

## Contributions to the Literature on Erratic Boulders.

By

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Most scientists are of course interested in the history of their science and — as a matter of fact — every paper or lecture on any branch of science commences with a historic introduction to the problems in question. If this historic introduction is extensive it is frequently seen that the author includes even rather old authors, if these have but merely happened to mention the phenomena under discussion. This is also the case in quarternary geology in general as well as the geology of erratic boulders.

From a scientific point of view this form of "history" is often rather unsatisfying. It is a well-known fact that great stones and boulders are mentioned—or made the subject of a more thorough discussion—by authors of the mediæval and the following centuries. The Danish historian SAXO GRAMMATICUS, f. i., deals with the huge stones of mesolithic buildings as far back as about 1200 A. D., but merely with the view-point that these huge blocks are brought about by "giants" in former times (HUCKE l. c.). Such discussions, referring in reality only to the folk-lore, are, of course, not to be looked upon as contributions to geology, no matter how interesting they may be. Of primary importance to a modern geologist must be whether the old authors have seen the problems from the right point of view, that is: have they seen the phenomena in relation to their surroundings and described the problems in adequate terms? — even in the case where they have been unable to solve the problems. In many cases the conscious omission of the solution of the problem is more scientific than many frustrated "explanations".

This paper is not meant to give a full account of the history of the study of erratic boulders; but I should like—just from the motive here explained—to draw the attention to a few authors of the 18<sup>th</sup> century on my subject.

In 1740 the Swedish mining inspector DANIEL TILAS published a paper comprising 4 pages: "Tanckar om Malmletande i Anledning

af löse Gråstenar" (On Ore Prospecting by Means of Loose Stones). Here he emphasizes the importance for the prospector to observe not only the solid rock but also the loose stones on the surface. If the loose stones show traces of ore they may often indicate that ore may be found somewhere in the neighbourhood,—even in case that the solid rock immediately beneath the surface is of another nature than the loose blocks<sup>1</sup>).

And now—as an example—TILAS proceeds:

„Hela tracten kring Åbo stad, Nådendahl, Lundo, Masko, Nausis, Lemo, ja och Wirno soknar består af enahanda bergslag, Nemligen: En fingrymig mörek gråsten af jemn blanding/ hwaruti ouphörligen stryka gångar/ rändar och körtlar til åtskillig mäktighet/ bestående af rödaktig/ hård och grof Feldtspat. I begge desse slagen wisa sig föränderligt små odugelige *granater*, Men i Feltspatsgångerna såsom besynnerligt och hålst kring Åbo, ser man som oftast en rik swart grofögd gläntsande Jernmalm/ som likwäl faller körtelwis/ och fortfar ej i något strykande. Uppå åtskillige ställen i denne tract, men serdeles en bar bergsträckning utan före Anigais Tullen i Åbo, Polota Bergen kallade, finner man store löse jordstenar, af et helt främmande stenslag, til en Mannastyrckan widt öfwerträffande storlek. De bestå af en stenart, som i Finland för *Rapakivi* eller sielf-frätsten nämnes/ och är sammansat af groftärnig hård/ röd- och brunachtig Fält spat/ samt små qwarts Korn/ och emellan spat tärningarne en swart fet skimmer. Denne stenarts beskaffenhet är, 1 at han såsom mäsk sönderfaller, särdeles emot Middags Solen, der man hela stenen med blotta händerne sönderriffwa kan, warandes ordsaken til sådan förwittring den ojämnne blandingen af de tre Hufwudslagen, Spat, Qwarts och skimmer. 2 De fine saltparticlar som i spatén finnas, och igenom regn och snö, samt påliggande heta Middags sol vplösas, och för det 3 Den swarte skimmern, som medelst sin fetma mera uplöser än tilsammanbinder; hafwandes jag äfwen i akt tagit, at denne skimmer warit med en blyertzaktig hinna öfwerdragen, ja ibland ren och skönjelig blyerts, som likt swafwelkies rostar och wittrar sönder.

Jag kunde i början intet finna, hwadan desse *Rapakivi* stenar

<sup>1</sup> He seems to have touched the same problem already in another paper in 1738, published in Åbo, Finland: „En Bergmans rön och försök i Mineral Riket“ (A Miners Experiences and Experiments in the Mineral Kingdom). — Experiences of this kind seem to have been more or less known to prospectors of that time. TILAS himself refers to RÖSSLER (Bergbauspiegel, 1. Book, chapter 28, page 29–30).

woro komna, ej heller någorstädes derikring något deråt liknande Bergslag. Omsider kom jag at resa NW. ut ifrån Åbo stad, igenom Wirmo och Letala soknar åt Nystad, då, ju längre jag kom ifrån Åbo, ju oftare förekom *Rapakiwi* arten i de lösa stenarne, särdeles emellan Wirmo och Letala kyrkor. Änteligen träffade jag sjelwa *Rapakiwi* Bergslaget igen i fasta bergen å hela tracten emellan Nystad, Nykörka och Letala kyrkor, alt up til Hinnerjocki Capell.

Sedan jag detta någorlunda utrönt, fant jag ej allenast dessa *Rapakiwi* utkasten wara skedde emot SO. och likasom hade dessa utkast warit sådde, liggandes när in til sit bergslag tätare, men längre ifrån glesare kringspidde, och det uppå 4. til 5. Mils längd, utan ock, at enär *Rapakiwi* Bergslaget til  $1\frac{1}{2}$  mil, på norra sidan om Hinnerjocki Capell emot Eura kyreka lyktar, så ser man sedan å de derintil stötande Bergshällar, som äro af en hel annan samman-sättning, altsinge eller och ganska få *Rapakiwi* utkast. — — —

När darföre enom några Mineraliska utkast förefalle, så måste man af des Bergart och stenslags igenkännande söka at utreda, ifrån hwad wäderstrek de löse jordstenarne på den orten måge ware komne, hwilket ej lika allestädes är, dock gissnings wis torde här i Norden inträffa ifrån de med och emellen NW och NO kommande wäderstrek, likwäl at då tages i akt, belägenheten af när intil liggande Hafswikar och store insjöar, som kunnat göre en liten förändring. Hinnar man då at utreda wäderstrek, så kan det icke fela, at man ju råkar på bergslaget, skönt skulle det på flera mils väg räcka, och sluteligen i följe deraf, äfwenledes fulfölja den Mineraliske tracten" (l. c. p. 192-193).

(The whole district around the city of Åbo and the parishes Nådendahl, Lundo, Masko, Nausis, Lehmo and Wirmo consists of one sort of rock: a fine-grained, dark, eruptive, rather homogenous rock, in which occur a lot of dikes and other inclusions, consisting of a reddish, hard and coarse feldspar. In both rocks may be found small and unusable *garnets*. But in the feldspar dikes, esp. around Åbo, you will often see a black, coarsegrained, lustrous iron ore, breaking up in nodules and not attaining the form of veins. In several localities in this district, esp. some bare rocks outside the Anigais customs house in Åbo, the Polota Mountains, are found great, loose stones, of quite a foreign rock, far bigger than a man. This rock which in Finland is called *Rapakivi*, i. e. "Self-mouldering rock", and which is composed of coarse-grained, hard, reddish and brownish feldspar, together with small quartz grains, and between the feldspars

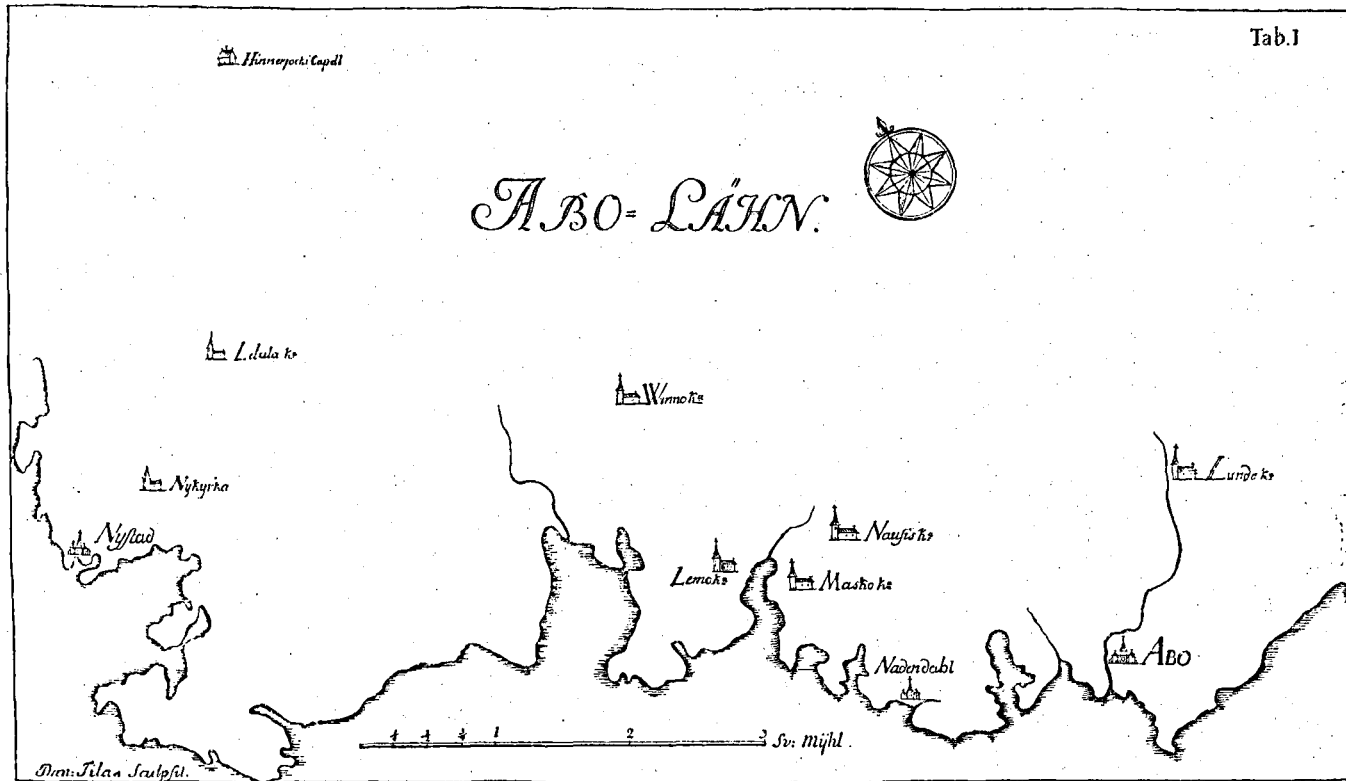
a black, soft mica. The characteristics of this rock is, 1) that it disintegrates as grains, particularly when exposed to the sun where you can break the rock apart with your bare hands, because the three main components, feldspar, quartz and mica, are mixed so irregularly together; 2) the fine salt particles in the feldspar, which are dissolved through the effect of rain, snow and the heat of the sun, and 3) the black mica, which because of its softness dissolves more than it binds together; furthermore I have observed that this mica can be coated with a film like lead ore, yes, at times pure and distinct galena which rusts and decomposes like pyrite.

At first I was unable to find out how these *Rapakivi* Stones had come, nor could I find any solid rock of this kind. Later on I happened to travel NW out from Åbo, through the parishes of Wirmo and Letala in the direction of Nystad, and I noticed that the farther I came from Åbo the more frequently occurred the *Rapakivi* among the loose stones, especially between the churches of Wirmo and Letala. At last I found the *Rapakivi* rock itself in the solid rock in the whole district between Nystad, Nykörka and Letala churches, as far as to Hinnerjocki chapel.

Having somehow discovered this I found not only that these *Rapakivi* ejections had taken place in the direction towards SE, almost "sown" in such a way that they lay most densely close to the source rock and more sparsely farther away, up to 4-5 miles; but furthermore that when the *Rapakivi* rock ends, 1½ miles North of Hinnerjocki Chapel, towards Eura Church, only a very few *Rapakivi* ejections (or none at all) were to be seen on the bare rocks of that district. — — —

So it may be concluded that when Mineral-ejections occur, one must from the rock and its identification try to find out from what quarter the loose stones of that district may have come; this is not the same everywhere, but here in the North it must be supposed to be from those directions lying between NW and NE (also it must be borne in mind that fjords and lakes may have caused a small change of the direction). Once the direction has been found out, then there is no doubt that you will succeed in finding the original rock, even if you have to trace the minerals ejected for several miles).

The same topic is briefly touched by TILAS in another treatise of the same year: "Mineral Historia öfwer Osmundsberget uti Rätt-



DANIEL TILAS: Map of the Åbo District. 1740.

wiks Sochen och Öster-Dalarne" (Mineral History of the Osmund Mountain in the Parish of Rättvik and E. Dalarne), and more thoroughly dealt with again, in 1742, in a lecture "Stenrikets Historia" (History of the Mineral Kingdom). Here the many loose boulders found everywhere in Scandinavia are referred to The Flood, the greater stones perhaps having been transported by means of floating ice from the polar regions ("De större stenar torde ock med mycken Drefis ifrån Polerna blifwit forthulpne och bortflyttade").

In 1745 CARL LINNÆUS describes a very great boulder of Rapakivi ("Själfrätsten") resting upon the silurian limestone on the Isle of Gotland, at Hoburg (l. c. page 262). LINNÆUS is well aware that this stone is foreign to the landscape of Gotland (he compares it to the rocks of Åland), and wonders how "the waters" have been able to transport it from Sweden or Russia. Nevertheless LINNÆUS does not go deeper into the problem.

The theme is taken up again 1759 by the Dane SØREN ABILDGAARD. ABILDGAARD describes the cretaceous chalks of Stevns Klint with the superposed strata of boulder-bearing moraine; and this gives him occasion to speculate over the effect of the transportation or dislocation of stones during The Flood. His reflections on this are of the same quality as those of other authors of the century, but finally—after referring to TILAS and LINNÆUS—he gives his own observations from Russia (l. c. page 50):

"Paa Vejen fra St. Petersborg, nogle Miile hen imod og noget paa hin Side Narva har jeg antroffen hist og her paa Marken adskillige store og smaa Stykker Siælv-Frætsteen, eller Fæltspat-Art af selv samme Slags, som den Finniske *Rapakivi*, saa og forefandtes paa adskillige Strækninger megen brunn-rødagtig Sand, som syntes at have sin Oprindelse af denne Steen-Art, da dog dette temmelig jevne og slette Land ikke, saa langt man kunde see, paa mange Miile viiste noget Bierg, ikke heller nogen saadan Steen-Grund, hvorfra disse løse Siælv-Frætsteene og Sand kunde have sit Udspring. Thi Grunden bestaaer nesten over alt i denne Strækning af en skivrig Kalksteen, hvorudi jeg forefandt steenhærdnede Snegle-Huuse og andre *petrefacta*. Mon nu bemældte Siælv-Frætsteene og Sand er ved nogen Naturens voldsom Virkning did henvførte over den Finniske Bugt fra Finland, som ligger

paa hin Side lige over for, hvor adskillige store Strækninger bestaaer deals af heele, deals af synderbrudte Bierge af samme Steen-Art?"

Disse mine Tanker tillige med denne ganske Afhandling underkaster jeg nu andres grundigere Indsigt, hvis Ædelmodighed vil undskylde mig i de Tilfælde hvor jeg kand have taget Fejl, eller ikke i alle Maader i Agt taget, hvad jeg burde".

(On the route from St. Petersburg, several miles on both sides of Narva, I have here and there in the fields found several great and small pieces of "Self-mouldering Stone" or feldspar of the same kind as the Finnish *Rapakivi*; and in several places also was found much reddish-brown Sand which seems to have its origin in this same rock, insofar as this rather flat country—as far as one could see—mile after mile displayed no mountain nor any such basement rock from which these loose »Self-mouldering Stones« and sand could have its source. The substratum consists almost everywhere in this country of a slaty limestone in which I found petrified snails and other petrefacts. I wonder if this "Self-mouldering Stone" and sand can, by any violent effect of Nature, have been brought to this place across the Finnish Bay from Finland which lies just opposite, and where several great stretches consist of either solid or disintegrated mountains of this same rock?

These my thoughts together with this whole treatise I now submit the more thorough insight of others, whose nobility will excuse me in those cases where I may have been wrong, and have not into consideration taken all I should).

So far *TILAS* and *ABILDGAARD*. — That which impresses one about these two authors is not so much their speculations or explanations in the style of their time as it is their clear observations. They have not only noticed the many erratic boulders, but they have in fact "determined" them and traced them back to their origin from solid rocks, — and clearly defined their directions of transport by some unknown power of Nature. The problems of modern studies on erratic boulders are exactly circumscribed. — Furthermore it will be seen that the later "Drift-theory" is clearly anticipated by *TILAS* in 1742. *TILAS* touches upon the topic once more in 1765 but without adding anything essential.

The rest of the story is told by others. VON AUERSWALD traces boulders from N. Germany back to Sweden in 1774 (HUCKE l. c. page 48), and in 1784 JOHAN JACOB FERBER explains the occurrence of erratic boulders in Kurland by assuming that they have been transported with driftice floes from Sweden or directly from the North. In the following years the Drift-theory is fully evolved (L. v. BUCH, SEFSTRÖM, LYELL a. o.),—and subsequently replaced by the Glaciertheory (JOHN PLAYFAIR, VENETZ, ESMARCH, CHARPENTIER, AGASSIZ a. s. o.).

As to FERBER I cannot but suspect that he must have been influenced by the Swedish authors, and possibly ABILDGAARD. FERBER was himself a Swede, born 1743 in Karlskrona, and a pupil of LINNÆUS, and it is improbable that he should not have been familiar with the works of LINNÆUS and the publications of THE ROYAL SWEDISH ACADEMY OF SCIENCE, where TILAS' treatises were printed.

I am obligated to my friend, GERHARD REGNELL PH. D., Lund, Sweden, for valuable suggestions and help.

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