, man i des lämningar igenfunnit. De klossar som voro qvare då jag kom hit til Lund 1757, liknade ingen ting mindre än redig murning, utan förekommo mig, som hade man hoprördt en ofantelig mängd Kalk med löf och halmstrå utan sand, och däruti vräkt tegelstenar och den omnämde svarta Kalksten. Vore icke desse stenarter däruti likasom inpackade, skulle jag vara benägen at tro detta murbruk vara naturligt och icke med konst tilredt; ty 1:o finner jag icke spor til sand däruti. 2:o har det en gul färg. 3:o Är det väl grynigt, men tillika poröst och tyckes hafva samma tillkomst som den stalactitiske Kalken från Stevens. 4:o Har jag därutinnan funnit några få ocalcinerade Snäckor» (»As I have mentioned All Saints' Church, I may be permitted to say something also of the remarkable mortar found in these ruins. The blocks which remained when I came here to Lund in 1757 resembled least of all proper mortar, but appeared to me as though an enormous mass of lime had been stirred up with leaves and straw without sand, and in it had been tumbled bricks and the black limestone referred to. If these stones had not been, as it were, packed into it, I should have been inclined to believe that this mortar was natural and had not been artificially prepared; for 1. I find no trace of sand in it, 2. it is yellow in colour, 3. it is very granular, but nevertheless porous and seems to be of the same origin as the stalactite limestone from Stevens, 4. I have found in it some few uncalcinated shells»).

Freshwater limestone from Benestad has been utilized in the Cathedral of Lund as well, e. g. for the vaults in the crypt.

13. *Corallii fossilis subalbidi ac levis ramuli tenuis geniculati ac ramosi. Ex insula Carolina montibus calcariis in Gothlandia.*



14. *Madrepore sive corallii fossilis punctulati ramuli diverse magnitudinis ac crassitiei, à digiti minimi ad pollicis latitudinem ascendentes. Ex eadem insula Carolina.*

Tenuioris ramuli imaginem figura addita sinit.



15. *Madrepore fossilis major bifurcata, sive corallium cinerei coloris fossilis ramosum, porulus stelliformibus pervium. Ex eadem insula Carolina montibus calcariis.*

Magnitudinem & iconem hujus ramuli figura addita exhibet, præter quem alium ejusdem generis ramulum sed elegantiore possideo, cujus in porosam & stellatam

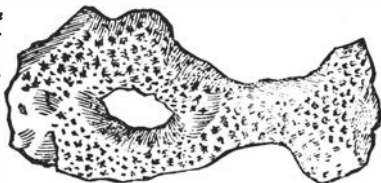


Fig. 4. Page 366 of BROMELL'S »Lithographia Svecana» (1728), showing specimens of *Thamnopora* and/or *Striatopora* (from Gotland). — Approximately 3/5 of the original size.

it is called in the original text, »ex agris monasterii Sancti Ovidii in Scaniae territorio Fersiano», are cited a couple of forms which could not be determined. On the other hand, a number of corals from Gotland and (probably Stora) Karlsö can be more or less recognized, viz. *Coenites* or possibly *Syringopora* (no. 11), *Thamnopora* (*Pachypora*) and/or *Striatopora* (nos. 13—15; cf. also LINDSTRÖM 1896, p. 23) (fig. 4). Another form, also from Gotland, may have been an *Astylospongia* (no. 24). In the second part of the chapter, »De lapidibus corallinis», forms are described, which are said to differ from those previously mentioned in that they have tubes instead of pores and are seldom ramified. Among them are *Favosites* and *Halysites* (figs. 5—6), of which fairly good illustrations are given. Others are more dubious. Thus one specimen (no. 11) suggested to BROMELL on the one hand an Indian flower with opened petals, and on the other hand the radial lamellar top of a fungus. The appended illustration appears rather to indicate a *Favosites*, a flattened colony seen from below. The third part deals with »Fungites», sponges from the depths of the Ocean. First are cited some from Scanian localities: Andraram, Övedskloster, and Lomma, clearly things which are but little comparable, and which can hardly be identified now. Then follow a number of corals, mostly simple corals, from Gotland, partly illustrated with fairly characteristic figures, thus »petrified ram's horns», almost certainly *Cyathophyllum* sensu lato (no. 6), *Chonophyllum?* *patellatum* (SCHLOT-

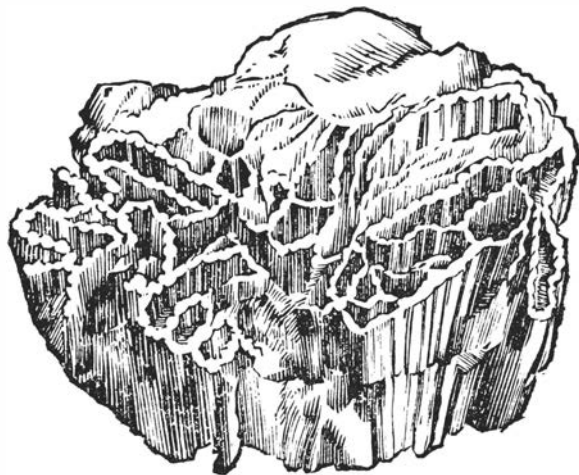


Fig. 5. *Halysites* (no. 4) (from Gotland), from p. 410 of BROMELL'S »Lithographia Svecana» (1728). — Reproduced in the original size.

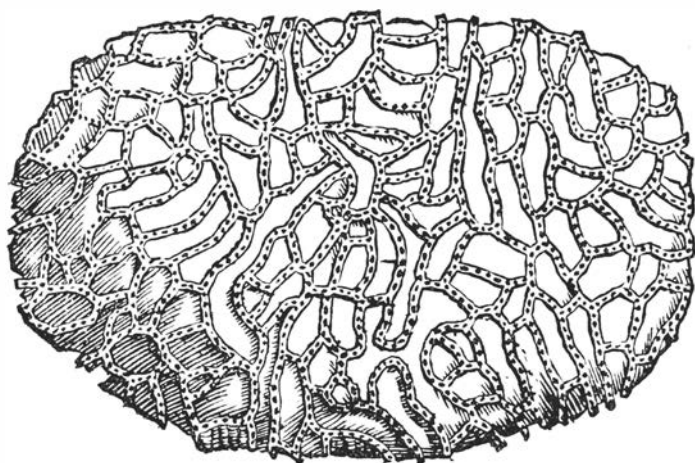


Fig. 6. *Halysites* (no. 7) (from Gotland), from p. 412 of BROMELL'S »Lithographia Svecana» (1728). — Reproduced in the original size.

HEIM) (nos. 7, 11, possibly 16) (fig. 7), *Goniophyllum pyramidale* (HISINGER) (no. 8) (fig. 8), *Porpites porpites* (LINNÉ) (*Palaeocyclus porpita*) (nos. 9, 10) (fig. 8), *Pseudomphyma turbinata* WEDEKIND (no. 12), probably *Cystiphyllum siluriense* LONSDALE (no. 18) and *Thecia cribrosa* (EICHWALD) or possibly *Strombodes* sp. (no. 20), *Codonophyllum truncatum* (LINNÉ) (no. 21) (fig. 9), and *Acervularia* sp. (no. 26, fig. 5). Further, some forms are given about which the present writer does not dare to express any opinion. One of them is said to have been described and illustrated in the previously mentioned work by LEOPOLD; the latter's figures cannot be identified, however.

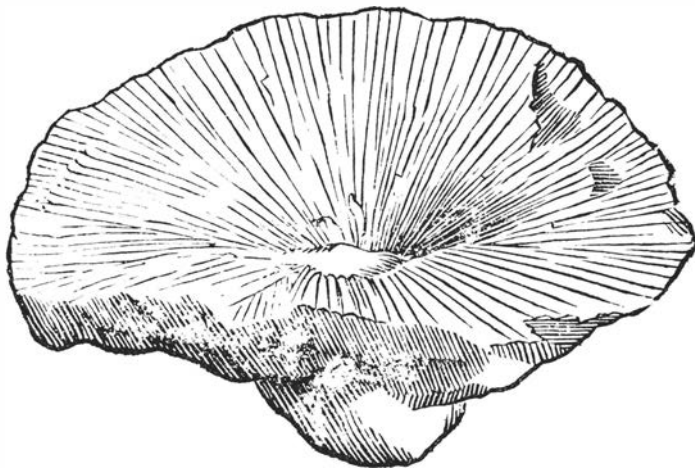


Fig. 7. *Chonophyllum? patellatum* (SCHLOTHEIM) (no. 11) (from Gotland), from p. 461 of BROMELL's »Lithographia Svecana» (1728). — Reproduced in the original size.

With this BROMELL concludes his account of the organisms which he assigns to the vegetable kingdom and passes on to the second part, which deals with the fossil animal kingdom of Sweden, as far as it was known to him. The first chapter is entitled »De lapidibus insectiferis & tubulis vermicularibus», and its first part »De lapidibus insectiferis Scanicis & Gothicis» (1729).

BROMELL emphasizes that it had been known from ancient times that insects may be enclosed in the hard and transparent amber. It is still more surprising, it is pointed out, that remains of insects, nay, even of worms, are found buried in the hardest stone. From abroad have come descriptions of living worms which live in stones and erode the rock itself, and of stones which are full of exuviae of bees, dor beetles and worms. In our country such phenomena are rare. What BROMELL apprehended as insects are, of course, in reality trilobites. He figures (pp. 496 and 497) shale from the Andrarum alum works containing a species of *Olenus*, according to WESTERGÅRD (1922, p. 7) probably *O. truncatus* (BRÜNNICH) (fig. 10). Further, we find trilobites from Vestergrötland, which can be recognized from the illustrations as *Agnostus pisiformis* (LINNÉ) (nos. 4 and 5) (fig. 11) and *Peltura*, according to WESTERGÅRD (l. c.) *P. scarabaeoides* (WAHLENBERG) (nos. 3, 6). Here is given, probably for the first time, the etymological explanation of the word »orsten» (Swedish name for stinkstone): the rock thus designated was used as a remedy for the so-called »oran», a pig disease¹ (BROMELL 1729, p. 525). The Latin name »lapis suillis», pig stone, refers to the same thing.

No immediate conclusions can be drawn as to what lies behind some of the other forms cited in this part. What are described as the impressions of butterflies are probably rather trilobite pygidia.² The second part of the chapter is entitled »De

¹ Really »ol»: Lameness in the feet (according to G. HOLM, 1901. Kinnekulle. — Sver. Geol. Unders. Ser. C. 172. Stockholm, pp. 18—19).

² It may be of interest to note in this connexion that specimens (pygidia) of *Dalmanites meridianus* in the quarry at Wandong in Victoria are known to the workmen as »fossil butterflies» (F. CHAPMAN, 1914. Australasian fossils. — Melbourne, p. 231).

tubulitis vermicularibus». Of the forms described here two, from Gotland and Bjär-sjölagård in Scania respectively, may possibly be tentaculites, the third — from Marstrand — is probably some recent worm tube.

Then follows the last chapter of the treatise, »Testacea fossilia lapidesque Conchi-formes continens». The first part is entitled »De Testaceis marinis variis, quae integra & immutata e tellure effodiuntur». Within »Testacea» are distinguished two

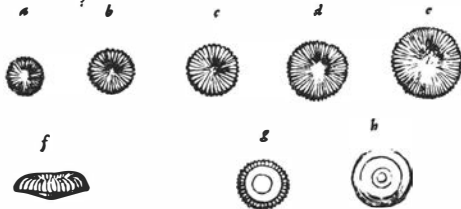
446 ACTALITER. SPECIÆ

8. *Fungita*, media magnitudinis, tetragoni Gotlandici, quorum pileoli orificium vel quadratum, vid. Fig. a, vel rhomboidate, Fig. b. pediculus autem brevis & exiguus existit.



9. *Fungitarum minimorum pediculo destitutorum capitula parva striata ac trochisforum instar crenata*, collecta in litore mari Gotlandie.

Fungitæ talis utrumque latus ex adverso depictum sicutur, ubi literæ a, b, c, d, e, & f, partem eorundem superiorem indicant. Lit. g autem & h inferiorem, in qua pediculi detriti superstes adhucdum vestigium distincte discernitur.



Lapillos tales ténues crenatos, & circulares, *Calceolaris* in Museo suo p. 328. Numismales, a similitudine cum numis, vocavit. *Luidius* autem similes in *Anglia* repertos loc. cit, N:o 151. porpitzæ minoris nummularis

Fig. 8. Page 446 of BROMELL'S »Lithographia Svecana» (1728), showing specimens of *Goniophyllum pyramidale* (HISINGER) and *Porpites porpitus* (LINNÉ) (from Gotland). — Approximately 3/5 of the original size.

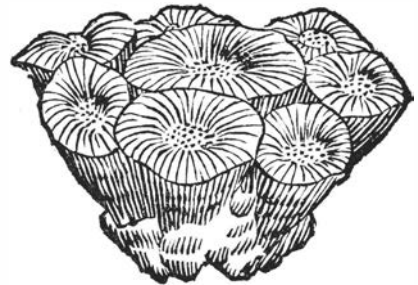


Fig. 9. *Codonophyllum truncatum* (LINNÉ) (no. 21) (from Gotland), from p. 465 of BROMELL'S »Lithographia Svecana» (1728). — Reproduced in the original size.

groups: Univalvia and Bivalvia. A shell-bearing Quaternary clay (»Bolus purpurei Coloris», according to MUNTHE 1895, p. 1, probably a *Litorina* deposit with *Mytilus* shells) from Österhaninge south of Stockholm, *Cardium edule* from Brunkebergsås, and shell-bed molluscs from Uddevalla are cited here along with Cretaceous fossils from Scanian localities, i. a. *Crania* (»brattingsborgspenning») from Ivö and Ignaberga, according to LUNDGREN (1885, pp. 25 and 30) *C. craniolaris* (LINNÉ)¹ and *C.*

¹ »6. Umbilici marini, an blattæ bysantinae vel alius testacei univalvis fossilis nova & ignota species, reperta in litore lacus Ifwö in Territorio Villandico, 2 milliar. ab urbe Christianstadt in Scania» (BROMELL 1729, p. 560).

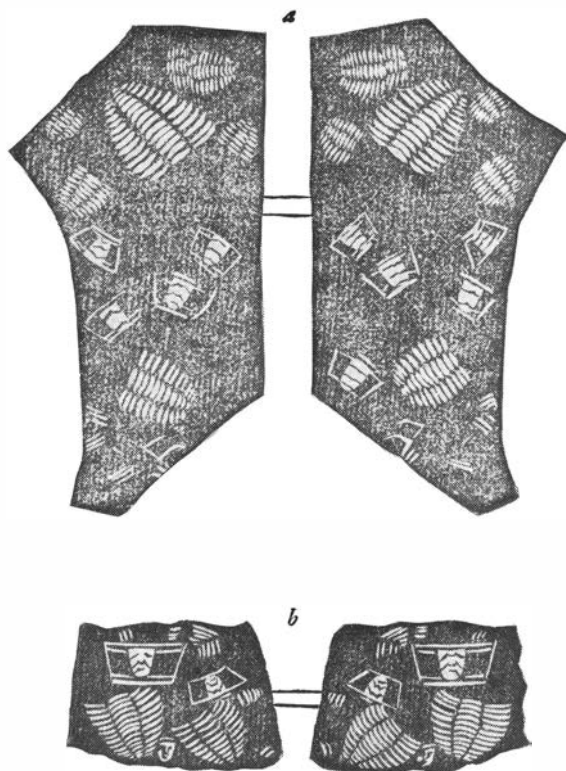


Fig. 10. Slabs of alum-shale with *Olenus* (from Andrarum), from p. 496 of BROMELL's «Lithographia Svecana» (1729). — Approximately 4/5 of the original size.

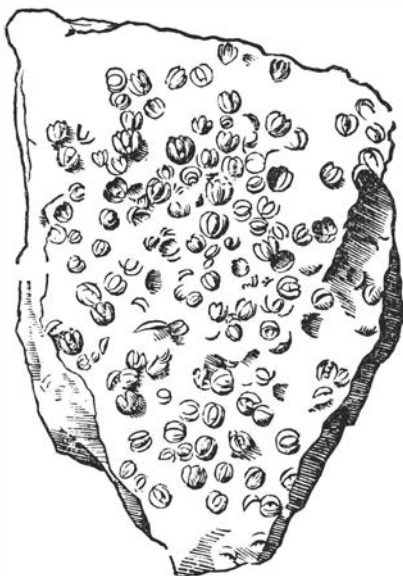
(*Isocrania*) *ignabergensis* RETZIUS.¹ Further, a description is given (pp. 558—560) of the Balsberg cave, or, as it is called, «Fläskegraven» (The Pork Cave), «Fossa lardi», according to statements made to BROMELL by JOHAN HENRIK FERBER, the apothecary at Karlskrona. The cave is said to have got its name from the inhabitants of the district having hidden pork and other foodstuffs in it during the free-booter feud.² A good account is given of the nature of the Cretaceous shell fragment limestone in the cave.

The last fossils mentioned in this part appear to have been remains of balanids found at Smedtofta in Vestergötland; they are said to recall exotic forms which are not met with in our seas, and therefore must be assumed to be proof of a general deluge.³

¹ »7. Ejusdem generis ac indolis alia minora specimina, lapidi calcario candido, ceu matrici adnata, ex lapidina Egnabergensi in Scania» (BROMELL 1729, p. 561).

² According to another explanation, the name «Fläskegraven» derives from an old method of blasting rock by means of making it extremely hot, which was effected by burning pork or other fat applied to the rock face, and subsequently pouring water on it (cf. GERTZ 1942, pp. 8 and 12). OLAUS MAGNUS tells that three hundred sides of pork were required for blasting the well at Läckö Castle in Vestergötland, which reaches 27 m down into the rock and is called «fläskgraven» (cf. G. NÄSSTRÖM, 1941. *Forna dagars Sverige*. Stockholm. P. 315).

³ »Ad substantiam earundem quod spectat, testacea haec est, testis balanorum exoticorum



5. Ejusdem generis lapides inſciſeri, circa cænobium We-
 progobis celebratiſſimum Varnhemeneſe collecti. Hi fi-
 gura cum proxime memoratis conveniunt, nec niſi
 natali loco differunt.

Tr. II.

Bbbb

6. Saxum

Fig. 11. Page 527 of BROMELL's »Lithographia Svecana» (1729), showing a specimen of stinkstone with *Agnostus pisiformis* (LINNÉ) (from Varnhem). — Approximately 3/5 of the original size.

Thus here a glimpse is caught of the conception that fossils, or at least certain of them, were organisms living in the sea, which in some way or other chanced to end up on land. In the same way LINNÉ considered that the fossil corals which he found along the coasts of Gotland, had been broken off by the waves and washed ashore from coral reefs growing at the bottom of the Baltic (LINNÆUS 1745 a, p. 190), an opinion which he later abandoned in the case of these corals (»Museum Tessinianum», 1753; cf. LINDSTRÖM 1895, p. 625). Another statement in »Öländska och Gothländska resa» (1745 a, p. 142) bears witness to a similar line of thought: »We searched in vain over the whole of Öland, to find on the shore the shell, of which the Dagers [i. e. the orthoceratites] which are found in all stones here, are undoubtedly petrifications: for such Dagers are often found here quite hollow, so that the shell and the dissepiments are quite empty» (translated from the Swedish).¹ In LINNÉ's »Wästgöta-Resa» (1747, p. 41) there stands: »'Pesar' [penes] and Stone Pistons are simillima, ita ut mirari liceat, quomodo, sine diluvii universalis praesuntione, animalculum marinum adeo peregrinum, nostroque oceano ignotum, ad Regionis Borealis loca mediterranea pervenerit» (BROMELL 1729, p. 562).

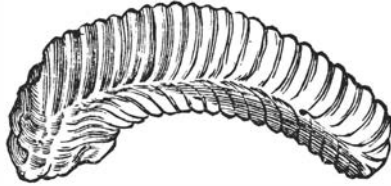
¹ »Wi sökte fåfångt öfwer hela Öland, att få det Snäckskalet vid stranden, hwaraf Darterna, som här finnas i alla stenar, äro ofelbart petrificationer: ty man finner här ofta sådane Darter aldeles iholige, at crusta och dissepimenta ligga helt tomma».

the names given here to the same kind of stones as those found in quantities on Öland, and are there called Dagers; they are found here in masses in the limestone, also as on Öland. They are nothing but petrifications of a kind of shell which is called *Nautilus rectus*, whose petrified shells are the rarest in all shell cabinets. That formerly such shells were fairly common in Sweden is shown by Öland as well as by Kinnekulle; but where they have now gone no one knows; some mussels and shells live close to the shores, other sorts never leave the depths; thus I do not know whether those mentioned above still exist in the depths of the Baltic, or whether they moved according to the seasons like the herring, to the deepest part of the Western Ocean» (translated from the Swedish).¹ Even later, as in the 10th edition of »Systema naturæ», which forms the basis of the Binary nomenclature, LINNÉ (LINNÆUS 1758, p. 711) writes about »*Nautilus Orthocera*»: »Habitat in alto Pelago? Fossilis», and in 1759 (pp. 19—20) he returned to the problem of the original habitat of fossil organisms. Further, a quotation may be cited here from a treatise by KALM (1754, p. 8), mentioned earlier: »Quis autem abyssos omnes maris pervestigavit & invisit? Petrificatorum vero maxima pars oceano suam originem debet. Nonne immensae copiae animalium marinorum, cornua ammonis aliaque testacea petrifacta exactissime repraesentantes, in profundissimo ac vastissimo oceano, multis a quacunq̄ue terra miliaribus, degere possunt? Exigua valde simulque imperfectissima est cognitio, quam de incolis oceani habemus». It is only entirely consistent that at this time a critical scientist could ask himself such questions, in view of the clearly realised and acknowledged imperfections in the actual knowledge of life in the great ocean depths at that time.² A similar opinion was expressed by BERGMAN (see above, p. 4) and by MODEER (see below, p. 49).

The last part of BROMELL's »Lithographia Svecana» to be published was the second part of the second chapter of the second section, entitled »De Testaceis univalvibus lapideis tortuosis sive turbinatis, ad Cochlearum imaginem formatis» (1730). Under the name of *Nautilites* and *Cornu Ammonis* are there adduced, as nos. 1—8, fossils which are said to originate from Gotland. Nos. 1—2 are gastropods, or possibly coiled nautiloids; no. 3 is a long and narrow specimen of *Ostrea diluviana* (LINNÉ) which can hardly have been found on Gotland (fig. 12). Nos. 4—8 are planospiral gastropods, and, judging from the figure, no. 6 is probably a *Poleumita*. As no. 9 is included an ammonite from Scania, quite certainly *Puzosia (Parapuzosia) stobaei* (NILSSON): »Ad cornu Ammonis genus referre tandem debeo rarum illum & insignem lapidem, serpentis skeleton referentem ex Scania, quem depictum verbis sequentibus descripsit OLAUS WORMIUS in musei sui lib. I. sect. 2. cap. XII. [OLE WORM: Museum Wormianum, Leyden 1655]. Ex ordine, inquit, lapidum, qui figura

¹ »Pesar och stenkolfwar kallades här på orten de samma slags stenar, som på Öland mycket finnes, och där kallades darter, de suto här öfwerflödigt i Kalkstenen, äfwen som på Öland. De äro ej annat än petrificationer af et slags snäcka, som kallas *Nautilus rectus*, hwilkens petrificerade skal äro de raraste i alla Mussle-Cabinetter. At sådane snäckor fordom warit ganska allmänne i Swerige, wisa så Öland, som Kinnekulle; men hwarest de nu tagit wägen, wet man icke; somlige Musslor och Snäckor holla sig nära intil stranderne, andra sorter lämna aldrig djupet; jag wet altså icke, om desse ännu holla sig uti Östersjöns djup, eller om de flyttat efter tidernas omlopp, såsom Sillen, til det djupaste af Wästerhafwet.»

² In connexion with and, if desired, as a confirmation of the applicability of the lines just quoted may be recalled the extremely sensational find in 1938 off the coast of South Africa of a »living fossil», *Latimeria chalumnae* SMITH, belonging to the Coelacanthidae (the youngest branch of the Crossopterygii), a group which was not previously even known from post-Cretaceous deposits, and whose last representatives were believed to have become extinct 60 million years ago.



gnitudo, heic exprimitur, parum differens a particula illa Ammonis lapidea, quam *Roëtius de Boor* in *Hist. lap. cap. 246. Imperatus* in *Hist. nat. lib. XXIV. c. 26. & Scheuchzerus* in *Lithogr. Helvet. fig. 81.* depictum exhibuerunt.

4. *Cornu Ammonis magnitudinis insignis, leve, quatuor angulatum sive spirarum, ex eadem Gotlandia.* Quamvis nec spina nec articuli nautilitatis exoticis adeo communes, in pereleganti hoc specimine Gotlandico apparent, cortex tamen tenuis, testaceus, striatus, eidem hinc inde adhæret, manifesto indicio nautili speciem fuisse rarissimam, & dignam sanctæ, quæ icone illustraretur.

5. *Cornu Ammonis candidum triplici orbe seu convolutione spirali instructum, & lapidi calcario fusco immersum.*



Ex eadem insula. Nautilitæ hujus imago a latere visitur, ubi pars nigra matricem, candida autem cornu Ammonis matrici innatum, indicat; utrumque autem lapidis hujus latus manu artificiosa positum est.

6. *Cor-*

Fig. 12. Page 30 of BROMELL'S «Lithographia Svecana» (1730), showing a specimen of *Ostrea diluviana* (LINNÉ) (from Gotland according to BROMELL) and a gastropod (from Gotland). — Approximately 3/5 of the original size.

serpentem in spiras convolutum referunt, insignem possidet D.[ominus] FABRICIUS, cuius cum mihi particulam communicaverit, integrum hic delineare operæ duxi præteritum. Grandis est, ambitu pedes ferme quatuor obtinens, in Diametro circumferentia pedem unum cum unciis quatuor.» — — «In Scania inventus hic lapis — —». — — «Ferunt huic lapidi caput annexum fuisse, sed a minus curiosis amputatum periisse. Figura tamen & circumvolutionibus, magis Nautilus quam serpentem mihi referre videtur. Hactenus Cl.[arissimus] WORMIUS, qui rem acutè tetigit, & verum lapidis nomen indicavit. Ad illud enim Nautilitarum genus referri debet lapis hicce serpentiformis Scanicus, quod juncturis suis in superficie ornamenta foliacea exprimit, de quo genere consulatur LANGIUS l. c. & in primis acutissimus BAJERUS in *Oryctogr. Noricæ cap. VII.* [J. J. BAIER: *Oryctographia Norica*, Nürnberg 1708] ubi vir idem Eruditissimus simul argumenta egregia adducit, quibus probat omnia hæc cornua Ammonis, non serpentum spolia vel naturæ lusus, sed veras conchyliorum testas vel testarum ectypos fuisse. Nos similes Nautilitas Scanicos nondum vidimus, Clariss. tamen & lapidum Scanicorum indefessus indagator D.[ominus] Professor STOBÆUS, nuper transmisit curiosissimam relationem, de lapide quodam Scanico Nautilitatis majoribus gravido, in Scaniae parocia Andrarumensi, adhucdum prope viam publicam conspicuo, & ab ignaris pro lapide tali ser-

pentifero vendidato; quam alibi & quidem in curis secundis, lubens communicabo» (BROMELL 1730, pp. 32—33).

Nos. 10—24 are gastropods from different parts of the country and of varying geological ages. The figure of no. 25 shows a specimen found »prope templum Warnesiöense [Vadensjö?] in Scania», with a turret-shaped gastropod, brachiopods (probably *Rhynchonella*) and pieces of stems of pelmatozoans. The block was of Silurian limestone, possibly from Gotland. As nos. 26—28 we find gastropods from Gotland (as regards the Gotland gastropods in »Lithographia Svecana», see LINDSTRÖM 1884, p. 33). No. 29 exhibits an internal cast of a turret-shaped gastropod, quite certainly Quaternary, from Stigberget near Gothenburg. This is the last of the forms described in »Lithographia Svecana». The work was interrupted by the author's death in 1731.

Apart from the work reviewed above, BROMELL published a small handbook, »Mineralogia, eller Inledning til nödig kundskap at igenkiänna och uppfinna Allahanda Berg-Arter, Mineralier, Metaller samt Fossilier, Och huru de måge til sin rätta nytta användas» (Mineralogia, or an Introduction to the knowledge of recognizing and detecting divers Rocks, Minerals, Metals, and Fossils, and how they are to be utilized), 1730. The book was so appreciated that a second edition was published in 1739, after the author's death. Further, in 1740, a German edition was published, into which was incorporated some of the material from »Lithographia Svecana». The eighth chapter, »Om allahanda Petrificatis eller uti Sten förvandlade diur, haf- och jord-wexter» (On various petrifications or petrified animals, sea plants and earth plants), which is on the whole a summary of »Lithographia Svecana», is reproduced here in its entirety. In order that the style of the original may not be entirely lost, the corresponding part from the 1740 German edition pp. 56 et seq. is cited, with corrections of slight printer's errors:

»§. 1. Vor eine gantz andere Art von Figur-Steinen, werden die so genannte petrificata, oder in Stein verwandelte Meer- und Erd-Gewächse gehalten, welche ihre Figur und Bildung nicht wie die jetzterwehnte Figur-Steine, von ohngefahr, oder einer uns unbekannten Ursache bekommen haben, sondern voraus dasjenige wirklich gewesen sind, dem sie nun gleichen, sie sind aber durch die allgemeine, grosse Sündfluth, oder einer andern späteren Fluth, aus dem Meere in die Berge gespület, und daselbst nachmahlen, durch eine subtile Kalck-Ausdünstung zu Stein verwandelt worden. Solche petrificata werden in- oder ausserhalb Landes überall in grosser Menge gefunden, jedoch von sehr ungleicher Gestalt, Art und Beschaffenheit. Deswegen werden sie am besten, in solche vertheilet, welche entweder zu *Vegetabilia* und Erd-Gewächse, oder zu *animalia* oder allerhand Thiere und See-Zucht gehören.

Zu denen petrificirten Erd-Gewächsen werden gerechnet:

1.) *Lithoxyla* oder in Stein verwandelte Bäume, Zweige und Wurtzeln.
2.) *Lithophyta*, allerhand Schiefer- Kalck und andere Steine, darin Abdrucke von Kräutern, Blättern und Stengeln zusehen. Wozu auch alles mit einer steinern Rinde überzogenes Grass und Moos gehöret.

3.) *Lapides corallini*, alle aus dem Berg und der Erde aufgegrabene Steine, Corallen, Stein-Schwämme, Stern-Steine und Corall-Steins-Gewächse. Von solchen petrificirten Erd-Gewächsen, werden ausserhalb Landes gantze Berge voll gefunden, insonderheit in Engelland, Schweitz, Italien und Teutschland. Bey uns sind die beyden ersten Arten, noch ziemlich unbekannt und rare. Dahingegen findet man von der letzteren eine desto grössere Menge, insonderheit in Schonen und auf Gothland,

allwo allerhand schöne Steine, Stein-Corallen, und Corall-Steins-Gewächse, Schwämme in grosser Menge aus der Erde gegraben werden.

§. 2. Zu petrificirten Thieren, kleinen Ungeziefer und See-Zucht werden gerechnet:

1.) *Lapides insectiferi*; alle Schiefer- Kalck- und Orstein, mit dem Abdruck von kleinen Würmern und Insecten, nebst allerhand Figuren. Auf solche Art, wird bey dem Alaun-Werck in Schonen, ein schwarzer Alaun-Schiefer, mit goldglänzenden Würmer-Schaalen und allerhand Zeug, davon sie generirt werden, gebrochen. In West-Gothland und Ost-Gothland aber, eine anderer Schiefer-Stein, wie auch eine stinckende Orsteins-Art, worinnen klare Spuren von petrificierten kleinen Ungeziefer und Würmern zusehen sind.

2.) *Ichtyolithi*, aller Kalck und Schiefer Stein, mit dem Abdruck und Figuren von allerhand Fischen. Von solcher Beschaffenheit, ist der bekannte Hessische Mansfeldische und Eislebische schwarze Kupffer-Schiefer, worinn ein klarer und reiner Abdruck von Karutschen, Bärchen und Hechten observirt wird. Hieher gehören auch alle so genannte *Ichtyodontes Cuspidati & Scutellati*, *Ichtyospondyli*, *Hammitae* &c. Das ist allerhand petrificirte Fisch-Steine, Fisch-Rück-Grade, Gräten, und Fisch-Rögen, welche an unzehligen Stellen, in Italien, Engelland und Teutschland, aus der Erde gehohlet, und unter dem Nahmen von Glossopetris, Natter-Stacheln, Ornitoglossis, Vögel-Zungen, bufonitis, Frosch- und Kröten-Steinen, und pisolitis, oder Erbsen-Steinen pflegen aufgewiesen zu werden; Von rechtswegen aber vor nichts anders, als vor petrificirte Fisch-Rögen, Fisch-Beine und Fisch-Zähne müssen gehalten werden.

3.) *Crustacea fossilia punctulata, Malacostraca, Echinitae, Belemnitae, Entrochi, Asteriae, Columnares* &c. Das ist allerhand in Steine verwandelte Krebs- und Krabben-Schalen, See-Aepffel-Schalen, See-Sterne, mit ihren Stacheln, Strahlen, Gliedern und Füßen. Unter diesen hält man die petrificierte Krebs-Schalen, vor die allerraresten, dieweil dieselben so selten anderswo, als in denen südlichen Ländern bishero sind gefunden worden. Sie werden aber nunmehr neben anderen petrificatis auf Gothland und in West-Gothland gefunden. Bekannter sind die in Schonen ange-troffene *brontiae spatagi* und *Echinitae*, eine Art kleine, knorrige, runde oder längliche, ebene und mit Puncten linienweiss gezeichnete Stein-Knöpfe, welche von unerfahren vor Kröten- oder Donner-Steine angesehen werden; Sie können aber vor nichts anders als vor die Schale selbst von einem kleinen See-Thiere *Echinus marinus*, See-Aepffel, Svet. Hafs-Igelkot genannt, gehalten werden.

Unter diesen findet man zuweilen einige kleine gekerbte längliche Stein Stacheln, ingleichen auch eine Art länglicher spitziger Stein-Stacheln, welche der gemeine Mann vor petrificirte Oliven, oder Luchs-Steine, ausgiebet, und ihre Ansehung dessen *lapides olivares, lyneis* und *lyneurios* nennt, jedoch nichts anders sind, als mancherley in Stein verwandelte Stacheln und Zacken, von denen jetzt angeführten See-Aepfeln, (oder Hafs-Igelkottar) welche mit solchen Stacheln auswärts überall bewaffnet sind.

So trifft man auch gleichermassen zum öfftern im Kalckstein auf Gothland [und] in Schonen eine Art kleine, platte, fünfkantige, oder runde dünne, einfache, ingleichen mit kleinen Gliedern zusammen gewachsene, inwendig hohle Steine an, welche unter dem Nahmen von *Entrocho Trochita* und *asteria columnari*, Stern- und Rad-Steine bekannt sind (Stiern och Hiul-Stenar). Von derselben Ursprung hat man zwar bishero noch keine vollkommene Kundschaft; jedoch werden sie von den mei-

sten Natur-Kündigern für petrificirte Füße, Glieder und Strahlen, von einem viel-füssigen Meer-Thiere, *stella marinae* und *medusae caput* genannt, gehalten.

4.) Es wird aber von keiner Art petrificatorum in- und ausserhalb Landes eine grössere Menge in denen Kalck-Bergen und unter der Erde, als von denen petrificirten Schnecken, und Muschel-Schalen, gefunden. Diese werden entweder gantz rein und unverändert, aus der Erde gegraben, wie bey Uddewalla in Bahus lähn, oder in Stein verwandelt. Bisweilen auch nur allein blosser Thon und Stein-Füllung, von den Schnecken- und Muschel-Schalen selbst, welche nachhero mit der Zeit hart werden, und vor petrificirte Meer-Schalen aufgewiesen werden.

Zu *Univalvia turbinata fossilia*, oder petrificierten einfachen Schnecken-Schalen, werden allerhand Cochlitae, Nautilitae, Buccinitae, Trochitae, Strombitae und Cornu ammonis gerechnet, das sind alle mehr und minder gedrehte, ebene, knorrichte und wie Post-Hörner, Ammons-Hörner, und Schrauben gebildete petrificirte Schnecken-Schalen.

Zu *Bivalvia fossilia*, oder doppelte Stein-Muschel-Schalen, gehören alle conchitae, Ostracitae, pectinitae, Bucarditae, Gryphitae, Musculitae &c. Das ist allerhand doppelte und einfache, ebene und gekerbte, ohne oder mit langen Ohren petrificirte Oster- und Muschel-Schalen. Von allen diesen Arten findet man ausserhalb Landes eine unglaubliche Menge, an unterschiedlichen Orten in Italien, Frankreich, Engelland, Schweitz und Teutschland, woher sie von curieusen Leuten gesammelt, und in denen Cabinetten, als ein Überbleibsel von der grossen allgemeinen Sündfluth verwahrt werden. Bey uns sind solche petrificirte Schneck- und Muschel-Schalen, nebst allen übrigen petrificationem bishero ziemlich unbekannt und rar gewesen, sie werden aber nun mit grösseren Fleiss aufgesuchet, nachdem man von unterschiedenen Orten, in West- und Ost-Gothland, Rosslagen, Dalarna, Oeland und insonderheit auf Gothland und Schonen, so schöne und artige petrificata bekommen, als von einigen Stellen ausserhalb Landes.

Diejenige, welche von diesen und allen übrigen Schwedischen petrifactis nähere Nachricht verlangen, können mein in denen *Actis liter. Upsalens.* angeführtes *Specimen IIdum Lithographiae Suecanae* von Anno 1727 lesen; als woselbst ihren Begehren hoffentlich ein Genüge geschehen ist.

§. 3. Ausser denen hier angeführten unterirrdischen Meer-Thieren, werden auch ebenfals öfters aus der Erde allerhand Knochen und Keulen von allerhand grossen vierfüssigen Thieren, ja bisweilen das gantze Gerippe von Wallfischen, Elephanten, See-Kühen, Crocodilen, wie auch anderen ungeheuren Thieren, wovon Italien, Teutschland und Siberien, täglich Exempel aufweisen kan, ausgegraben.

Hier bey uns hat man an einigen Orten in West-Gothland zu ein oder andermahl aus der Erde grosse Schulter-Blätter, Rippen, Rück-Grade, Keulen und andere Knochen genommen, welche der gemeine Mann vor Riesen-Knochen hält, mit mehreren Recht aber, vor Knochen von Wallfischen und andern Meer-Thieren gehalten werden, so auf gleiche Art, als alle nechstvorher erwehnte unterirrdische See-Thiere und Muscheln, ausser Zweifel durch die grosse allgemeine Sündfluth, aus dem Meere in die Erde hinein geworffen sind, allwo sie die gantze Zeit über verborgen gelegen haben.»

BROMELL was more doubtful as to the real nature of certain other fossils. In the seventh chapter of his »Mineralogia», »Om allahanda Stenar, som någon sällsam owanlig Figur samt skapnad hafwa» (On various stones of singular strange figure and shape), is to be read: »On Öland is quarried a kind of grey-speckled coarse marble, used for floor-stones, in which are seen, not only various figures and paintings of

landscapes and maps, but also a kind of long, brownish spikes resembling in appearance narrow sticks, spears, rings and crescents, the origin and nature of which are still unknown. Similarly, sunk in the Gotland limestone, there are often a kind of round Stone balls, from the size and calibre of a small bullet to that of a large bomb, all so neatly rounded and turned that they could be used instead of balls in Cannons» (BROMELL 1739, pp. 41—42; translated from the Swedish¹). Obviously these are i. a. different sorts of cephalopods and, possibly, cystoids, even though in reality the latter do not appear in aggregations in the Gotland limestone, but rather in certain beds of the orthoceratite and Chasmops limestones.

One of those who contributed material to BROMELL's palaeontological works was JOHAN HESSELIUS, who, although not an expert, deserves to be remembered in this connexion. HESSELIUS never presented any of the results of his investigations in print, but at the meeting of Bokwettsgillet (the Guild of Book-learning) in Uppsala on 9th September 1720 »There was displayed a manuscript or description of petrifications and other species of stones in Vestrogothia, written by Mr. HESSELIUS, Medical Officer of the Province. When it was read out the following desires were expressed: 1. That of the there mentioned curled and rounded stinkstone lenses one or two should be sent up: also one with crystals in: those with petrified insects and sorts of dor beetles» etc. (translated from the Swedish², SCHÜCK 1918, p. 29).

HESSELIUS was SWEDENBORG's companion on his journey abroad in 1721 and collected some of the fossil plants which were described by the latter (NATHORST 1908, p. 27).

7. Kilian Stobaeus

Another of BROMELL's correspondents was KILIAN STOBÆUS (the Elder), the bearer of the most illustrious name in the earlier annals of natural scientific research in Lund. STOBÆUS was the first holder of a chair in natural science at Lund University and the founder of the natural history collections there. In his writings he deals in many places with palaeontological objects.

In the year 1752 STOBÆUS's »Opvscvla in qvibvs petrefactorvm nvmmismatvm et antiqvitatvm historia illvstratvr, in vnvm volvmen collecta», containing a collection of previously published papers, later worked up again in part, appeared posthumously in Dantzic. The first work included in them is »De Nvmvlo Brattensbvrngensi, singvlari illo in Scania fossili: nec non de frondosis Cornv Ammonis cvisdam maioris fragmentis. Scripta A. 1731», which is based on papers of 1731 and 1732.³ There two species of *Crania* are described. One, which is referred to as »Ostracites mini-

¹ »Uppå Öland brytes en art gråspråklig grof marmor, brukelig til gålfsten, hwaruti ei allenast åtskillige figurer och målningar af Landskap och Landkort synas, utan också ett slags långa brunachtiga piggar, liknandes til anseande smala kieppar, spiut, ringar och halfmånar, om hwilkas ursprung och beskaffenhet man ännu är okunnig. Likaledes ligga uti den Gotlandske kalkstenen ofta ett slags trinna Stenbållar nedsänckte, ifrån en liten kulas til en stor bombs storlek och calibre, alla så nått rundade och swarf Wade at de i ställe för stycke kulor i Canoner skulle kunna brukas.»

² »Opwistes et manuscript, eller relation om petrificationer och andre stensorter i Westergylln, opsatt af Herr HESSELIO Medico Provinciali der i Provinsen. Wid Opläsningen desiderades följande

1. At af de där nämbde Ohrsteens bullar krusade och swarf Wade opsändes en eller två: också en sådan med christaller it: de med försteente insecter och af Tordyfwel Sectar.»

³ Cf. the list of sources and literature.

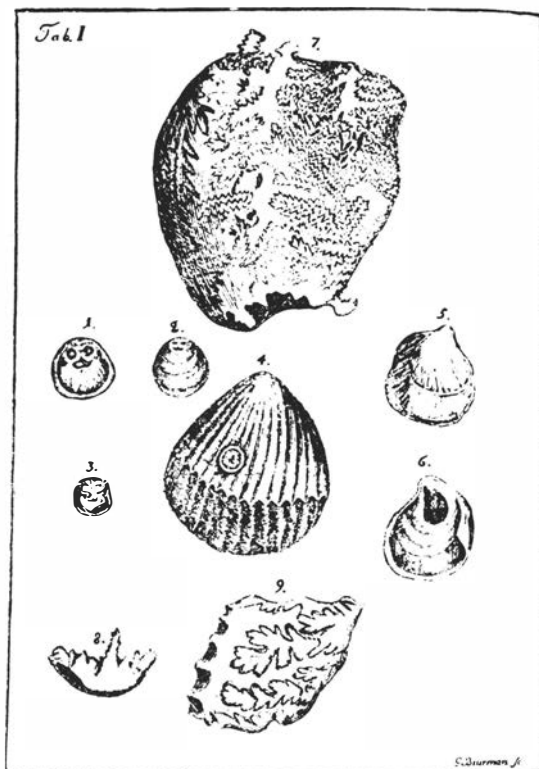


Fig. 13. Plate I (facing p. 31) of STOBÆUS's »Opuscula» (1752). For explanation cf. the text. — Approximately 3/5 of the original size.

mus parasiticus caluariam hominis vtcunque referens qui vulgo Numulus Brattensburgensis dicitur» (STOBÆUS 1752, pp. 11—12), and which derived from Ivö (STOBÆUS's Tab. I, figs. 1—2), is *C. craniolaris* (LINNÉ); the other, from Ignaberga and mentioned as »Numulus minor rarissimus» (op. cit., p. 31; Tab. I, figs. 3—4), is *C. (Isocrania) ignabergensis* RETZIUS (fig. 13). BROMELL, who had earlier obtained specimens of them through STOBÆUS, had expressed the opinion that *Crania* were the operculum of a shell which, in a letter (1727), he advised STOBÆUS to look for in lake Ivösjön. The opinion is shared for the rest by LINNÉ considerably later. For instance, in 1758 (p. 700) he says about »*Anomia*» *craniolaris*: »Habitat in Scania ad Ifvö & Balsbergam, non dum viva reperta.» No »fossilis» — as otherwise in the case of extinct forms — is added there. In opposition to BROMELL and the Danish Doctor TH. W. GROTHAUS, who also assumed in a letter that it was a matter of the scutellum of an insect (among »Insecta» were reckoned, inter alia, Crustacea at this time), STOBÆUS asserts that *Crania* should be classified among the lamellibranchs (»Restant itaque sola bivalua, quo referri potest», STOBÆUS 1752, pp. 19—20) which must be said to approach more closely to the real state of things.

Further a description is given of »Cornu Ammonis», i. e. the ammonite *Puzosia (Parupuzosia) stobaei* (NILSSON). STOBÆUS's specimens were from Ignaberga. One

of them (reproduced in Tab. I, fig. 7) (our fig. 13) was found by J. C. MOBERG in the collections of the Geological Institution of Lund University and is now kept there as one of the few identified palaeontological objects from STOBÆUS's »Promptuarium rerum naturalium».¹ STOBÆUS refers to a number of earlier works, i. a. to »Museum Wormianum» (1655), in which WORM reproduces the ammonite in question and speaks of it as »skeleton serpentis». The original is said to be from Scania and to be embedded in grey sandstone. MOBERG (1885, p. 21) thinks it probable that it originated from Köpinge.

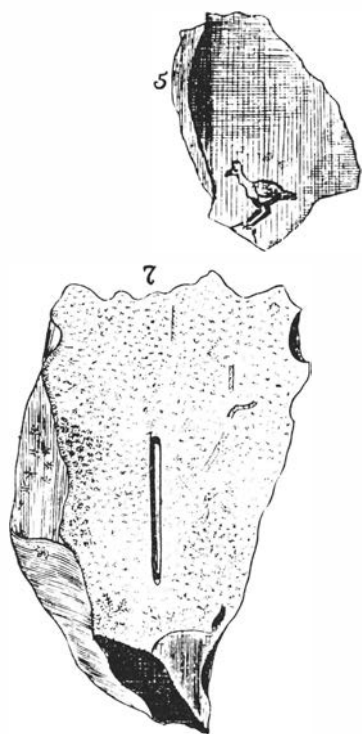


Fig. 14. Section of plate III (facing p. 107) of STOBÆUS's »Opuscula» (1752). For explanation cf. the text. — Somewhat reduced from the original size.

Belemnites.

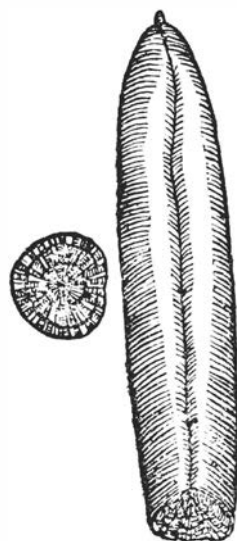


Fig. 15. *Actinocamax mammillatus* (NILSSON), fig. on p. 126 of STOBÆUS's »Opuscula» (1752). — Approximately 4/5 of the original size.

A number of other fossils are touched upon in passing.

Work no. 3 in »Opuscula» bears the title »Historia naturalis dendritæ lapidumque cognatorum. Scripta A. 1734».² In it STOBÆUS gives a not unsatisfactory explanation of the origin of the dendrites and reproduces a large number of them. We find there also the oldest — as far as the present author can find — statement about fossil-bearing strata at Fågelsång to the east of Lund. On p. 106 is to be read: »In Pæroecia Hardeberga ad Villam Fågelsång olim in vsus militares erutos fuisse py-

¹ Concerning »Museum Stobæanum», see HILDEBRAND (1934) and BERLIN (1935).

² Refers to a thesis of the same name (1734). A similar subject had already been dealt with, although briefly, by STOBÆUS in 1730.

ritas, res quidem est notissima. Hi tanquam glandulae inhaerent lapidi fissili nigro, variis rerum marinarum, *pectinum* sc. *Chamarum* & praecipue *acuum marinarum minimarum* vestigiis insigni». The reference in this passage is obviously to graptolites and possibly to *Onniella* («*Orthis*») *argentea* (HISINGER) («*pectini* sc. *Chamari*»). Fig. 7 in Tab. III (our fig. 14) would seem to reproduce a piece of graptolite shale, even though the rock is spoken of by STOBÆUS as «silex», i. e. flint, from Rosendal in the parish of Kropp, Scania. In any case it was a matter of a loose stone, as the site of the find is within the Rhaetic-Liassic area. The largest of the supposed graptolites is characterized as «Radioli oblongi & striati vestigium» (STOBÆUS 1752, p. 110). From the same district came the original of fig. 5 in the same plate (our fig. 14), «Silex seu pyromachus vulgaris auiculae figura insignitus» (op. cit., p. 109). The otherwise dispassionate and discerning research worker has there given free rein to his imagination in the reproduction of the original specimen. It is not easy to decide whether it is a dendrite or possibly some fossil that has taken on the shape of a meticulously drawn little bird.

In a paper written in 1738, «Ceravnii betvliqve lapides» («Opuscula» IV), STOBÆUS disproves the superstitious idea inherited from olden times about certain peculiarly shaped stones, fossils, and Stone Age implements, as being «thunderbolts», «ceravnii» (Swedish: åskviggår) hurled down by lightning. Fairly good pictures are given of an «*Echinites*», which seems to be a species of *Echinocorys* (STOBÆUS 1752, p. 119), further of a «*Glossopetra*», i. e. a tooth of a *Carcharodon* (p. 122)¹, «*Belemnites*», very clearly *Actinocamax mammillatus* (NILSSON) (p. 126) (fig. 15), «*Astroites maior*», most closely resembling a *Stauria*, and «*Astroites minor*», probably a *Heliolites* (both on p. 129). Quite naturally STOBÆUS was not always able to place these fossils quite adequately within the zoological system.

STOBÆUS's last geological work is «Monvmenta dilvvi universalis ex historia natvrali. A. 1741» («Opusculæ» VII). In this, partly with the help of a large body of literature, he has collected data to prove that there was a universal deluge. In this connexion a good many fossils are mentioned. In the three plates accompanying the paper are reproduced shells of *Balanus* from the shell beds near Uddevalla (Tab. XV), a piece of fossilized wood from Vallkärra, north of Lund (Tab. XVI), and a ramified colony of corals, obviously a Favositidae, from Bjärsjölagård in Scania (Tab. XVII).²

8. Linné

It is well known that STOBÆUS gave strong impulses to the student LINNÆUS, who lived in his house at Lund, was allowed freely to use the library and collections, and received «instruction on all Petrifications and Molluscs» (AFZELIUS 1823, pp.

¹ Glossopetrae were mentioned already by authors of antiquity and were believed to have fallen down from the heavens. Their similarity to the teeth of certain sharks was observed as early as 1565 by CONRAD GESNER (ADAMS 1938, pp. 113—115).

² The explanation of the plates («Opuscula», p. 328) is as follows:

«Tab. XV. Tulipae testaceae fossilis, seu Balani marini maioris fossilis, ex monte quodam prope Vddeuallam in Praefectura Bahusiensi, nec non testarum separatarum, e quibus componitur, ibidem reperiundarum delineationem exhibet.

Tab. XVI. Lithoxilon seu Lignum petrefactum non inelegans, in vicinia huius loco paludoso, ad pagum Walkierra inuentum, repraesentat.

Tab. XVII. Madreporam fossilem Loricatam siue squamatim punctatam, e Latomiis Fersianis ad villam Bieroeds Ladugård erutam, ob oculos ponit.»

103—104; translated from the Swedish). From STOBÆUS's museum LINNÉ obtained some of his material for his first paper on the mineral kingdom, »Pluto Svecicus». The manuscript of this work, the title page of which is dated 2nd September 1734, was not published until 1907 (by C. BENEDICKS) and may to a certain extent be considered a preliminary work for »Regnum lapideum» in »Systema naturæ», the first edition of which appeared in 1735 and made that year one of the most noteworthy in the annals of natural science. Even after more than two hundred years, it is still something of an experience to turn over the folio pages in the original edition, which on its twelve pages of text presents a tabular survey of the three natural kingdoms in accordance with the young author's »Methodus» for describing objects of nature presented on the last page in 38 points.

To posterity LINNÉ has come to stand out in the first place as the great re-creator within systematic botany, but one is right in asserting that his contributions in certain other fields of natural science alone would have been sufficient to place him in the van. In a paper (1751) PER WARGENTIN, the then secretary of the Swedish Academy of Science, says some words on the science of zoology, which could equally well be applied to geology and allied fields: »Such was the state of Zoology up to the year 1735 when Mr. LINNÆUS put it on quite a different footing with his Systema Naturæ, then published for the first time, which he greatly increased and improved in the later editions and daily cultivates further» (WARGENTIN 1751, p. 87; translated from the Swedish).¹

However, to a certain extent it is perhaps to be considered an indication of a change of interest in LINNÉ that in the first and earlier editions of »Systema naturæ», the »Regnum lapideum» is dealt with first, but in the later editions is placed in the last part of the work. In the case of palaeontology especially, this science, as being »useless», could not gain the unreserved approval of the 18th century utilitarian LINNÉ, as emerges from a passage in his series of lectures »Beskrifning öfwer Stenriket» (Description of the Stone Kingdom), which, like the corresponding part of »Systema naturæ», builds on »Pluto Svecicus». In the notes made by JOHAN WALLMARK from LINNÉ's verbal presentation in 1747 or 1748 we read the following expression of opinion on the branch of science which has for its object »Petrificatæ»: »This science has enamoured curious people in Germany and is actually more curious than useful. They have made a great lot of trouble for themselves in setting up a genus for each petrification — —». »May be agreeable but of little use — —» (BENEDICKS 1907 b, p. 89; translated from the Swedish).²

It would carry us all too far to enter here into a detailed scrutiny of »Regnum lapideum» in »Systema naturæ», however tempting the task may appear, as would also a comparison between the material in the first edition and in some of the later ones. Some short indications of the disposition of the material will not, however, be out of place.

Three main divisions are distinguished: Petrae or rocks, Mineræ or ores, and Fossilia or gravels. The latter are divided into Terræ or soils, Concreta or agglomerat-

¹ »Således hade sig Zoologien, in til år 1735, då H. LINNÆUS satte henne på helt andra fötter, genom Des då första gången utgifne Systema Naturæ, hwilket han i de senare upplagorna mångfaldigt ökt och förbättrat, samt dageligen vidare upodlar.»

² »Denne wettenskapen har intagit de curieusa i Tyskland och är werkeligen mer curieus än nyttig. De hafwa giordt sig et stort hufwudbråk, at uprätta et genus för hwart och et petrificat — —.» »Kan wara artigt, men föga nyttigt — —.»

ions, and Petrificata or petrifications. The last-mentioned group comprises the following »genera»:

1. *Graptolithus*. Petrificatum pictura assimilians. 2. *Phytolithus*. Petrificatum vegetabilis. 3. *Helmintholithus*. Petrificatum vermis. 4. *Entomolithus*. Petrificatum insecti. 5. *Ichtyolithus*. Petrificatum piscis, among which *I. dentis charcharodon* or *Glossopetra* and *I. ovorum* or *Oolithus*, roe stone.¹ 6. *Amphibiolithus*. Petrificatum amphibii. 7. *Ornitholithus*. Petrificatum avis. 8. *Zoolithus*. Petrificatum quadrupedis.

Practically the same division is applied in the 12th edition of »Systema naturae» (1768), the last of the original editions, »every single word in the introduction to which, not to mention other things, is worthy of thought» (AFZELIUS 1823, p. 63; translated from the Swedish)². The order of sequence is reversed, however, and the number of »species» is considerably increased. Of the genus *Graptolithus* eight »species» are given: *mappalis*, *ruderalis*, *dendrites*, *fusciformis*, which are probably all

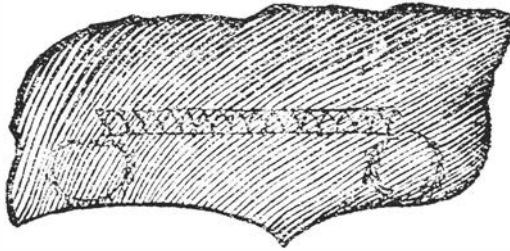


Fig. 16. Graptolite shale with *Climacograptus scalaris* (LINNÉ) and *Demirastrites triangulatus* (HARKNESS)? (from S. E. Scania, fig. on p. 147 of LINNÆUS'S »Skånska resa» (1751). — Reproduced in the original size.

dendrites, *serpulites*, which has the shape of concentric circles attached to the shells of fossil oysters and other (mainly Cretaceous) lamellibranchs and other fossils, and which manifestly refers to so-called siliceous rings (Swedish: kiselringar)³, further, *sagittarius*, which cannot be identified (cf. TULLBERG 1882, p. 6; according to BULMAN 1946, p. 163, possibly refers to a fossil plant), *scalaris*, which is described and reproduced in a rude figure in LINNÉ'S »Skånska Resa» (LINNÆUS 1751, p. 147), along with two curved Monograptidae (fig. 16), according to NATHORST (1907, p.

¹ It is strange that the oolite really was apprehended by LINNÉ, as well as by BROMELL, as petrified fish roe. On the other hand, J. G. WALLERIUS (1747, p. 330) maintained that the »Råm-Sten» — »har sitt ursprung af jord[-] eller stenblandat vatten, som droppevis fallit i någon lös mjuk jord, hvarefter de runda dropparna först coagulerat och hårdnat, och sedan sjelfva jorden i hvilken de legat» (»Roe stone» — »has its origin in water mixed with earth or stones, which fell drop by drop into some loose soft earth, after which the round drops first coagulated and hardened, and then the earth itself in which they lay»). BERGMAN (1773, p. 278) considered »Roe or pea stones» to be »hardly anything more than grains of sand, covered over with several calcareous coatings» (translated from the Swedish). In the 12th edition of »Systema naturae» the oolite is not found among the »Fossils». On the other hand, »Oolithus» is included in the group »Petrae. Calcariae. Marmor [Marbles]», and is explained as a purely mechanical formation (»Natum e Calce coalescente fluctibus maris rotundata», p. 43) and in the group »Fossilia. Concreta. Tophus» (p. 189). In the edition of »Systema naturae» mentioned »Glossopetra» has been transferred to »Amphibiolithus».

² »hwars introduction, att förtiga annat, är äfvertänkelig uti hwart enda ord».

³ In »Pluto Svecicus» (BENEDICKS 1907 a, p. 45) mentioned as »Grapt. annularis in testa ostreae. Concha anomia. Scan. Åhus» (cf. GERTZ 1928, p. 11).

68) (after TULLBERG 1882) probably *Monograptus triangulatus* (HARKNESS) (owing to a slip of the pen designated *M. triangularis* by NATHORST). *Graptolithus scalaris* refers to *Climacograptus scalaris*. The last species, *strobiloides*, is not a graptolite, and what has suggested the name is not clear. Thus we find there only one genuine graptolite, but the »species» of the first edition were all dendrites.¹ For the rest, in »Systema naturae» LINNÉ introduced a number of specific names for fossil forms which are still current.

¹ In »Pluto Svecicus» (BENEDICKS 1907 a, p. 45) »*Graptolithus*» comprises six forms, some of which undoubtedly refer to genuine graptolites, while in the lecture notes referred to previously (BENEDICKS 1907 b, pp. 89—90) the designation was used synonymously with dendrites. The inorganic nature of the formation in question is strongly stressed, and its origin is explained: »Detta genus är artigt til deras Faveur, som göra så mycket hufvudbråk af petrificater. Utomlands kan man få se stora cabinetter fulla med petrificater, som ej med fog kunna föras til följande genera. Skulle man då aldeles utesluta dem, änskönt de ej annat äro än *lusus naturae*, så droge man på sig alla d' s s älskares wrede. Genereras när viciolwatnet går emellan Lamellerna på en chiffer, som spruckit, då der förut inkrupit någon växt eller diur och rutnat; ty då chrialiseras watnet inuti och genom myllans tillhjälp förvandlas i en mörk Figur» («This genus supports those who puzzle their heads so much about fossils. Abroad can be seen large cabinets full of fossils which cannot justifiably be assigned to the following genera. If then one were to exclude them entirely, albeit they are nothing but *lusus naturae*, one would call down the wrath of all their lovers upon oneself. Are generated when the vitriol water runs between the layers in a shale which had cracked, where some plant or animal had previously crept in and decayed there; for then the water is crystallized inside and together with the mould is transformed into a dark Figure»).

With regard to the nature of the graptolites, strange ideas were long hold. WAHLENBERG (1818, p. 44), for example, speaks of »the small Orthoceratites, which have been called graptolites» (translated from the Swedish). He still retained the same conception in 1821 (WAHLENBERG 1821, p. 92; cf. BULMAN 1946, p. 163).

I, *Chonophyllum? patellatum* (SCHLOTHEIM 1820). II, »*Omphyma*» *turbinata* (LINNÉ 1761). III, »*Omphyma*» *turbinata verrucosa* (HISINGER 1831). IV, *Entelophyllum articulatum* (WAHLENBERG 1821)? V a—b, *Porpites porpitus* (LINNÉ 1767). VI, *Sarcinula organum* (LINNÉ 1758). VII, *Aulacophyllum mitratum* (HISINGER 1837). VIII, *Acervularia ananas singularis* LANG & SMITH 1927. IX, *Acervularia ananas ananas* (LINNÉ 1758). X, *Codonophyllum truncatum* (LINNÉ 1761). XI, *Strombodes stellaris* (LINNÉ 1758). XII, *Thamnopora lamellicornis* (LINDSTRÖM 1873)? XIII, »*Madrepora*» *flexuosa* LINNÉ 1758 (non SOLANDER & ELLIS 1786). XIV, *Coenites juniperinus* EICHWALD 1829. XV, *Cladopora seriata* HALL 1851? XVI, *Stauria favosa* (LINNÉ 1758). XVII, *Favosites gotlandicus forbesi* EDWARDS & HAIME 1851? XVIII, Indeterminable coral. XIX, *Fuistra membranacea* (LINNÉ 1758) (recent bryozoan). XX, *Halysites catenularius* (LINNÉ 1767). XXI, *Favosites hisingeri* EDWARDS & HAIME 1851? XXII, *Aulopora* or *Syringopora* sp. (»*Tubipora*» *serpens* LINNÉ 1758, ex parte). XXIII, *Favosites fibrosus* GOLDFUSS 1829? XXIV, *Heliolites interstinctus* (LINNÉ 1767). XXV, *Chaetetes bowerbanki* EDWARDS & HAIME 1851? XXVI, *Aulopora* or *Syringopora* sp. (»*Tubipora*» *serpens* LINNÉ 1758, ex parte). XXVII, *Favosites gotlandicus gotlandicus* LAMARCK 1816. 1, *Sarcinula organum* (LINNÉ 1758). 2, *Acervularia ananas ananas* (LINNÉ 1758). 3, *Codonophyllum truncatum* (LINNÉ 1761). 4, *Strombodes stellaris* (LINNÉ 1758). 5, »*Madrepora*» *flexuosa* LINNÉ 1758 (non SOLANDER & ELLIS 1786).

The attribution of the figures is mainly in accordance with the list published by LINDSTRÖM (1895, pp. 640—641). The nomenclature has been brought up to date as far as possible. A few emendations of LINDSTRÖM's determinations are due to suggestion in LANG, SMITH & THOMAS (1940), or in other papers quoted in the Index mentioned.

It may be assumed that at least the bulk of the fossil material described in »*Corallia baltica*» was collected during LINNÉ's travel on Gotland in 1741 and reasonably mainly by one of his companions, F. ZIERVOGEL, who devoted a special interest in collecting fossils. The collections made by ZIERVOGEL on Gotland in 1741 seem later to have been handed over as a gift to Vetenskaps societeten of Uppsala but are unfortunately lost now (cf. SERNANDER 1943, p. 51).

A reproduction of the plate in the original dissertation of 1745 is given by NATHORST (1907, pl. 1). As appears from a comparison, the individual figures show slight differences in the two editions and have been re-arranged on pl. 4 in »*Amoenitates academicae*».

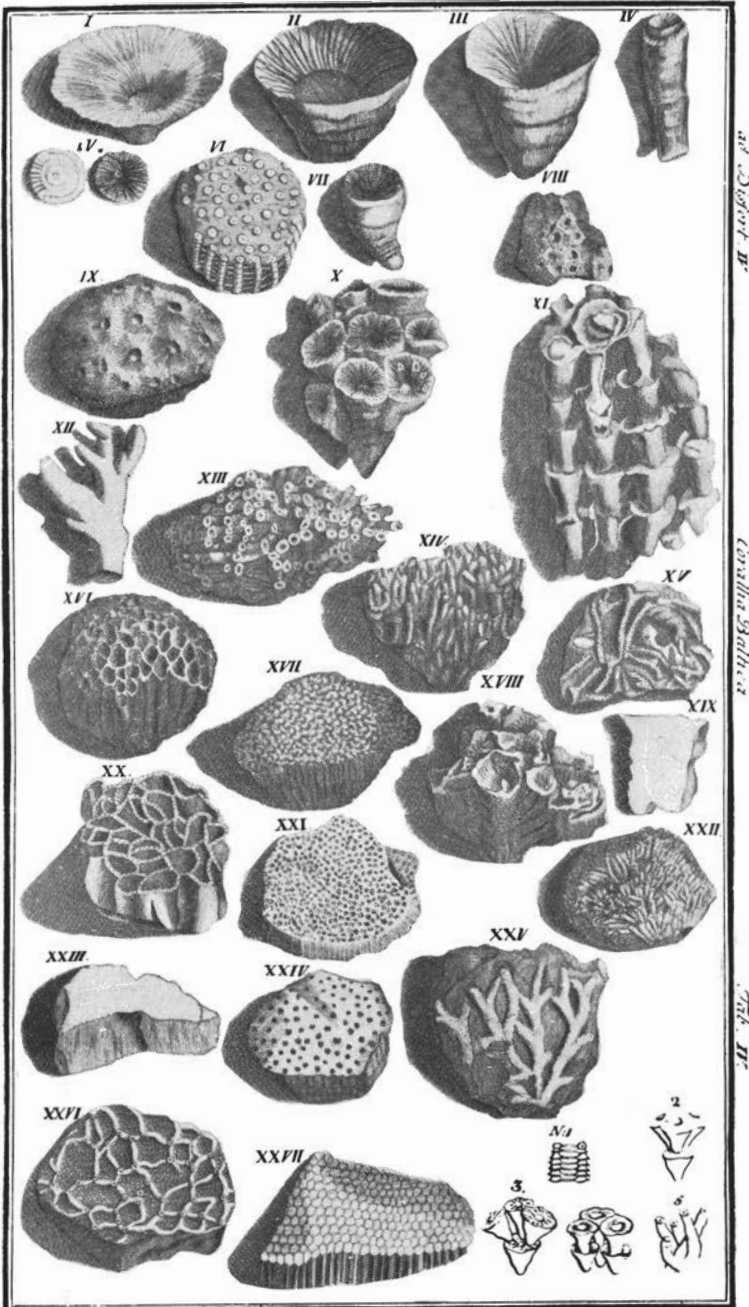


Fig. 17. The plate accompanying LINNAEUS's »Corallia baltica», the edition in »Amoenitates academicae», Holmiae & Lipsiae 1749, pl. 4 (facing p. 74). — Somewhat less than 1/2 of the original size. (Explanation of the plate on p. 34.)

As has been briefly pointed out earlier (p. 22), LINNÉ several times expressed the opinion that fossils would be found living in the sea adjoining the fossiliferous strata or the find-spot. On the other hand, he definitely and repeatedly rejected the Deluge theory, which was then fairly generally held. Let us see, for example, what is said in LINNÉ's previously mentioned »Beskrifning öfwer Stenriket»:

»They [the fossils] convince us, where they are found, that they were by no means products of the Deluge. Especially as no petrifying power of the latter can be proved. We often find shells and mussels among fossils which otherwise are not found except in the depths of the sea. Fossils are never found except where there is lime. They are not generated in such a way that the animal itself is turned into stone; but it is like an artist's casting mass in a form, which there leaves an impression of that which has been enclosed in it.

For when a body has been surrounded by lime, and the lime has hardened, the body gradually decomposes and leaves in the cavity, which is a real mould, a fine deposit. Then after the salt water has penetrated through the lime, the latter gradually coagulates into a stone, which is a true impression of the original itself. From this it follows that all petrifications are nothing more than impressions.

With regard to the man at Falun, he is not petrified but only preserved with vitriol; and as salt is dissolved by the air, so will he vanish in time» (BENEDICKS 1907 b, p. 89; translated from the Swedish).¹ »The man at Falun» is, of course, identical with the so-called Fat Mats (cf. above p. 16).

There exist only a few special works in palaeontology and geology from LINNÉ's hand. The most important of them is »Corallia baltica», published in 1745 as a dissertation with HENRICUS FOUGT (who drew the figures on the plate accompanying the paper) as the respondent. It contains descriptions and reproductions of twenty-five species of Silurian corals from Gotland, sixteen of which can be determined definitely and eight with hesitation, while one is undeterminable; further, there is a recent bryozoan (*Flustra membranacea*). LINDSTRÖM (1895) subjected the treatise to a critical scrutiny. About the importance of the »Corallia baltica», see also LANG in LANG, SMITH & THOMAS (1940, p. 8; see also p. 200). Cf. further the explanation of fig. 17.

In »Museum Tessinianum» (1753) quite a large number of fossils are dealt with, among them a fine specimen of *Entomolithus paradoxus* (now in the Mineralogical-Geological Museum, Copenhagen), later usually identified with *Paradoxides paradoxissimus* (WAHLENBERG) (= *P. tessini* BRONGNIART), but, according to WESTERGÅRD (1940, p. 7, note 1) diverging from the species mentioned. Of »vildmuslorna»², the brachiopods, it is said that they »are unknown to us as regards the creatures

¹ »De öfvertyga oss, hvar de finnas, at de ingalunda varit foster af syndaflo den. Hälst ingen petrification deraf kan bewisas. Wi finna offta snäckor och musslor ibland petrificater hwilka annars ej finnas utan på diupaste hafsbotten. Petrificater finnas aldrig, utan der kalk är. De genereras ej på det sättet, att sielfwa diuret förwandlas i sten; utan dermed förhåller sig som med en konstnärns giutdeg uti en form, som der lemnar et aftryck af det som varit uti honom inneslutit.

Ty då en krop blifwit med kalk omgifwen, och kalken hårdnat, så rutnar kroppen efter hand, och lemnar i denna caviteten, som är en riktig form, en fin mylla. Då sedan saltwatnet kommit at tränga sig genom kalken, coaguleras myllan efter hand til en sten, som är et riktigt aftryck af sielfwa originalet. Här af följer at alle petrificater ej äro annat än idel aftryk.

Hwad karlen i Falun widkommer, så är han ej petrificerad utan allenast saltad med victriol; och som salt solveras af luftten, så förgår han ock med tiden.»

² The etymology of the word will probably be »villmusslor»: organisms misleadingly like mussels, »pseudo-mussels».

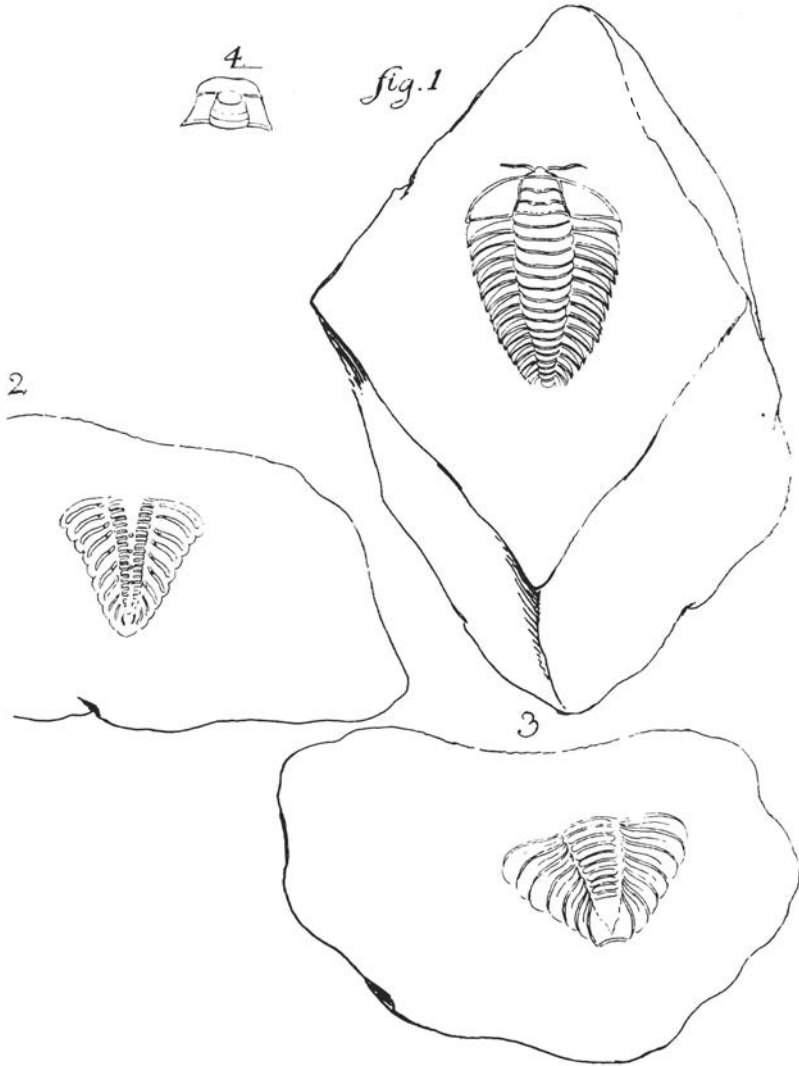


Fig. 18. Trilobites figured on pl. 1 accompanying LINNÆUS's »Petrificatet *Entomolithus Paradoxus*» (1759). Cf. the text. — Approximately 4/5 of the original size.

themselves and unchanged shell, so that we never find them in shell collections, and we do not know what in the world has become of them. But we never believe that any species has ever completely vanished from the earth» (quotation from NATHORST 1907, pp. 44—45; translated from the Swedish).¹

LINNÉ subjected the trilobites to special treatment in a paper published in *Veten-*

¹ »Äro oss nu förtiden til sina kräk och oförändrade skahl, obekante, at vi aldrig finne dem i musle-Cabinetten och vete vi ej hvar de i verlden tagit vägen. Dock tro vi aldrig, at något slägte aldeles förgåts på jordklotet.»

skapsakademiens Handlingar (Proceedings of the Swedish Academy of Science) (1759) on »Petrificatet *Entomolithus paradoxus*». This is a collective name of LINNÉ's for all trilobites. In the paper is described and illustrated *Encrinurus punctatus* (BRÜNNICH) (Tab. 1, fig. 2)¹, further a species which is considered by DALMAN (1827, p. 78) to be *Calymene blumenbachi* BRONGNIART, but which in the opinion of the present author should rather be interpreted as a *Dalmanitina* or some other phacopid trilobite (Tab. 1, fig. 3), and a couple of olenids (Tab. 1, figs. 1 and 4; Tab. 2, fig. 1) (fig. 18).² Two complete specimens of the last mentioned are shown, and they are remarkable in that they are equipped with a pair of antennae. Whether LINNÉ really had before him specimens with these organs preserved, which were not definitely established in trilobites until much later, appears uncertain, and at one time gave rise to a controversy between S. L. TÖRNQUIST and C. E. BEECHER (cf. NATHORST 1907, p. 67). Part of LINNÉ's Tab. 1 is reproduced in our fig. 18.

In this connexion a statement may be cited — kindly sent by letter by Dr. N. ZENZÉN — from P. J. HJELM's catalogue (III, 1807, pp. 573—574) of the Council of Mines' (Bergskollegium) collection, running in extenso: »Billingen. Ulunda Rivulet. No. 8. Greenish-grey, dense, splintery, mixed with clay, horizontally bedded limestone with petrifications of Entomolites, their antennae, and clear ingrown calcite in spots and streaks, and rusty yellow weathering outside» (translated from the Swedish).³ The specimen referred to was probably handed over to the Palaeozoological Department of the Swedish State Museum of Natural History in Stockholm along with other fossils, where, however, they cannot be traced, and therefore the question as to what was the basis of HJELM's notes must be left unanswered.

A profusion of geological, stratigraphical, and palaeontological observations is contained in LINNÉ's descriptions of his journeys, from »Iter Lapponicum» (1732, published 1889) to »Skånska Resa» (1751). The most important of them have been collocated in NATHORST's work »CARL VON LINNÉ såsom geolog» (1907), and therefore they can be passed here.⁴

LINNÉ published one single small geological paper, namely »Kinne-Kulle Aftagen i Profil och beskrifven af Volontairen vid Kongl. Fortificationen Herr Johan Svenson Lidholm» (1747), tallying with the corresponding description in »Wästgöta-Resa» of the same year. As appears from the title, the former paper is based upon investigations carried out, at LINNÉ's suggestion, by J. SVENSON LIDHOLM.

The Västergötland mountains had already been described earlier by KALM, whose famous »Wästgötha Och Bahusländska Resa» appeared in 1746, and by PETER SWEDBERG, who submitted to the Council of Mines a »Kort berättelse om det uti Wästergjötland belägne Billinge berget» (Sketch of the Billinge Mountain in Vestrogothia), written in 1723 (published by NELSON 1915, p. 99 et seq.). On the other

¹ On LINNÉ's Tab. 1 the numbering of figures 2 and 3 has been reversed, so that the references in the text to fig. 2 really refer to fig. 3 and vice versa.

² According to TÖRNQUIST (1896 a, p. 142), fig. 1 on Tab. 1 represents *Parabolina spinulosa* (WAHLENBERG); however, it is not adduced by WESTERGÅRD (1922, p. 134; cf. also p. 7) in the list of synonyms for the species in question. According to DALMAN (1827, p. 97) the specimen in fig. 4 on LINNÉ's Tab. 1 is *Olenus gibbosus* (WAHLENBERG). In describing this species WESTERGÅRD (1922, p. 124) does not refer to LINNÉ's paper.

³ »Billingen. Ulunda Bäck. N. 8. Gröngrå, tät, splittrig, lerblandad, flolägrig Kalksten, med försteningar af Entomoliter, deras Antenner, och klar inväxt kalkspat i fläckar och strimor, samt gulrostig vitring utan på.»

⁴ In view of the existence of the work mentioned, LINNÉ has on the whole been dealt with quite summarily here.

hand, one searches in vain for information of a geological or topographical nature in B. ÖSTERPLAN's dissertation »De Kinna-Kulle» (1699; pres. J. ESBERG), which is chiefly devoted to etymological speculations.¹

9. Further contributions to palaeontology during the 18th century: Gyllenhaal, Modeer, and others

There still remain to be mentioned some palaeontological works by Swedish authors during the 18th century.

H. D. SPÖRING (Professor of Medicine at Åbo) contributed to the Proceedings of the Swedish Academy of Science (1745) a paper on »Ägg och Ungar af Sneckor och Musslor fundne i petrificerade Mussel-skal» (Eggs and Brood of Shells and Mussels found in petrified Mussel-shells). One may venture the presumption that the supposed embryos, which were examined under a microscope, were in reality foraminifers.

An invertebrate palaeontological study deserving of recognition is JOHAN ABRAHAM GYLLENHAAL's² »Beskrifning på de så kallade Crystall-äpplen och kalkbollar, såsom petreficerade Djur af *Echini* genus, eller dess närmaste släktingar» (A description of the so-called Crystal-apples and lime-balls, as petrified animals of the genus *Echinus*, or its nearest relatives) (1772), which contains extremely remarkable observations and reflections for that time. »For the sake of convenience as well as of conformity with the accepted manner of characterizing natural objects» (op. cit., p. 253; translated from the Swedish) two species are distinguished, *Echinosphaerites aurantium* and *Sphaeronites pomum* (figs. 19—20) according to modern nomenclature, both assigned by GYLLENHAAL to the genus *Echinus*. »It is quite unknown in what seas these kinds of animals now live: But they undoubtedly live under fairly deep sea-water: For neither they, nor any of the multifarious species which are found petrified in association with them, are ever thrown up on the shores of the seas.

The petrified animals have undoubtedly both been brought forth, lived and died in the same place where their petrified remains are now found; For if the water had rolled the shells there, shingle and gravel of the same weight as theirs would have accompanied them: But the layers in which the lime balls have hitherto been found, consist entirely of a petrified fine silt» (op. cit., pp. 253—254; translated from the Swedish).³ Thus GYLLENHAAL shares with the majority of his contemporaries the conception that fossils are representatives of recent forms (cf. also REGNÉLL 1945, p. 1 seq.).

This paper was the only one from GYLLENHAAL's hand to be printed. However, GYLLENHAAL carried out extensive investigations of, inter alia, the Palaeozoic se-

¹ As so often in the case of earlier Swedish academic dissertations, it is somewhat uncertain whether the real author is respondent or president. In this case it appears most probable that the thesis was written by the respondent, who manifestly came from Österplana at Kinnekulle.

² In Vetenskapsakademiens Handlingar (1772) the spelling is GYLLENHAHL.

³ »Det är aldeles obekant, i hvilka haf desse slags djur nu för tiden uppehålla sig: Men utan tvifvel lefva de under ganska djupt hafs-vatten: Ty hvarken de sjelfva, eller någon af de mångfaldige arter, som finnas petrificerade i deras sällskap, upvråkas någonsin til hafsstränderne.

Utän tvifvel hafva de petrificerade djuren både alstrats, lefvat och dödt på samma ställen, där deras förstenade lämningar nu finnas; Ty om vattnet hade rullat dit skalén, skulle äfven klappur och grus, af samma tyngd som de, hafva följt med: Men hvarfven, hvaruti kalkbollar hittills funnits, bestå hele och hållne af et förstenat fint slam.»

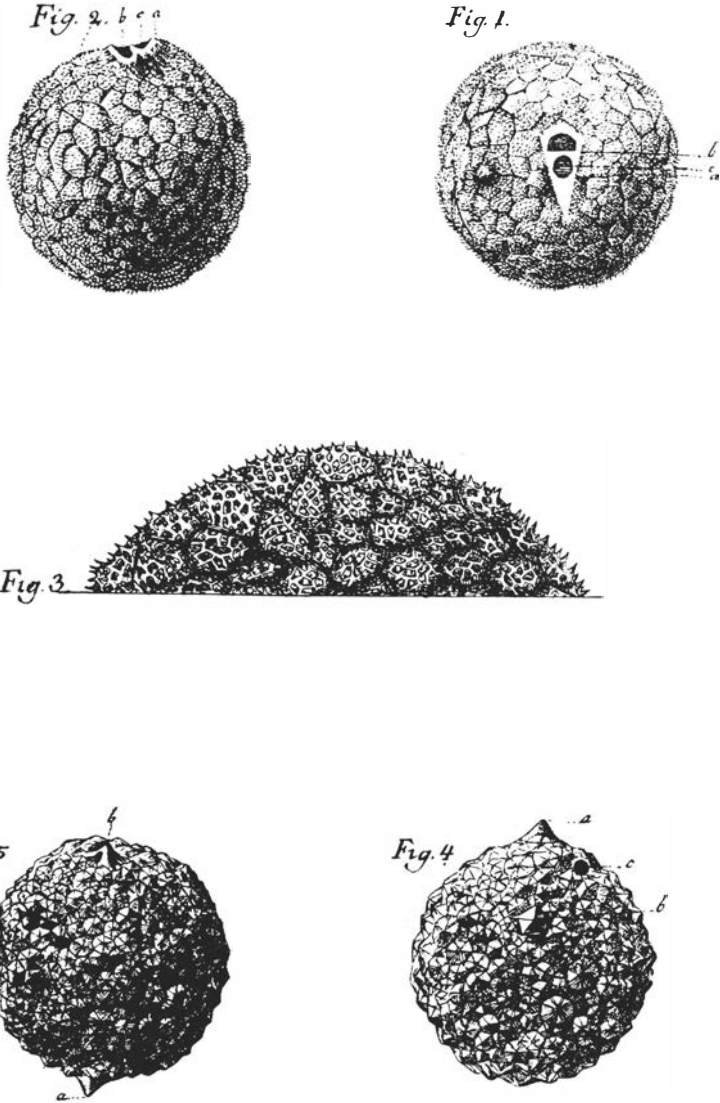


Fig. 19. Pl. 8 accompanying GYLLENHAAL's paper of 1772. 1—3, *Sphaerulites pomum* (GYLLENHAAL). 4—5, *Echinosphaerites aurantium* (GYLLENHAAL). — Slightly reduced from the original size.

ries of strata of Närke and Östergötland, collocated in a comprehensive manuscript which is now preserved in the Swedish State archives (see ZENZÉN 1920, p. 47; cf. also SERNANDER 1943, p. 42 et seq.). Cf. also below, p. 53, foot-note 2.

It deserves mentioning that GYLLENHAAL's interest in fossils was roused already during his school-days at Skara in Vestergötland. It is not unreasonable to suggest — as thinks SERNANDER (1943, p. 19 et seq.) — that his knowledge of the fossils

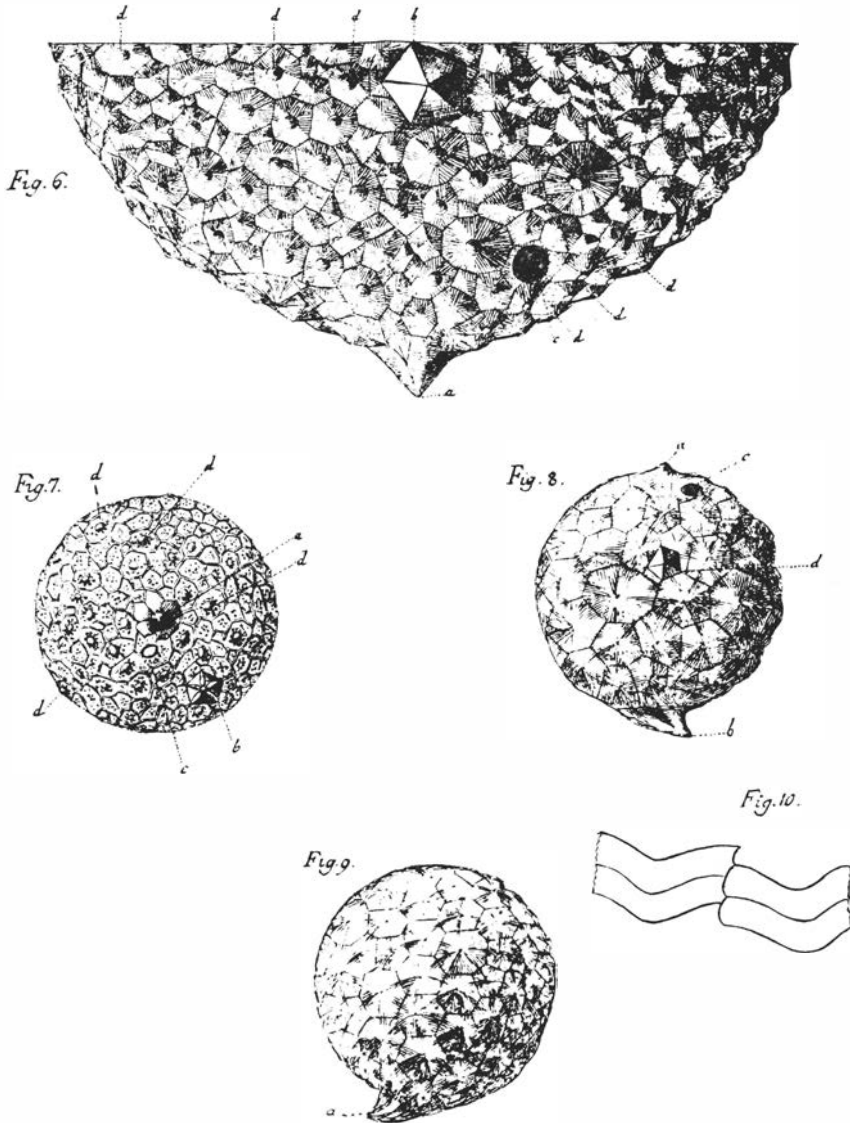


Fig. 20. Pl. 9 accompanying GYLLENHAAL's paper of 1772. 6—9, *Echinospaerites aurantium* (GYLLENHAAL). 10, «Major plates of a foreign echinit». — Slightly reduced from the original size.

found at his native place was to no small extent promoted by studies in the collections at the Skara gymnasium. These had been brought together by the learned philologist SVEN HOF, who was also well informed in a variety of natural sciences. Inter alia, HOF had collected the large specimen of «*Entomolithus paradoxus*» described by LINNÉ in «*Museum Tessinianum*» (1753).

ADOLPH MODEER, who is chiefly known as a writer on matters concerning econom-

ics and agriculture, and in bad repute as a numismatist (HILDEBRAND 1937, p. 109), also published works on natural science. Among them we are interested in the first place in »Anmerkungen über einige Nerkische Versteinerungen» (1785 b), in which a number of remains of trilobites are described, with figures that are not particularly true to nature (our fig. 21). Figs. 1—2 in Tab. II represent some species of *Agnostus* (according to DALMAN 1827, p. 19, »*Battus pisiiformis*). »LINNÉ glaubte, dass diese Versteinerungen der Figur eines Cantharidis gleich käme, welches ich nicht finde. Sie scheinen die allgrösste Aehnlichkeit mit den Indianischen Cassidis zu haben, denn die Fig. 1 zeigt erstens deutlich die eingebogene und an den Leib schliessende Elythra (vergl. Fig. 2), und zweitens mit dem *angulo antico prominente* versehen den kein anderes Insekt als die Cassidae haben (vergl. Fig. 4. 12). Was in dieser Fig. 1 den Kopf vorstellet, ist nichts anders als der Hals worauf der Thorax mit seinem Clypeo ruhet und sich bewegt, welcher nun verlohren gegangen, wovon ich aber doch sehr selten und minder deutlich eine Anzeige gefunden habe. Die Fig. 2 zeigt die Elytra in der möglichsten Helle, mit seiner *Sutur* und *Scutello* oder *puncto Scutelli*. Aber der äusserst gezeichnete Rand soll allein die *deflexionem marginis Elytrorum* bedeuten, wie aus dem Durchschnitt an der Mitte des Körpers Fig. 2 zu erkennen ist» (MODEER 1785 b, pp. 248—249; unretouched, as are also all subsequent quotations from MODEER).

Further, a complete specimen of an Olenidae and various parts of others are reproduced, and they are more or less fantastically interpreted: »Die 3 Figur [a cranidium, twisted a half-turn in relation to the correct orientation] ist ein Abdruck in Schweinstein von der untern, und die 4 Figur [a free cheek, twisted 1/4 turn] von der obern Seite, auf gleiche Weise wie oben gesagt, von einer andern Cassida [according to DALMAN 1827, p. 97, = *Olenus gibbosus* (WAHLENBERG)]. Am Leibe und an der untern Seite werden vier schräg gestellte Eindrücke vorkommen, welche ohnfehlbar von den vier hintersten Schenkeln entstanden, und der oberste gerade Eindruck wird wohl der Unterschied zwischen dem Bruststück und dem Körper seyn. Die Fig. 4 stellet genau und richtig die Oberseite deren Elytrorum vor, die gemeinlich sehr ordentlich chagriniert sind (*punctato-scabra*). Man siehet auch die gewöhnliche Ausschneidung des Scutelli» (op. cit., pp. 250—251).

The following expression of opinion is given in connexion with the complete specimen in fig. 7 [according to DALMAN 1827, p. 98, possibly = *Peltura scarabaeoides* (WAHLENBERG)]: »aber ich wage kaum die Vermuthung, zu welchem Geschlecht unter den Lebendigen diese ganz deutlich abgedruckte Thier gehören möchte. Keine *Anomia*, kein *Chiton*, denn wie könnte wohl der weiche Leib, Fuss und Mantel derselben in dem Stein sich ausdrücken? Auch kann es nicht der *Monokulus* [= *Daphnia* or related forms, as conceived by LINNÉ 1758, pp. 634—635; *Monoculus* was also used occasionally as a designation of trilobites] seyn; es wäre denn ein *Oniscus*, oder ein Geschlecht, dass dem *Onisco* am nächsten käme, aber bis jetzt noch unbekannt ist» (op. cit., pp. 253—254; agrees mainly with the discussion presented by LINNÉ in 1759, p. 23; cf. also DALMAN 1827, p. 19 et seq.).

Concerning an object reproduced in MODEER's Tab. II as figs. 9 and 10, the possibility is advanced that it is »ein Ruin eines *Echini*» (op. cit., p. 255). It will probably have been a concretion with radiating calcite crystals.

As regards his idea of the origin of fossils, MODEER is clearly influenced in certain respects by KALM (cf. above, p. 4 and also p. 22): »Gemeinlich hat man sich vorgestellt, dass die originalen der Versteinerungen nicht Weit zu suchen wären, das[s]

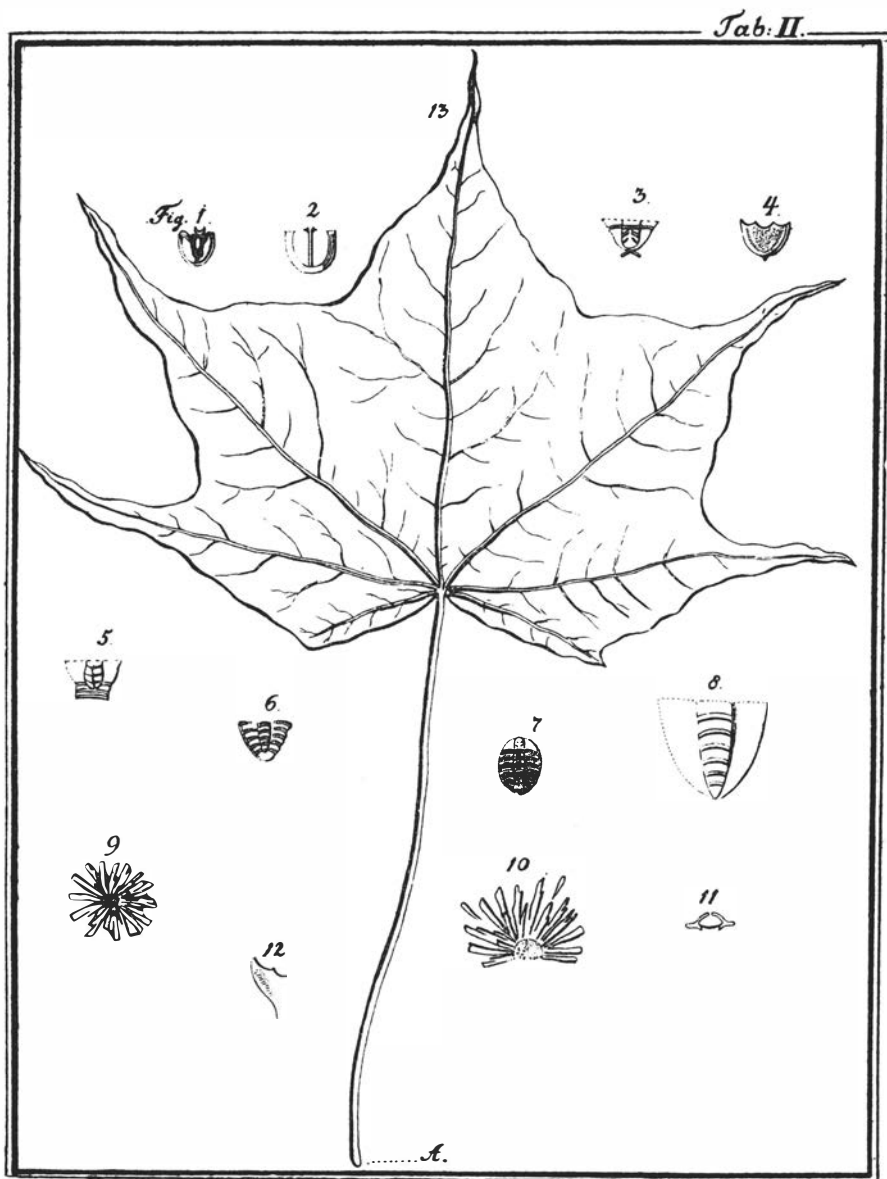


Fig. 21. Pl. II accompanying MODEER's »Anmerkungen über einige Nerkische Versteinerungen» (1785). For explanation cf. the text. (Fig. 13 does of course not belong to MODEER's paper, nor does fig. 11, although in the heading it is said to do so). — Somewhat more than $\frac{3}{5}$ of the original size.

z. B. das Original des *Nautili orthocerae* in der Ostsee zu Hause sein sollte (cf. the quotation on p. 23 from LINNÉ'S »Öländska och Gothländska Resa«); aber man hat wohl dabey sich sehr betrogen. Von den auf denselben *Nautilo* angewachsenen Versteinerungen, als *Lepadibus quibusdam* und *Asteriae minutae* gleichenden [probably refers to disks of attachment of pelmatozoans], die gar nicht in der Ostsee sich befinden, ist deutlich zu schliessen, dass die *Nautili in originali* in der Ferne zu suchen sind. Hierzu kömmt noch, dass man nicht selten bey den Norwegischen Küsten Indianische Früchte *ec.* angetroffen, wie in der Norwegischen Gesellschaft Schriften zu lesen, auch dass man zuweilen verschiedene Insekten und Heuschreckenzüge aus andern Welttheilen gesehen hat. So mag wohl ehemahls ein grosser Orkan oder eine andere ausserordentliche Begebenheit in der Natur eine unzählbaren Menge Indianischer Cassiden hierher gebracht haben, welche in den ausgetrockneten Europäischen Morästen verhärtet und versteinert sind, warum sollten denn da nicht sowohl Wasser- als Landthiere an einen und denselben Ort zusammengekommen seyn? Jene sind früher in der Versteinerungslage gewesen, und diese sind hernach von ohngefähr hinzugekommen» (op. cit., pp. 249—250). Cf. also p. 45 below.

In the Proceedings of the Swedish Academy of Science (1788) MODEER dealt in a monograph with »Slätet Pipmask, *Tubipora*», including in this heterogeneous »genus» also a couple of fossil forms.¹ The latter may be adduced here.

By »Stjern-Pipmask (*Tubipora stellata*)» (MODEER 1788, p. 230, Tab. VII, fig. 1) should be understood, according to LINDSTRÖM (1895, p. 632 and elsewhere), *Sarcinula* (»*Syringophyllum*») *organum* (LINNÉ), while »Knipp-Pipmask (*Tubipora fascicularis*)» (op. cit., p. 241), as also »Kast-Pipmask (*Tubipora strues*)» (op. cit., p. 247) is a *Syringopora* or *Aulopora*, a »Pipmask-rör» (Tubeworm-tube) which »is found petrified on the shores of Gotland, and also here and there in the limestone rocks in the same place» (op. cit., p. 242; translated from the Swedish). »Kryp-Pipmask (*Tubipora serpens*)» (op. cit., p. 243, Tab. VII, fig. 3) is an *Aulopora*. Fig. 3 a—d, which

¹ It must be remembered that, in conformity with the delimitation given by LINNÉ in »Systema naturae», the conception »worms» or »worm creatures» (Swedish: »maskkräk») covered an entirely different field than from what it does now: »Under namn af Maskar, förstår man väl i allmänhet både de til *Maskkräken* (Vermes) egenteligen hörande och hvarom här skal handlas, som och Yrfä-larver eller Skräpukar (Insectorum Larvae l. Erucae) hvilka ännu icke blifvit utvuxna eller förvandlade til fullkomliga yrfä, men dessa höra aldeles icke hit. Til en skilnad ifrån desse sistnämde Maskar, har man altså velat kalla de förstnämde *Maskkräk*, såsom fullkomliga kräk eller kreatur, hvilke framfödas i deras förblifvande skapnad utan att undergå någon förvandling. Man har någon gång kallat dem Skridfä, som också kunde antagas, om icke namnet *Maskkräk*, såsom mera känt eller brukadt, gäfvé mera begrepp om dem: ej at förtiga det namnet *Skridfä* äfven är lämpeligt til förberörde larver, ormar m. m., och således tvetydigt.» — »Vi säge altså, at *Maskkräk* äro sådana, som äro blöte, utvidgelige, vätskefulle, ofotade, utan eller med *Trefvare*: *nakne*, eller omgijne med någon särskildt sig tilhörig *Betäckning*» (»Under the name of Worms is understood in general both those really belonging to the *Worm Creatures* (Vermes), and which will be dealt with here, and the larvae of flying creatures or caterpillars (Insectorum Larvae or Erucae) which are not yet developed or changed into perfect flying creatures, but these by no means belong here. Thus to distinguish these last-mentioned Worms it has been suggested to call the former *Worm Creatures*, as mature creeping things or creatures, which are brought forth in their future shape without undergoing any changes. They have sometimes been called »Creeping Creatures», which could also have been accepted, had not the name »Worm Creatures», as being better known or used, given more idea of them: not forgetting that the name »Creeping Creature» is also applicable to the above-mentioned larvae, snakes, etc., and is thus ambiguous. — We thus should say that *Worm Creatures* are such as are *soft-bodied, capable of extending themselves, full of fluid, footless, without or with tentacles: naked or surrounded by some covering specially belonging to them*) (MODEER 1792, pp. 5—6). Thus a very large number of extremely heterogeneous invertebrates are included.

is said to show »the shell-dwelling in its simple appearance rarely met with of this Tube-worm» (op. cit., p. 245; translated from the Swedish), seems possibly to be a *Cornulites*. About »Kädje-Pipmask (*Tubipora catenularia*)» it is said: »On the shores of Gotland this petrified Tube-worm is thrown up, often in fairly large pieces, nay, even in enormous masses. It very much resembles the Kädje-Corall (*Madrep. catenul.*), which ought to be described in its place, and they have also been confused; but the 'Kädje-Pipmask' has very much longer labyrinths, walls closer to each other and often packed together, and is chiefly distinguished by having no stellate openings» (op. cit., pp. 248—249; translated from the Swedish).¹ In spite of the alleged difference the »Kädje-Pipmask» is certainly identical with the »Kädje-Corall», *Halysites*.

A couple of years later MODEER published a similar, fairly lengthy survey of »Släktet Rörkamring, *Orthocera*» (1796).

The following diagnosis of the »genus» in question was made: »The shell free, tube-shaped, narrowing downwards, equipped with dissepiments, usually straight, in certain forms bent like a spring at the back; inside divided by dissepiments as though in storeys one above the other, through which runs a pipe. The creature [i. e. the soft parts of the animal] is still practically unknown» (MODEER 1796, p. 66; translated from the Swedish).² »A great many and the largest of this genus are petrified; most of the other species which have been found in the natural state or non-petrified are usually so small that they are hardly visible to the naked eye» (op. cit., p. 72; translated from the Swedish). The last-mentioned group consists, inter alia, of foraminifers.³

Among the fossil forms are described several kinds of orthoceratites: »Strim-Rörkamring (*Orthocera striata*)» »Has not yet been found in its natural state, but only petrified, met with almost more in the red than in the grey marble or limestone, especially on Öland and at Kinne-kulle» (op. cit., p. 73; translated from the Swedish). »On some there are smaller and larger exterior protuberances here and there, which resemble 'Skäggekoppor' (*Balanus*) [undoubtedly these are disks of attachment of pelmatozoans; cf. above, p. 44], also, though rarely, some which resemble the so-called *Asterias minuta*. There is more reason to conclude from these parasites that the natural 'Strim-Rörkamringar' are not found in the Baltic, but probably in the lowest depths of the North Sea» (op. cit., p. 77; translated from the Swedish⁴; cf. LINNÉ's similar opinion reproduced on p. 23 above). The siphuncle is assumed to be »a smaller 'Rör-kamring' which has accidentally been forced in there» (»en mindre Rör-kamring, som vådeligen blifvit dit inträngd») (l. c.).

¹ »Vid de Gothländske stränder finnes denne stenvandlade Pipmask upvräkt, ofta i ganska stora stycken, ja väl ofantliga massor. Mycket liknar den Kädje-Corallen (*Madrep. catenul.*) som på sitt rum bör beskrivas, och man har äfven hopblandat dem; men Kädje-Pipmasken har mycket långsträcktare irrgångar, tätare tilhopastående och ofta tillsammanspackade väggar, samt är huvudsakeligen därigenom skild at den har inga stjernlika öppningar.»

² »Skalet oanvuxit, rörformigt, utföre afsmalnadt, med ledskilnader försedt, merändels rakt, på någre bakefter fjäderlikt inkrökt; invändigt med botnar afdelt, liksom i våningar den ena öfver den andra, genom hvilka en pipa går. Kräket är ännu så godt som aldeles obekant.»

³ The Foraminifera were apprehended by authors earlier than or contemporary with MODEER, such as BREYN, SOLDANI, FICHEL & MOLL, and also by later ones, e. g. D'ORBIGNY, as molluscs and were called »Cephalopoda foraminifera», as distinct from »Cephalopoda siphonifera». The majority of species of *Nautilus* described by LINNÉ (1758, p. 709 et seq.) are foraminifers, as are also the forms belonging to *Orthocera* LAMARCK (cf. TROEDSSON 1931, p. 9).

⁴ »På en del finnas utantill här och där mindre och större uphöjningar, som likna Skäggekoppor (*Balanus*), äfven fast sällan de som likna den så kallade *Asterias minuta*. Af dessa snyltgäster är det mera anledning sluta, at de naturliga Strim-Rörkamringar icke finnas i Östersjön, men väl i de djupaste Norrsjöns afgrunder.»

Further, mention is made of »Våg-Rörkamring (*Orthocera undata*)», »Löf-Rörkamring (*Orthocera frondosa*)» [= *Baculites* sp., from Maastricht and other localities; »Krus-Rörkamring (*Orthocera crispata*)» belongs to the same genus], »Får-Rörkamring (*Orthocera sulcata*)», »Klo-Rörkamring (*Orthocera adunca*)», the last-mentioned »a Gotland petrification in the grey shaly limestone» with the »shell somewhat roller-like-cone-shaped and a little bent at the end, the joints almost unnoticeable; the tube generally running through the middle» (= *Cyrtoceras*) (op. cit., p. 150; translated from the Swedish), »Krok-Rörkamring (*Orthocera recurvata*)», which is a form from Normandy with the »shell long-round [i. e. oval] and the end curved backward, the articulations low, the joints raised and oblique» (= *Scaphites* sp.) (op. cit., p. 151; translated from the Swedish) and, finally, »Kryck-Rörkamring (*Orthocera lituus*)» (= *Lituites* sp.). »Kryck-Rörkamringarna» are said »to have the same burial places as the 'Strim-Rörkamringar', which they most resemble, except that the lower, or narrow end is bent in in a flat coil of 2 to 3 turns, which are generally not — and certainly never in the natural or living state — connected with each other or joined to each other, but clearly separated. 'Kryck-Rörkamringar' are also infinitely rarer than 'Strim-Rörkamringar' (op. cit., p. 153; translated from the Swedish).¹

We cannot discuss here the »natural» or recent »Rörkamringar».

MODEER's last palaeontological work was probably a paper in the Proceedings of the Swedish Academy of Science (1797), »Uptäckt angående Blankenburger Schraubenstein med platta Skifwor och runda Pipor, varande *Tubipora Epitonium* eller Harp-Pipmask». Concerning this »strange petrification» many had thought they could safely guess what it had been. With all his enlightenment, however, LINNAEUS did not venture to go so far; in the absence of more experience he called it simply [LINNÉ 1768, p. 170] *Helmintholithus Epitonium dissepimentis orbiculatis [distantibus] filo centrali connexis*» (MODEER 1797, p. 50; translated from the Swedish).² MODEER refers to the entirely correct interpretation given by certain German authors of such so-called »Schraubensteine», namely that they are moulds of crinoid stems showing the cast of the axial canal and the spaces between the individual columnals.³ He maintains, however, that no opinion »can be more unreasonable» (op. cit., p. 51) and refers the fossil to »*Tubipora*».

MODEER also published a handbook on the »Stone kingdom» referred to below, and a bibliographical work entitled »Bibliotheca Helminthologica» (1786), which contains, inter alia, references to several older authors dealing with various invertebrate fossils.

On the whole it must be said that there is a touch of dilettantism about MODEER's palaeontological writings. In view of the fact that this side of his activities as an

¹ »Kryck-Rörkamringarna» ha »fått lika Grafställen med Strim-Rörkamringarna, dem de i det aldranärmaste likna, undantagande at den nedra eller smala ändan är inkrökt i en platt vinding af 2 til 3 hvarf, hvilka gemenligen icke och väl aldrig i det naturliga eller lefvande tilståndet äro sammanhängande eller liggande vid hvarandra hopfogade, utan tydeligen åtskilda. Äfven äro Kryck-Rörkamringarna oändeligen sällsyntare än Strim-Rörkamringarna.»

² — — (hade) »många trodt sig med säkerhet kunna gissa til hvad den varit. LINNAEUS, med alt sit ljus, vågade dock ej så mycket: väntande mer erfarenhet, kallade han den blott *Helmintholithus Epitonium dissepimentis orbiculatis [distantibus] filo centrali connexis*».

³ According to WAHLENBERG (1821, p. 106) the name »Screwstones» (Swedish: Skrufstenar) is used for pseudo-morphoses from fragments of crinoid stems. The same author also gives another meaning of the word, for the inhabitants of Kinnekulle are said to refer to certain orthoceratites (or in many cases perhaps rather to the isolated siphuncle) as »Screwstones» (op. cit. p. 88, note).

author is probably relatively unknown, it has, however, been dealt with somewhat fully here.

As we have seen, on several occasions the brachiopod genus *Crania* had attracted the interest of the first Swedish palaeontologists. In a paper, »*Crania* oder Todtenkopfs-Muschel», printed in 1781 in »Schriften der Berlinischen Gesellschaft naturforschender Freunde», A. J. RETZIUS recurred to this subject. In the work mentioned a careful diagnosis is given of the genus and descriptions of *C. (Isocrania) ignabergensis* and *C. brattenburgensis* [i. e. *C. craniolaris* (LINNÉ)] and of a recent species from the waters off Manila in the Philippines.

Notices on Swedish fossils are found in several places in the writings of foreign authors but can be passed by here as being of no great interest as a rule. However, mention may be made of a work by NICOLAUS VON HIMSEL of Riga, »De rariore quadam Orthoceratitidis specie, in Suecia reperta, tractatus» (1759), containing descriptions and figures of loose finds of a number of orthoceratites »in loco quodam Kelwika dicto, prope Fahlunam in Dahlia», i. e. Källviken near Falun in Dalecarlia (see TROEDSSON 1931, p. 9).

10. Treatment of fossils in the so-called »Mineralogiae»

The scholars of the 18th century generally made no real distinction between palaeontology and mineralogy. In the surveys of the mineral kingdom collocated by different Swedish authors more or less space was allotted to the »petrificata».

BROMELL's »Mineralogia» has already been mentioned, as has also the third part of LINNÉ's »Systema naturae» which deals with the »Regnum lapideum». Later came J. G. WALLERIUS's »Mineralogia, Eller Mineral-Riket, Indelt och beskrifvit» (1747; several editions abroad also), AXEL FREDRIK CRONSTEDT's anonymously published »Försök till en Mineralogie, eller Mineral Rikets Upställning» (1758; second edition 1781; translated into several languages), TORBERN BERGMAN's »Sciagraphia regni mineralis» (1782; in five years there appeared eight editions in four languages), MODEER's (anonymous) »Anledning til Stenrikets upställning på stadgade grunder» (1785; a second edition appeared in the same year), and A. J. RETZIUS's »Försök til Mineral-Rikets Upställning» (1795).

In WALLERIUS's »Mineralogia» »Stenvandlingar. Petrificata» are dealt with as the second part of »Fjerde Flokken» (The Fourth Group), which comprises »Stone in-durations» (Swedish: Stenhårdningar). With great erudition and thoroughness a systematic survey covering 65 pages is presented of »Petrified Plants», »Corals, Coralla, Stone plants» — which are evidently considered to occupy an intermediate position between the other two groups¹ — and »Petrified Animals».

¹ In his conception WALLERIUS concurs in the statement formulated by LINNÉ (in »Philosophia botanica», 1751) »Natura non facit saltus», but which had already been conceived earlier by the philosophers BACON OF VERULAM and LEIBNIZ. Thus WALLERIUS (1748, from »Förberedelse») writes: »However, it also should be noted in this connexion that Nature in her division and placing of the borderlines of her realm as elsewhere, does not leave any gaps; but there are bodies which, as it were, are ambiguous between 2 and 2 of these realms of Nature, and are like means or something between, by means of which Nature gradually rises to its height from the one realm to the other. Thus it is found that the Natural mineral Liquids in a certain way belong to the Water kingdom, and will here below be included in our Water kingdom; but in a certain way they also belong to the Mineral kingdom; *Lithophyta* or Stone plants are dealt with in both the Vegetable and the Mineral kingdoms; *Zoophyta* or Plant animals are not widely different from other plants» (translated from the Swedish).

In the treatment of the petrified plants an express distinction is made between real fossils and pseudo-fossils: »These vegetable trace stones [Swedish: Spårstenar] are distinguished from real petrifications in that, firstly, petrifications generally constitute another body, differing in material and colour from the stone in which the petrification lies; on the other hand, these stones with tracings will sometimes differ in colour a little — but for the rest not at all — from the mass of the stone in which the figure appears, and secondly, petrifications are usually raised above the stone in which they lie, but these are more or less impressed». — — »As these stones have not had their perfect figures impressed by mere chance, but owing to the fact that the plant was really lying in the rock when it was still soft, and thus left a perfect trace while the rock material hardened into stone, in the same way as one sees the impress of the shoe in stiff clay when one walks on it; owing to this fact they cannot readily be referred to stone freaks, but it has been necessary to give space to these trace stones, especially as they are sometimes included as »petrifications» by Lithographis» (WALLERIUS 1747, p. 337; translated from the Swedish).¹

Within the group »Petrified animals» the first place is given, as it should be, to »Fossilized Human Bodies», about which one learns, inter alia, that they »are easily recognized by their shape. At Aix in France a complete person was found petrified in a mountain in the year 1583; the brain was so hard that steel struck sparks against it; the bones were brittle» (op. cit., p. 356; translated from the Swedish).² WALLERIUS is more sceptical about the statement that »a whole troupe of Spanish horse-men who, in their march in the West Indies, were said to have been turned to stone: »such Stories really require closer confirmation before they can be held probable» (l. c.; translated from the Swedish). A special paragraph is devoted to »Vitriolized Human Bodies». »An example is met with at Falun mine. There are no known specimens of vitriolized animals» (op. cit., p. 370; translated from the Swedish).³ Among »salted» animals are registered the find »of a hen, which with its eggs was found in a salt-mine, not petrified, as BACCIUS says, but presumably indurated by salt» (l. c.; translated from the Swedish). The chapter contains a great many amusing items which, however, cannot be gone into here for reasons of space.

The question of how »Conchylia from the bottom of the sea and farthest from the East Indies, and ivory from elephants and similar things, have come far up on the mainland and on high mountains in Europe and in the North» (op. cit., p. 397; translated from the Swedish), is answered by »they may probably be deduced from the general Deluge. Particular inundations on low-lying places will also have contributed to some extent» (op. cit., p. 398; translated from the Swedish).

¹ »Desse vegetabiliska spårstenar skiljas ifrån rätta petrificater derutinnan 1) at petrificater constituera merendels en annan kropp, til materien och färgen skild ifrån den sten i hvilken petrificatet ligger; deremot desse spårstenar skiljas väl något litet til färgen ibland, men för öfrigt icke, ifrån den öfriga stenmassan i hvilken figuren sig visar 2) at petrificater merendels äro uphöjde öfver den sten i hvilken de ligga, men desse äro mer eller mindre intryckte.» — — »Emedan desse stenar ej af någon pur händelse fåt sina intryckta fullkomliga figurer, utan deraf, at örten legat verkeligen i sten-materien, då den ännu var mjuk, och således efter sig lemnat fullkomligt rum och spår, under det sten-materien til sten hårdnat, på samma sätt, som man i segt ler ser aftryck efter skon då man går; ty kunna de ej lätteligen föras til stengyckel, utan har man bort här lemna desse spårstenar rum, hälst ock de af Lithographis äro ibland petrificater uptagne.»

² »Igenkännas lätt nog af skapnaden. Vid Aix i Frankrike fants i et bärg en hel människa petrificerad år 1583; hjernan var så hård, at den tog eld mot stål; benen voro möre.»

³ »Exempel härpå finnes vid Fahlgrufva. Vitriolescerade oskälige djur är intet bekant exempel på.»

From the organic fossils are distinguished »Stone freaks. Figurata. *Lapides Heteromorphi. Lusus Naturae*. They are stones, which are found of a rare and curious and unstable figur in the Mineral kingdom, which resembles some plant or animal or something else» (l. c.; translated from the Swedish). A miscellaneous collection, from dendrites to stone axes and crocks, is included.

In his »Mineralogie», which in several respects is admirable, CRONSTEDT shows that he is in advance of the majority of his contemporaries, in that he draws a sharp border-line between the objects to be studied within mineralogy and those within palaeontology. Himself a mineralogist, he had no great interest in palaeontology. To collect fossils »can have no other motive than to learn to know the bodies in the animal and vegetable kingdom, which are not so easy to find, and thus it is the business of zoologists and botanists; for a mineralogist is satisfied with one specimen of each substance, which has assumed the guise of plants and animals, by which he can conclude at its origin. Whether corals are plants or worm dwellings¹ he leaves to others to decide, and at first receives them with great indifference when they have mouldered into chalk, become changed into spar, or something similar» (op. cit., 2nd edition, 1781, from the preface; translated from the Swedish).² CRONSTEDT's very compressed chapter on »Mineralia Larvata, vulgo Petrificata» is accordingly relegated to an appendix. That they are cited at all is explained to be »for the sake of household utility».

No fossils were listed in TORBERN BERGMAN's »Sciagraphia» (1782) but reference was made (p. 158) to the classification adopted by CRONSTEDT. BERGMAN, on the other hand, remained in no way indifferent to the study of fossils: »Absit, ut petrefactorum cognitionem sterilem parumque utilem putemus. Considerari namque et possunt, et debent, tamquam nummi memoriales [cf. quotation from BERGMAN 1766, p. 4 above], naturae manu depositi, in memoriam notabiliorum operationum in construendo telluris cortice, e quibus tempus et ordo artificii quodammodo dijudicari possunt, dum alia silent monumenta. Hi, ope genuinae interpretationis, suis locis natalibus de pristino superficiei statu, de vastissimo maris imperio et insequentibus vicissitudinibus nos instruunt» (p. 157).

In his handbook »Anledning til Stenrikets Upställning på Stadgade Grunder» MODEER (1785 a, p. 33) was aware of the fact that fossils should be classified in the same way as living organisms. His argument for this declaration was that more light was shed over the animal kingdom by such an arrangement, »because in the mineral kingdom there are many animals, which otherwise or not yet have been found in their natural state» (translated from the Swedish). The »Petrificata» form the 6th class (pp. 59—61) in his »Tentamen prodromi systematis regni mineralis». The section under consideration is largely an epitome of the corresponding part in LINNÉ's »Systema naturae» (1768).

¹ This two-thousand-year-old subject of contention was settled in 1753 by PEYSSONNEL in an account of a manuscript entitled »Traité de Corail, contenant les nouvelles découvertes qu'on a fait sur les Corail, les Pores, les Madreporas, Scharras, Lithophyttons, Esponges & autres corps & productions que la mer fournit» (Philos. Trans. 47. London) where it was clearly proved that the corals belong to the animal kingdom (cf. ADAMS 1938, p. 132).

² — — »kan ej hafwa någon annan orsak, än att lära känna de Kroppar i Djur- och Wäxt-Riket, som wi icke så lätt igenfinna, och således blir det Zoologorum och Botanisters göromål; ty en Mineralogus har nog af et Exemplar af Hwardtera ämnet, som tagit an hamn af Wäxter och Djur, för Generations Historiens skull. Om Coraller äro wäxter eller matkebon lemnar han til andras afgörande, och tager dem först emot med mycken kallsinnighet, när de förmultnat til Krita, blifwit förwandlade til Spat eller dylikt.»

In 1787 P. A. GADD, Professor of Chemistry at the University of Åbo, published »Inledning Til Sten-Rikets Känning». The circumstance that fossils are not mentioned at all in this work is perhaps connected with the complete absence of pre-Quaternary, definitely fossil-bearing strata in Finland.

In his view as to the unsuitability of including fossils in a mineralogical system A. J. RETZIUS (1795) agrees with CRONSTEDT. »The study of them is a special and mixed science, or, more correctly, a branch of Physical Geography, for the understanding of which a knowledge of mineralogy is necessary. Following CRONSTEDT's example, I have therefore given in an appendix as much about them and Vulcanica as I believed to be important in mineralogical respects» (RETZIUS 1795, p. 24; translated from the Swedish). The classification of »Petrefacta» agrees on the whole with LINNÉ's arrangement in »Systema naturae».

II. The development of regional and stratigraphical geology in Sweden up to 1800: A. J. Retzius, Tilas, Hisinger, and others

LINNÉ is the most famous of the scientific travellers who gathered the first information about the regional geology of our country, but he was not the only one in Sweden. Other names have emerged in the above presentation (e. g. SWEDENBORG, 1719, p. 13 above), and some more will be given here.

To begin with our southernmost province, among the research workers in Scania we may mention H. H. VON LIEWEN,¹ who in the Proceedings of the Swedish Academy of Science (1752) gave a »Beskrifning På de under-jordiska gångarna uti Balsbärget eller den så kallade Fläske-grafven vid Råbelöf i Skåne» (A description of the subterraneous passages in the Balsberg mountain or the so-called Pork Cave at Råbelöv in Scania), further S. G. HERMELIN, who in the same periodical (1773) presented »Anmärkningar om Boserups Stenkols-Grufva, och de öfriga Stenkols-försök uti Skåne» (Notes on Boserup coal-mine and other coal prospecting in Scania) with geological, stratigraphical, and lithological observations, MICH. MALMSTRÖM, who in the first part of »Physiografiska Sällskapet [i Lund] Handlingar» (1776) published »Mineralogisk beskrifning öfver Andrarums Alun-Skiffer-Brott» (A mineralogical description of the Alum-shale quarry at Andrarum), and finally, A. J. RETZIUS, with his »Anmärkningar vid Skånes Mineral-Historia» (Notes on the Mineral History of Scania), published the same year. From the last-mentioned work, which contains a good deal of information about the distribution of the sedimentary rocks within the province, some extracts may be given here:

»The limestone [at Balsberg] consists of an indescribable multitude of shell-fish, some whole and some crushed. All are marine animals, and no species conforms with those thrown up by the adjoining seas; but with those farthest away. I will only mention one remarkable example: As far as I know, the so-called 'Brattensborgs-penningar' (*Crania*) are not found anywhere except at Ifwö, Balsberg, Egnaberga, and one single shell in the sand at Hwitsköfle; no collector in Europe is said to have seen others than those found at these places. Who would then believe that the originals of them would have come from Manilla? Nevertheless it is so, and I first became aware of them on a piece of Coral picked up on the beach at Manilla» (cf. p. 47 above).

¹ In Vetenskapsakademiens Handlingar (1752) the spelling is LIWEN.

»In Balsberget there is said to be the largest supply of the so-called Wätteljus, or *Belemnites*, which exists anywhere, for they form the uppermost stratum — one span in thickness — of the limestone; underneath lies the limestone, as has been said before, consisting only of whole, broken and crushed shell fish, though by no means in confusion, but in defined strata, the largest of which consists of a multitude of *Ostrea diluviana*, which even among themselves are so varied that he who does not see a considerable collection of them at the same time would hardly believe that they were of the same species. In vain one searches among these for Belemnites, Echinites, or other kinds of bivalves [than *Ostrea diluviana*], they have their special strata separate from those mentioned; but, on the other hand, among themselves fairly well mingled. I am convinced that a complete description of the Petrifications from Balsberg would be a pleasure to devotees of Testaceology, but here it would take up too much space» (RETZIUS 1776, pp. 81—82; translated from the Swedish).

From Tykarp is reported (p. 83), inter alia, »the whole bottom of an *Echinus* which is more than a hand's-breadth in width» (translated from the Swedish), which may be noted as the specimen referred to, is still preserved in the museum of the Palaeontological institution at Lund University, where it is found in the collection of type specimens under the name of *Cardiaster(?) ignabergensis* SCHLÜTER 1897.

»At Bieröds Ladugård or, as it is generally called, Biärslagård in the district of Färs there is a limestone quarry close to the Manor House, which is said to have been worked for a considerable time. The place is low-lying, and the rock lies almost under the soil. It is stratified, and the strata are horizontal; the rock itself is very hard, grey, glittering, and full of fossils. Shell fish [this term might correspond fairly adequately to 'skalmaskar' of the Swedish original text] are extremely rare here; but, on the other hand, *Helmintholithus Entrochus* S.[ystema] N.[aturae] 18. T. 3 p. 168 [crinoids] abound. I have been assured that a petrified crayfish has also been found [the basis for this statement was probably a *Homalonotus*]; but I have not seen it. Large balls of *Millepora poris contiguus angulatis; diaphragmatibus transversalibus plurimis*. Amoen.[itates] Acad.[emicae] [a collection of academical disputations under the presidency of LINNÉ, 1743—76] T. 1. p. 101. T[ab.] IV. f. 21¹ [*Favosites*], are met with here and there, which must be carefully looked for; for in the heat they explode with a strong report and may spoil the furnace» (RETZIUS 1776, pp. 84—85; translated from the Swedish). Several other occurrences of limestone and shale are indicated.

A notice of finds of Cretaceous fossils at »grop-qvarnen» (Gropemöllan) in the parish of Karup is given by FISCHERSTRÖM (1761, p. 270) in his »Anmärkningar om Södra-Halland» (Notes on the Southern part of Halland). According to BEXELL (1938, p. 342), the site is probably identical with the exposure of Cretaceous limestone south of the mill uncovered by Stensån.

HERMELIN contributed towards the knowledge of the Vestergötland Cambro-Silurian districts with »Rön och Försök, hörande til Mineral-Historien öfver Skaraborgs Län i Wästergötland» (Observations and Investigations relating to the Mineral History of Skaraborg County in Vestergötland) (1767), TORBERN BERGMAN² with »Anmärkningar om Vestgötha-Bergen» (Remarks on the Vestergötland Mountains) (1768), and W. HISINGER with »Minerographiska Anmärkningar öfver en del af Skaraborgs Län, i synnerhet Halle och Hunneberg» (Minerographical remarks on part of Skaraborg County, with special reference to Halle- and Hunneberg) (1797).

¹ Refers to »*Corallia baltica*» (cf. above, p. 35).

² In Vetenskapsakademiens Handlingar (1768) the spelling is BERGMANN.

The works mentioned are mainly of a stratigraphical-topographical nature. BERGMAN (op. cit., p. 330), however, also dwells a little upon the fossil contents of the alum-shales: »Around Hunneberg it [the alum-shale] is loosest, generally blackens the hands when it is touched, like black chalk. Some strata are full of sea creatures, others again are quite free of them. In this connexion it should be noted that the great *Entomolithus paradoxus*, which is described and drawn in Museum Tessinianum [LINNAEUS 1753], has been found in the shale quarry at Oltorp in the parish of Dimbo [cf. above, pp. 36, 41]. I have recently seen their equals in the geological collection of Count LAGERBERG, Provincial Governor» (translated from the Swedish).

In connexion with his journey in Vestergötland LINNÉ visited the shell-beds at Uddevalla in Bohuslän and (LINNAEUS 1747 a) dealt with their composition and indicated their marine origin. The paper in which OLAVUS BRUHN later (1764)¹ deals with the subject, gives but little information beyond LINNÉ's description. The discussion of different conceptions as to the origin of the fossils affords the greatest interest. BRUHN assumes that the shell-beds were formed during the Deluge, which caused the surface of the sea to rise. For him the authority of the Bible is unassailable, inasmuch as he thinks that the violent movements of the sea, which are the pre-condition for the accumulation of so much loose material, can only have occurred at the beginning of the Deluge, when the fountains of the deep were broken up, or at its finish, when Noah's ark rested on Mount Ararat; before that the ark had moved smoothly, and therefore, according to BRUHN, the shell-beds must have been formed at one or both of the times indicated.

On his retirement from the presidency of the Swedish Academy of Science DANIEL TILAS (miner and geologist, mentioned previously in another connexion, p. 2) held a speech on 6th February 1765 entitled »Utkast til Sveriges Mineral-Historia» (A sketch of the Mineral History of Sweden) (reprinted in the same year), and then gave the first survey of the regional geology of Sweden. The work was intended chiefly as an inventory of the supplies of minerals, ores, and species of rocks of the Swedish provinces. However, there is also information about sedimentary rocks:

»Two stratified and fairly extensive limestone tracts occur in Närke. I was compelled to create a new name for this species of limestone and call it 'Flokalk'², and understand by that name all such as is quarried in horizontal layers and rocks and generally bears larger or smaller quantities of fossils or clear traces of the occurrence of a flood. To such a species or 'Flokalk' I thus assign, not only the one mentioned, but those from Rättvik, Vreta Kloster Parish in Östergötland, and especially the one from Öland» (op. cit., p. 19; translated from the Swedish).³

In the Proceedings of the Academy of Science (1740) TILAS published a geological-stratigraphical detail study, »Mineral-Historia Öfwer Osmunds-Berget uti Rättviks

¹ Professor J. NORDSTRÖM, Uppsala, (in litt.) kindly drew the attention of the present writer to this work.

² »Floar» are defined by BERGMAN (1766, p. 90) as »varv» — »som ligga ungefärligen vågrätt eller åtminstone icke märkeligen stupa. Hit höra således bergsmäns sväfvande gångar och för öfrigt alt, hvad hos dem heter Flötser. När en flo kan delas uti flera mindre, dock alla af samma ämne, kallar jag dessa tunnare varf Lager» («strata — — which lie approximately horizontally or at least do not dip noticeably. Thus this includes the miner's horizontal dykes, and for the rest all that among them is called seams. When a »flo» can be divided up into several smaller ones, but all of the same substance, I call these thinner strata 'layers'»).

Approximately the same definition is repeated in the second edition (BERGMAN 1773, p. 198).

³ »Tvenne flolägrige och tämligen vidsträckte Kalkstens-tracter förefalla i Nerike. Jag nödgas åt denna Kalkstens-art skapa et nytt namn, och kalla honom för Flokalk, samt begriper under det namnet sådane, som brytas i liggande hvarf och hallar, samt gemenligen föra mer eller mindre

Sochn och Öster-Dalarnes» (A mineralogical description of Mount Osmundsberg in the parish of Rättvik in Eastern Dalecarlia). In it are described stratum by stratum the shale and limestone beds which build up »slope and precipice» (Swedish: »backa och brant») (TILAS 1740 a, p. 202) accompanied by a coloured profile drawing. Special attention is devoted to the occurrence of petroleum within certain parts of the series of strata. The following fossils are reproduced as figs. 18—22 in TILAS's Tab. II: a cross-section of a cystoid (*Echinosphaerites*) a longitudinal section of a tabulate or heliolitid coral, a brachiopod (*Camarella* sp. ?), a fragment of a stalk of a pelmatozoan (all from Osmundsberget) and a free cheek of a trinucleid, probably *Tretaspis seticornis* (HISINGER) (from Gulleråsen). The following note is attached to the last-mentioned fossil:

»Notwithstanding that it has been difficult to examine in detail the few specimens and the small figures, nevertheless the thought has occurred to me that they are some species of small anthraconite stars, such as are usually found in the alum-shales» (op. cit., p. 208; translated from the Swedish).¹

As noticed by ZENZÉN (THORSLUND 1947, p. 138), the strata referred to by TILAS as »valklera» (fuller's earth) are bentonite beds (TILAS's layer 11).²

TILAS made extensive journeys in the Swedish-Norwegian high mountain districts, some years as a member of the boundary commission. Hardly any of the geological observations made in that connexion were published, however. In a number of works (1925, 1927, 1930 b, 1931, etc.) ZENZÉN throws light on TILAS's activities and publishes extracts from his manuscripts; TILAS importance as a pioneer for geological map-drawing should be especially noted. His best known work is perhaps »Tanckar om Malmletande i anledning af löse gråstenar» (Ideas of ore prospecting guided by erratic boulders) (TILAS 1740 b; cf. ØDUM 1945). In this connexion it is perhaps worthy of attention that, as early as in 1780, in the investigation of erratic boulders in the drift of North Germany J. CHR. FUCHS understood how, with the guidance of the lithological character and the fossil contents of the blocks, to locate their mother rock in Sweden, whence they were said to have been transported to their find-spots by the flooding of the Baltic. It may be appropriate to recall here that some years later (1784) a research worker of Swedish extraction, JOHAN JAKOB FERBER, son of the previously mentioned FERBER, apothecary at Karlskrona (p.

petrificationer eller tydliga spår til en flods händelse. Til sådan art eller Flokalk hänföer jag altså ej mindre den nämde, än den ifrån Rättvik, Wreta Klosters Soken i Östergötland, och särdeles den ifrån Öland.)

¹ »Ehuru swårt jag för de få stufferne och de små figurernes skuld haft, at noga ransaka dem, så har jag likwist blifwit brakt på den tankan, at det wore någon art of små orstens stienor, sådana som pläga följa alunhaltige skiffrar åt.»

² The occurrence of bentonite beds in the Swedish Ordovician — Silurian sequence has not been realized until quite recently. As we have seen, this kind of rock was yet observed as early as in 1740 by TILAS, whose description of its properties is fairly adequate. It seems to be reason to believe that the Middle Ordovician bentonite at Fågelsång in Scania was also paid attention to by geologists of the 18th century, as appears from the following quotation from RETZIUS (1776, p. 77): »Stenmürg eller Lera, som under smältning förhåller sig lika med Zeoliten, är mig vetterligen endast funnen af Hr Auscultanten J. A. GYLLENHAHL, vid Fogelsång, 3/4 mil från Lund; men icke til någon myckenhet. Den utgjorde et hvar af 1/4 tums tjocklek imellan de andre lerbäddarna i branten af backarne vid bäcken och är perlfärgad» [»Stone-marl (the direct translation of the Swedish word would be »stone-marrow») or Clay, which during melting reacts in the same way as the zeolite, has been found — as far as I know — only by Mr. J. A. GYLLENHAHL, Auditor [at the Council of Mines], at Fågelsång three quarters of a mile [old Swedish] from Lund; but not in any quantities. It formed a layer, one quarter of an inch in thickness, between the other clay beds in the precipice of the hillocks at the rivulet, and is pearl-coloured»].

21), and finally member of the Prussian Council of Mines, constituted himself the interpreter of the conception that the numerous blocks of granite and other kinds of rock which are found scattered over Kurland, had possibly been carried there by drift-ice from Sweden. In view of this expression of opinion FERBER appears as an early advocate of the »iceberg theory», which is usually ascribed to CHARLES LYELL (cf. DOSS 1901, HUCKE 1940, and ØDUM 1945).

Among TILAS's unpublished manuscripts there is one from the beginning of the 1740's dealing with »Jemtlands Känning» (The knowledge of Jemtland). On the other hand, a geological description of the province mentioned was published in 1763 by the previously mentioned celebrated mineralogist CRONSTEDT. This work, »Rön och Anmärkingar vid Jämtlands Mineral Historia» (Observations and notes on the Mineral History of Jemtland), also contains some information about the distribution and stratigraphy of the sedimentary rocks. One extract may be cited here:

»In Offerdal, just below the vicarage, the rock consists of a black and white dense limestone, irregularly mixed with corals and shells, the latter being white and having a pleasing appearance against the dark background [= Pentamerus limestone].» — — »Farther down in the parish by Enge bridge the same limestone is less full of petrifications and mostly black with white veins and fissure fillings [Swedish: »drummer»] running through. There, too, it has thick beds, so that large blocks of it can be obtained whenever it is used. By Rödö Sound many loose, well worn and rounded stones lie knocked off; but through the parishes of Näskott and Rödö there are no such rocks, but alum-shale in small steep and usually earth-covered hillocks, the shape of which is due to the disturbances to which the layers have been subjected, presumably when Lake Storsjön came into being.

On Frösön, and still more in the parish of Brunflo, is found limestone of the dense variety, grey or reddish brown in colour, which is called 'Alvarsten' (lapis calcareus, *particulis impalpabilibus, cinereus rubescens*). As usual it is in thick beds lying horizontally. Against the joints fossils have accumulated, mostly Orthoceratites, and this rock is said to extend up to the parish of Lit.

In Lockne the limestone was dark grey and white-veined without fossils, and there was also a blackish-grey hard kind of sandstone in shaly beds, which in the district is called 'Lofter sten' [loftarsten], and is famed for its resistance to fire and water, although a little lime was mixed in its matrix.

In the parish of Näs and on the shores of Lake Näckten stuck out layers of a strange species of rock containing alum, which, as it breaks up into wedge-shaped pieces with shining surfaces, was considered to be coal. Among them are seen a little of the dry alum-shale, black stinkstone, and the usual balls, which consist either of pyrite or liver-stone [limestone] with shells in it». — — »Thus all the rocks found in the country between Offerdal Church and across the parish of Näs are of the same species as those usually found together in other parts of the Kingdom, such as on Öland, in Scania, Östergötland and Vestergötland, Närke, and Rättvik in Dalecarlia, though with some differences in colour and texture, by which Jemtland retains its special character; but probably has its counterparts in the world even in these respects.

As long as one has not had an opportunity to see clearly several kinds above and below each other, one cannot say whether they were created at one time and in one way; for it is easily understood that in such places as now prove to be layers of

stone which contain fossils and consequently are the product of [recent] time (Swedish: 'tidens foster')¹, there were formerly mountains of greater age, and that the latter either were too high to become covered, or in more recent destructions have again become exposed, as they have nothing more in common with the former than, speaking figuratively, ice has with stones and rock-faces in a frozen lake. In Jemtland there is no profile which exhibits layers of several kinds on each other, not even of those which appear to be identical with each other, limestone and alum-shales; but the former seem to appear at higher levels than the latter» (CRONSTEDT 1763, pp. 281—283; translated from the Swedish).

In 1790 W. HISINGER published anonymously his »Samling til en Minerographie öfver Sverige» (Materials for a Minerographical description of Sweden). In the introduction the formation of the sedimentary rocks in south and central Sweden is sketched in broad outline:

»Sedimentary rocks on the Flat country, solitary, or on the slopes of primitive rock, are still more numerous and have a more regular position. A great part of Närke is covered with sedimentary rocks. The sandstone bed which is the lowest, and has — on account of the rock bitumen and culm concretions mixed in it — given occasion for a search for coal with drills at Nasta near Örebro; Alum and bituminous shale constitute the second layer, and horizontally bedded limestone the uppermost one. In Östergötland there is a considerable sedimentary rock district which includes the plain between Lakes Vetter and Roxen, of an underlying layer of sandstone, above which is alum-shale and horizontally bedded limestone, and also breccia [i. e. conglomerate] on several islands in Lake Vetter and on its shores round Grenna.

In Vestergötland by Lake Vener and around Falköping, where the order of the strata is sandstone undermost resting on granite; above that horizontally bedded limestone, clay-shale and marl-shale, and uppermost the highest peaks of Kinnekulle, Hunneberg and Halleberg, Mösseberg and Älleberg, etc., which consist of thick beds of trap-rock. In the same province and the parish of Lugnås there is a small seam consisting of two layers, sandstone and alum-shale, of which the first rests on a weathered granite.

Scania is largely covered with sedimentary rocks, both in the centre of the province and on its east and west sides. Apart from those bearing coal at Helsingborg, of sandstone, iron-clay and clay-shale, there is a large sedimentary rock district in the eastern part of the province of fairly hard, ice-grey and quartzitic sandstone, which contains fluorit and galena², partly covered by alum-shale and black bedded limestone. In the Frosta and Bjäre districts beds of sandstone and coarse breccia [i. e. conglomerate] are met with. In Färs district of pinkish sandstone and grey dense limestone with a great number of fossils. On the south-west shore of Malmö of stratified petrified coarse chalk. At Ignaberga, Balsberg, and Båstad thick beds of shell-fragment limestone etc.

¹ This line of thought was adopted by TORBERN BERGMAN (1766, p. 145): »all the kinds of rock which contain or constitute the substance of the petrifications are the product of the time [Swedish: 'tidens foster'], and thus could still be generated daily» (translated from the Swedish). Obviously BERGMAN was aware of CRONSTEDT's paper, as also appears from a note on p. 81.

² These and other mineral occurrences in the Lower Cambrian sandstone of the Simrishamn district have been known for a long time (exploratory working for galena was made already towards the end of the 17th century). They are mentioned e. g. by MALMSTRÖM (1776, p. 41) and are closely described by GEIJER (1786, pp. 34—45).

Gotland and Öland are covered with sandstone, alum-shale, and bedded limestone» (HISINGER 1790, pp. 25—26; translated from the Swedish).¹

The geologist of today can orientate himself without difficulty in the picture drawn by HISINGER and need not hesitate as to which formations are referred to.

This »Minerographie» was the first of the long series of works which HISINGER devoted to the topography, regional geology, stratigraphy, and palaeontology of Sweden. One paper has already been mentioned in an earlier connexion (p. 13, foot-note 2). In 1799 appeared »Minerographiske anmärkningar öfver Gottland» (Minerographical notes on Gotland), containing topographical, stratigraphical, lithological, and palaeontological observations. At the end of the paper is given a list of »petrified Shell Creatures and Animal Plants», mainly comprising corals. Further, inter alia, a short description is given of »*Anomia hysterita*», i. e. *Conchidium biloculare* (LINNÉ).

The largest and most considerable of HISINGER's works was written during the 19th century. With him we enter the portals of the new century. Before us wait WAHLENBERG, DALMAN, SVEN NILSSON, SVEN LOVÉN, and ANGELIN, ready to take over and carry on the heritage from those who laid the foundation of palaeontological and historical geological research in Sweden.

12. Biographical index

(Where not otherwise indicated, the nationality is Swedish).

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¹ »Flötzer på Slättlanden, enstakade, eller vid slutningarne af uråldrige berg, äro ännu flere och hafva ordenteligare läge. En stor del af Nerike är betäckt med Flötzer. Sandstens hvarfvet som är det understa, har af inblandat Bergbeck och Kolm gifvit anledning till Stenkols eftersökande med jordbör på Nasta ägor vid Örebro; Alun och Brandskiffer utgör andra hvarfvet och Flokalk det öfversta. Uti Östergötland är en ansenlig flotrackt, som intager slätten imellan Sjöarne Wettern och Roxen, af ett underliggande Sandstens-hvarf, hvaröfver Alunskiffer och Flokalk, samt dessutom Breccia på åtskilliga öar i Wettern och vid dess stränder kring Grenna.

I Västergötland vid Wenern och omkring Fahlköping, där hvarfvens ordning är underst Sandsten, som hvilat på Granit; deröfver Flo-kalk, Ler- och Mergel-skiffer, och öfverst de högste toppar af Kinnekulle, Hunne och Halleberg, Mösse och Olleberg, m. fl., som bestå af mäktige hvarf Flo-trapp. I samma landskap och Lugnäs Sockn, finnes en liten Flötzt, bestående af tvenne hvarf, Sandsten och Alun-skiffer, hvaraf det första hvilat på en vittrad Granit.

Skåne är til stor del, så väl mitt uti landet, som vid dess Östre och Vestra sida betäckt af Flötzer. Utom de Stenkols förande vid Helsingborg af Sandsten, Jern-leror och Lerskiffer, märkes en stor flötstrakt på Östra delen af landet, af ganska hård, isgrå och kvartsig Sandsten, som förer flusspat och blyglants, till en del betäckt af Alun-skiffer och svart Flokalk. I Frosta och Biära Härad förekomma flötser af Sandsten och grof Breccia. I Färs Härad, af rödlet Sandsten och grå tät Flokalk med en myckenhet petrificater. Vid Malmös S. V. strand af flolägrig förstenad grof Krita. Vid Egnaberga, Balsberg och Båtsta mäktige bäddar af Skölp-grus m. m.

Gotland och Öland äro betäkte med Sandsten, Alun-skiffer och Flokalk.»

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LIONARDO DA VINCI (1452—1519), Italian artist, polyhistorian	2
LOTHICIUS, JOHANNES PETRUS (1598—after 1652), German doctor and historian.....	10
LOUBÈRE, SIMON DE LA (1642—1729), French mathematician and diplomat.....	5
LOVÉN, SVEN LUDVIG (1809—95), zoologist, Professor at the State Museum of Natural History in Stockholm.....	56
LUDENIUS (LUDEEN) (WESTROGOTHIAE), JACOB(US) (17th century—18th century), doctor	11
LYELL, CHARLES (1797—1875), English geologist.....	54
MAGNUS, OLAUS (1490—1557), Dean at Strängnäs, appointed Archbishop by the Pope (never held office, as Protestantism was introduced).....	9, 21
MALMSTRÖM, MICHAEL C:SON (1732?—95), Inspector of the Andrarum alum-works....	50, 55
MERIAN, MATTHAEUS (1593—1661), Engravor on copper, of Swiss birth.....	10
MODER, ADOLPH (1739—99), Land-surveyor.....	4, 23, 41—47, 49
MOLL, KARL EHRENBERT VON (1760—1838), German geologist.....	45
NILSSON, SVEN (1787—1883), Professor of Natural History at Lund, archaeologist.....	56
D'ORBIGNY, ALCIDE CHARLES VICTOR DESSALINES (1802—57), French palaeontologist and geologist	45
ÖSTERPLAN, BENEDICTUS ANDREAS (died 1713), Teacher at Skara, clergyman.....	39
PALISSY, BERNARD (about 1510—90), French ceramist and natural scientist.....	5
PEYSSONNEL, JEAN-ANTOINE DE (1694—?), French doctor and natural scientist	49
PLINY the Elder (23—79), Roman polymath.....	9
POLHEM (before ennoblement POLHAMMAR), CHRISTOPHER (1661—1751), mechanical engineer, inventor, Counsellor of the Board of Trade.....	9
RAY (RAJUS), JOHN (1628—1705), English naturalist.....	4
RETZIUS, ANDERS JAHAN (1742—1821), Professor of Natural History at Lund	16, 47, 50—51, 53
RISTORO D'AREZZO (CECCO D'ASCOLI, 1257—1327), Italian cosmographer	2
ROBERG, LARS (1664—1742), Professor of Anatomy and Practical Medicine at Uppsala	10, 11, 13—14
ROBINSON, TANCRED (Englishman, no biographical data available)	5, 6
SMITH, WILLIAM (1769—1839), English geologist.....	8

SOLDANI, AMBROSIO (1733—1808), Italian, General in an Italian order, naturalist	45
SPÖRING, HERMAN DIEDRICH (1701—47), Professor of Medicine at Åbo	39
STENO, NICOLAUS (STENSEN, NIELS) (1638—86), Danish naturalist and doctor	6, 7
STOBAEUS, KILIAN, the Elder (1690—1742), doctor, Archiater, Professor of History at Lund	
	2, 16, 24, 28—31, 32
SWEDBERG, PETER, the Younger (1685—1731), Auditor at the Council of Mines, later Director	
of the Stegeberg lead-works	38
SWEDENBORG (before ennoblement SVEDBERG), EMANUEL (1688—1772), Assessor of the	
Council of Mines, naturalist	8, 9, 11—13, 23, 50
TATISCHOW (TATICHEW), BASILI (VASILIJ) NIKITICH (1686—1750), Russian member of the	
Council of Mines, historian	10
THOMSEN, CHRISTIAN JÜRGENSEN (1788—1865), Danish archaeologist	8
TILAS, DANIEL (1712—72), Member of the Council of Mines, King-at-arms	2—3, 9, 52—54
VOLTAIRE, FRANÇOIS MARIE (AROUET) DE (1694—1778), French author	6
WAHLENBERG, GÖRAN (1780—1851), Professor of Medicine and Botany at Uppsala	6, 13, 34, 46, 56
WALLERIUS, JOHAN GOTTSCHALK (1709—85), Professor of Chemistry, Metallurgy, and	
Pharmacy at Uppsala	2, 9, 33, 47—49
WALLMARK, JOHAN (1728—1802), Building engineer	32
WARGENTIN, PER WILHELM (1717—83), Statistician and astronomer	32
WERNER, ABRAHAM GOTTLÖB (1749—1817), German geologist and mineralogist	13
WORMIUS, OLAUS (WORM, OLE) (1588—1654), Danish doctor, archaeologist, and collector	23, 24
XENOPHANES (about 565—after 473 B. C.), Greek philosopher	2
ZIERVOGEL, FREDRIK (1727—92), Court apothecary in Stockholm	34

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Sparse references only have been made to the biographical literature consulted by the present writer. Biographies of members of the Swedish Academy of Science are as a rule to be found in the publications of that Society. For references, see **Dahlgren** 1915.

Addendum

Too late to be referred to in the text the author became aware of a paper by K. A. GRÖNWALL, 1916 (Om ett förmodat mammutfynd vid Falkenberg från 1700-talet. — Geol. Fören. Förh. **38**. Stockholm), in which is shown, definitely as it seems, that the bones found at Falkenberg and described in 1740 by DÖBELN (cf. p. 11 above) did not belong to a mammoth but to a whale.

Tryckt den 20 maj 1949

Uppsala 1949. Almqvist & Wiksells Boktryckeri AB