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Did Goethe discover the ice age?

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(Contribution at a meeting of the International Commission on the History of the Geological Sciences (INHIGEO), Neuchâtel, 9–11 September 1998)

Key words: Ice age, Goethe

ABSTRACT

Jean Louis Agassiz and Jean de Charpentier confirmed in 1837 and 1841, respectively, that Johann Wolfgang von Goethe in his novel "Wilhelm Meisters Wanderjahre" had expressed in 1829 the theory that during a past epoch of grim cold rock masses were transported by ice into northern Germany and the forelands of the Alps. Goethe's idea was based on his and Johann Karl Wilhelm Voigt's discovery in 1780 of granite boulders in Thuringia and on records which he later received from several informants on crystalline rocks from Scandinavia, widely distributed in Northern Germany, and granite boulders from the Central Alps at the shore of the Lake of Geneva.

ZUSAMMENFASSUNG

Jean Louis Agassiz (1837) und Jean de Charpentier (1841) bestätigten, dass Johann Wolfgang von Goethe 1829 in seinem Roman «Wilhelm Meisters Wanderjahre» die Theorie ausgesprochen hatte, dass während einer früheren Epoche grimmiger Kälte Gesteinsmassen durch Eis in das nördliche Deutschland und in das Alpenvorland transportiert worden seien. Goethes Idee beruhte auf das von ihm mit Johann Karl Wilhelm Voigt 1780 beobachtete Vorkommen von Granitblöcken in Thüringen und auf Nachrichten, die er später von Korrespondenten über die Verbreitung kristalliner Gesteine skandinavischen Ursprungs in Norddeutschland und über Granitblöcke aus den Zentralalpen am Genfer See erhielt.

Jean de Charpentier and Louis Agassiz, the founders of the theory of the ice age, credited to Goethe the idea that in a past epoch of great cold erratic blocks were transported by ice. They both referred to a paragraph in Goethe's "Wilhelm Meisters Wanderjahre", written in 1828 and published in 1829.

In the 9th Chapter of the 2nd Book of this novel miners and their guests assemble on a festival evening and discuss vehemently geologic hypotheses: several derive the present form of our earth from the gradual recession of the waters which covered the globe; others believe that fire which initially had heated and melted the surface of the earth had retreated into the depth from where it had nourished the volcanoes and built up the highest mountains, by ejecta and lava flows; still others maintain that large formations which were prepared in the depths of the earth had been extruded through the earth crust, by irresistible elastic forces; another party asserts that many features of the earth's surface were produced by masses fallen from the sky. A last small group pleads, finally, for ice as geologic agent:

Zuletzt wollten zwei oder drei stille Gäste sogar einen Zeitraum grimmiger Kälte zu Hilfe rufen und aus den höchsten

Gebirgszügen, auf weit in's Land hingesenkten Gletschern, gleichsam Rutschwege für schwere Ursteinmassen bereitet, und diese auf glatter Bahn, fern und ferner hinausgeschoben im Geiste sehen. Sie sollten sich, bei eintretender Epoche des Auftauens, niedersenken und für ewig in fremdem Boden liegen bleiben. Auch sollte sodann durch schwimmendes Treibeis der Transport ungeheurerer Felsblöcke von Norden her möglich werden. Diese guten Leute konnten jedoch mit ihrer etwas kühlen Betrachtung nicht durchdringen. Man hielt es ungleich naturgemäßer die Erschaffung einer Welt mit colossalem Krachen und Heben, mit wildem Toben und feurigem Schleudern vorgehen zu lassen. Da nun übrigens die Glut des Weines stark mit einwirkte, so hätte das herrliche Fest beinahe mit tödtlichen Händeln abgeschlossen.¹

Finally two or three quiet guests invoked a period of fierce cold, when glaciers descended from the highest mountain ranges far into the land, forming in effect slides for ponderous masses of primeval rock, which were propelled farther and farther over the glassy track. In the subsequent period of thaw, these rocks had sunk deep into the ground, to re-

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main forever locked in alien territory. In addition, the transport of huge blocks of stone from the north might have been made possible by moving ice floes. However, the somewhat cool views of these good people did not make much headway. The general opinion was that it was far more natural to have the world be created with colossal crashes and upheavals, wild raging and fiery catapulting. And since the heat of the vine was now adding its strong effect, the glorious celebration might almost have ended in fatal clashes.²

Louis Agassiz, in a paper³, presented on 24. July 1837 at the Société Helvétique des Sciences at Neuchâtel, says: "In respect to the theory of the ice-age, it can be found most clearly from Goethe what I learned later . . . Goethe alone unified all the indications into a definite theory". Jean de Charpentier in 1841 puts the first lines of this passage as motto in front of his book "Essay sur les glaciers"⁴ and writes with regard of the transport of rock debris in alpine valleys: "The genius of Goethe has recognized that ice must be the cause of this transport. I don't know when this great man has conceived this idea . . ."

What Agassiz and Charpentier admired as ingenious anticipation of a theory which they had developed and defended by empirical observations and arguments was not a poet's intuition but had a life-long background in Goethe's geologic studies.

I will follow this course of Goethe's observations and thinking on the basis of the Leopoldina Edition of Goethe's writings on natural sciences (LA) which contains his texts with commentaries in chronological order, drafts and notes from his literary remains and all letters and other documents, testifying Goethe's studies.

The story begins in 1780. Goethe, since five years in Weimar, is in charge of mining operations in Ilmenau where Karl August, Duke of Saxe-Weimar-Eisenach, wants to re-open an old copper and silver mine. Three years ago, the duke had sent, at his expense, Karl Johann Wilhelm Voigt to the Bergakademie at Freiberg with the intention that he should take over the technical management of the planned Ilmenau mine. At Voigt's return from Freiberg, 1780, Goethe instructs him with a written mandate, preserved in Goethe's remains (LA I 11, 1f.), to undertake a survey on rocks and minerals in the dukedom, along the principles of geognosy and oryctognosy which he had learned at Freiberg, especially from Abraham Gottlob Werner. Voigt delivers to Goethe a report on the results of excursions which he undertook during the summer of 1780, in part together with Goethe (LA II 7, 12-24). It turns out that all rocks in central Thuringia can be identified by means of the stratigraphic sequence, developed by Werner, except some exotic boulders of granite and other crystalline rocks at some localities in northern Thuringia (LA II 7, 18.25).

Goethe discusses with Voigt the origin of these rocks; the Thüringer Wald mountains would be a possible source, but an origin from the north appears more probable because the boulders were found only in the northern part of Thuringia.

Goethe assembles several pieces of these rocks in his private collection and lets install a huge granite boulder from the Mühl-valley near Jena in front of the Museum in this town. From a boulder at Münchholzhausen, west of Weimar, vessels are made and transferred to Weimar (LA I 11, 224).

Voigt publishes the results of his survey 1782 in his book „Mineralogische Reise durch das Herzogtum Weimar und Eisenach". Describing occurrences north of Weimar, he writes:

*In dem Dorfe Kleinbrennbach, auch nicht weit davon in Ramsla, liegen ungeheure Stücke Prophyry, Quarz, Granit und versteinert Holz, wovon ich zu wissen wünschte, durch was für Zufälle es dahin gekommen ist.*⁵

In the village Kleinbrennbach and not far from it, in Rams-la, there are very large pieces of porphyry, quartz, granite and lithified wood; I would like to know by which chances they came to that place.

Two years later, Voigt proposes in another book "Drei Briefe über die Gebirgslehre" a possible mechanism to transport the erratic boulders. He reports that fishermen had observed that rocks were moved on ice floes to the shore of a lake. He continues:

*. . . so wäre das Eis . . . ein Mittel, Steine und andere Lasten von einem Ufer eines Stromes oder Sees an das andere zu bringen. Es läßt sich daher auch gar wohl denken, daß als bey Abnahme des alten Meeres unsere Hügel nach und nach zu Sandbänken und Inseln heranwuchsen, auf eben diese Weise Stürme viel Eis mit inliegenden fremdartigen Steinen an dieselben getrieben haben können.*⁶

. . . in this way, ice could be an agent to transport rocks and other loads from one shore of a stream or lake to the other. It is, therefore, imaginable that when our hills grew slowly to sandbanks and islands, at the diminution of the old ocean, storms could have driven on them much ice containing foreign stones.

For the next 30 years, we find nothing on exotic boulders in Goethe's papers. In May 1816 Goethe writes an appendix to an article of his brother in law Christian August Vulpius on pre-historic stony axes, found in Thuringia. Dealing with their lithology, he says:

*Die drei Hauptstücke sind sämtlich fremde, bei uns nicht vorkommende Steinarten, sie haben vielmehr etwas von denen, die an den Ufern und Inseln der Ostsee zu Hause sind.*⁷

The three main pieces are all foreign kinds which do not occur with us, being rather similar to those which are at home on shores and islands of the Baltic Sea.

At his sojourn at Bad Tennstedt from July to September of the same year, Goethe collects, among other rocks, samples of granite and gneis from boulders at this locality in northwestern Thuringia.⁸

In 1819 Goethe becomes for the first time acquainted with specimens of the crystalline rocks which are widely distributed in northern Germany. His nephew Franz Nicolovius sends him, the 16th August 1819, a suite of rocks collected in the environment of Berlin, together with a comment by an unnamed friend who points out that it is a great riddle how these rocks originating from the far north were transported over so large distances. He says that he does not believe that they are remnants of former local mountain-ranges, because the underground of northern Germany is formed by younger sediments.⁹

Some months later, in April 1820, Goethe receives further informations on foreign rock boulders in northern Germany: Karl Anton von Preen, landowner in Mecklenburg, sends him samples of crystalline rocks from his country. In his accompanying letter von Preen calls the abundance of granite boulders in Mecklenburg and adjacent litorals of the Baltic Sea an extremely remarkable phenomenon and describes the Holy Dam (Heiliger Damm), an accumulation of crystalline gravel on the coast, near Doberan. He reports on observations which could explain the transport of boulders and gravel from the far north:

*Vor 6 Wochen sah man, wie die Zeitungen berichteten, den Sund mit ungeheuren, aus dem Norden kommenden, mit großen Granitblöcken übersäeten Eisschollen angefüllt.*¹⁰

Six weeks ago one observed, as journals reported, that the Baltic Sea was filled by giant ice floes coming from the north and studded with large granite boulders.

Goethe now realizes that both phenomena, foreign boulders in Thuringia and in the northern countries were caused by the same geologic event. Remembering the boulders, observed in Thuringia, he writes to von Preen the 18th April 1820:

Schwer zu entziffern möchte fürwahr dieses geologische Phänomen sein, welches wunderbar genug sich bis zu uns auf unsere Kalk-Flöze erstreckt. Bei Eckardsberga liegen Granitblöcke . . .

*Was die Wanderung der Granitblöcke betrifft, so will ich gestehen daß Bergrat Voigt zu Ilmenau schon vor vielen Jahren auf den Gedanken gekommen, oben erwähnte bei uns zerstreute Blöcke einem solchen Eistransport zuzuschreiben . . .*¹¹

Hard to decipher, indeed, might be this geologic phenomenon which extends, surprisingly, until our limestone beds. Granites lie at Eckertsberga . . .

I will confess that Bergrat Voigt at Ilmenau has had, many years ago, the idea to ascribe the boulders, disseminated in our country, to a transport by ice.

The 3rd September 1822 Goethe receives from Karl Ernst Adolf von Hoff his important book "Geschichte der durch Überlieferung nachgewiesenen Veränderungen der Erdoberfläche"¹². In January 1823 he writes a review on this book. Following von Hoff's report on the distribution of boulders in all countries around the Baltic Sea, Goethe describes the localities in Thuringia, shown in Fig. 1, where, forty years ago, he with Voigt had found granite blocks. In addition, Goethe enumerates occurrences of such blocks between Dessau and Potsdam, around Potsdam, around Berlin, in Mecklenburg and at Danzig, shown in Fig. 2.

Furthermore, Goethe points out that the similarity is so striking between these boulders and the rock formations in the north, on the other side of the Baltic Sea, that the paternity can not be doubted. He then quotes Voigt's hypothesis and develops the following scenario:

*. . . da es unleugbar schien, daß zu gewissen Urzeiten die Ostsee bis ans sächsische Erzgebirge und an den Harz herangegangen sei so dürfe man es natürlich finden daß bei laueren Frühlingstagen im Süden die großen Eistafeln aus Norden herangeschwommen seien und die großen Urgebirgsblöcke, wie sie unterwegs an hereinstürzenden Felswänden, Meerengen und Inselgruppen aufgeladen und hierher abgesetzt hätten . . . In diesen letzten Jahren erhielt ich von . . . dem Kammerherrn von Preen die Nachricht daß bei eintretendem Frühling große Eismassen mit Granit beladen den Sund hereingeschwommen seien.*¹³

. . . because it appears undeniable that in primeval times the Baltic Sea extended as far as to the Sächsisches Erzgebirge and the Harz, it seems natural that on milder spring days in the south large ice foes had approached from the north and deposited in our countries great blocks of primeval rocks which they had saddled on the way from rock faces, sea channels and island groups. . . In the last years I learned from the Kammerherr von Preen that at the beginning of spring large masses of ice floated into the bay.

In December 1827 Goethe obtains new informations on granite boulders in northern Germany. A. Nicolovius sends him the lithography of a large granite boulder, the so called Markgrafenstein, from near Fürstenwalde, east of Berlin, together with samples from this one and other occurrences at Oderberg.¹⁴

In March 1828 Goethe writes, for the new version of "Wilhelm Meisters Wanderjahre", the already mentioned episode on the nocturnal discussion of geologic ideas. In this text Goethe pronounces for the first time the hypothesis that a general climatic change, a "period of fierce cold" had caused, the deposition of alpine boulders at the shore of the lake of Geneva as well as the distribution of Scandinavian rocks in northern Germany and Thuringia. With the concluding remark, that the majority of miners and guests vehemently opposed this theory and "found it more natural to have the world created with

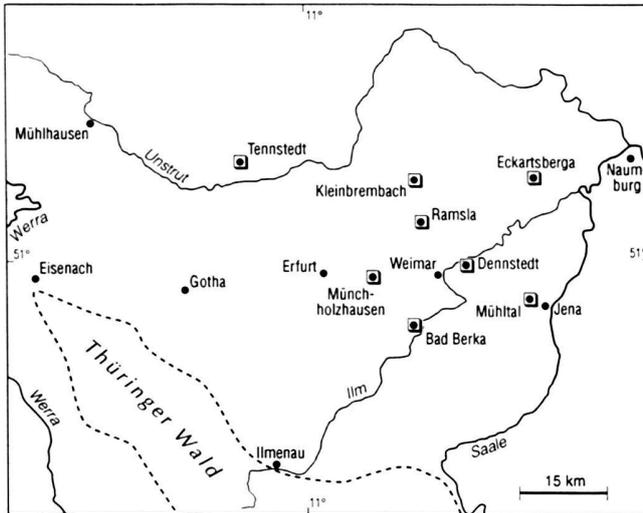


Fig. 1. Localities of crystalline rocks found by J. K. W. Voigt and Goethe in Thuringia.



Fig. 2. Occurrences of crystalline rocks in Northern Germany, mentioned by Goethe: around Schwerin and Rostock, at the Heilige Damm on the coast of the Baltic Sea, around Dessau, Potsdam and Berlin, at the hills of Rauhen, south of Fürstenwalde, east of Oderberg and around Danzig.

colossal crashes, and upheavals, wild raging and catapulting” Goethe refers to L. v. Buch’s theory, that eruptions in the central Alps and Scandinavian mountains had catapulted boulders into the forelands of the Alps and across the Baltic Sea.¹⁵

It seems that in the summer of 1828 the origin of erratic boulders was a popular subject of conversations in the Weimar society. Alexander von Humboldt reports from a conversation which he had with the duke Karl August on the 13th of June 1828, at the eve of the duke’s death:

... er war krank, konnte nicht essen und fragte dennoch

*nach denen von Schweden herübergekommenen Granitgeschieben baltischer Länder...*¹⁶

... he was ill, could not eat, but asked about the granite boulders in the Baltic countries which came over from Sweden...

In the following years, until the last weeks of his life, Goethe repeats, precises and modifies his theory in some texts and notes.

In Juni 1828 Goethe publishes in his Journal “Kunst und Altertum” an article on the use of granite boulders in Berlin in architecture and art.¹⁷ He mentions the occurrence of such boulders near Oderberg and describes the huge Markgrafenstein in the hills of Rauhen, south of Fürstenwalde, from which a bowl was made which still stands in front of the Altes Museum in Berlin. Goethe suggests that the Markgrafenstein was not transported, but might indicate a local uprising of primeval rocks.

In November 1829 Goethe composes a draft on some geologic problems. He points out in this text that disseminated granites in northern Germany can be explained in two ways: They are either – examples might be the Markgrafenstein and the Heilige Damm – remnants of local crags which decayed by the action of weathering, or they are boulders transported by ice floes in an epoch of cold climate which was responsible also for granite rocks at the lake of Geneva:

Kälte

Für das viele Eis brauchen wir Kälte, ich habe eine Vermutung, daß eine Epoche grosser Kälte wenigstens über Europa gegangen sei, etwa zu der Zeit, als die Wasser das Kontinent noch etwa bis auf 1000 Fuß Höhe bedeckten und der Genfer See zur Tauzeit noch mit dem nordischen Meer zusammenhing.

*Damals gingen die Gletscher des Savoyer Gebirges bis an den See und die noch bis auf den heutigen Tag auf den Gletschern niedergehenden langen Steinreihen, mit dem Eigennamen Gufferlinien bezeichnet, die sich eben so gut durch das Arve- und Transetal herunter ziehen und die oben sich ablösenden Felsen unabgestumpft und – abgerundet in ihrer natürlichen Schärfe bis an den See bringen konnten, wo sie uns noch heut zu Tag bei Thonon scharenweis in Verwunderung setzen.*¹⁸

Cold

We need cold for so much ice and I suppose that an epoch of great cold overcame at least Europe, at a time when the waters still covered the continent up to 1000 feet high and the lake of Geneva still communicated with the ocean in the north.

At that time the glaciers of the Savoyan mountains extended until the lake. The long stone rows, called “Gufferlinien” which until today descend on the glaciers came down through the valleys of Arve and Dranse and transported

the above loosened rocks, without truncating and rounding, in their original sharpness to the lake where we are surprised by their multitude.

“Gufferlinien” is a local term for moraines on a glacier which Goethe borrowed from the description of a tour to the Jungfrau in Switzerland, as shown by a note in his remains¹⁹. An undated manuscript in Goethe’s remains, entitled in WA “Conversation on the movement of granite boulders by glaciers” is probably the draft of an extended version of the talk of “two or three quiet quests” who invoked “a period of fierce cold” in Wilhelm Meisters Wanderjahre. Because argumentation and wording closely resemble the text from November 1829, it was written at about the same time. Here, Goethe points out more decidedly that, probably, not all granite rocks in northern Germany came from the north; some boulders might be remnants of locally uprising primeval underground:

*Das nördliche Deutschland hatte seine Granitfelsen, aber verwitterliche, sie sind zusammen gesunken; der Heilige Damm stammt so gut aufwärts wie die norwegischen Schären . . . Die in den Oderbrüchen liegenden Gesteine . . ., der Markgrafenstein . . ., an Ort und Stelle sind sie liegen geblieben, als Reste großer in sich selbst zerfallener Felsmassen.*²⁰

Northern Germany had its granite crags, but weatherable ones, they collapsed; the Heilige Damm raises up like the norwegian cliffs . . . Rocks near Oderberg . . . the Markgrafenstein . . . remained in place as remnants of large decomposed rock masses.

In this text, Goethe mentions not only granite blocks at the lake of Geneva, he describes the same phenomenon also from the lake of Luzern:

Wenn am Luzerner See das Ähnliche geschehen so ist es nicht schwer eben dergleichen Trümmer auf den Weg nach Küßnacht zu bringen.

If similar things happened at the lake of Luzern, it is not difficult to bring such debris on the way to Küßnacht.

Here, Goethe remembers what he observed in Küßnacht, Switzerland, the 7th October 1797:

*Küßnacht, Gasthof zum Engel. Nach Tische gingen wir ab und fanden einen sanften, in die Höhe steigenden angenehmen Weg; gesprengte Granitblöcke lagen an der Seite . . . Die Steinart ist die des Gotthards . . .*²¹

Küßnacht, tavern “Zum Engel”. We departed after dinner and found a smoothly ascendig, pleasant path; aside were ruptured granite boulders . . . The kind of rock was that of the Gotthard . . .

In January 1831 Alexander von Humboldt visits Goethe in Weimar and reports on results of his voyage through Russia in 1829. Humboldt maintains that Caucasus, Altai and Himalaja had been raised through clefts from the depth of the earth²². In opposition to such tumultuary ideas Goethe composes in February 1831 a statement on geologic phenomena which can be explained without tumultuary events in which he repeats his hypothesis, exposed in the text of November 1829²³.

Goethe was moved until the last weeks of his life by the problem of the erratic boulders. Johann Friedrich Hausmann, Professor of Geology at Göttingen publishes in 1832 a latin dissertation on the origin of rocks dispersed through northern Germany²⁴. Hausmann displays the regional distribution of the boulders, describes their lithology and confirms their origin from Sweden and the shores of the Baltic Sea. Because Hausmann says nothing about the mode of their transport Goethe writes a supplementary comment to this publication, preserved in his literary remains.²⁵ After praising Hausmann’s precise description Goethe refuses explanations by violent eruptions and presents his own theory that in a time of cold climate and high ocean level rocks were transported from the central Alps into the foreland by glaciers and on ice floes from Scandinavia into northern Germany.

This is Goethe’s last statement on a geologic epoch for which later the name ICE AGE was coined.

Conclusion

It can be said that Goethe has, in fact, for the first time pronounced the idea that ice transport in a past epoch of great cold was responsible for two phenomena: the granite boulders from the Central Alps deposited on the shore of the lake of Geneva, on the one hand, and Scandinavian rocks disseminated in northern Germany and Thuringia, on the other. Goethe was led to his hypothesis by own observations, by reliable records of informants and by his tendency to explain geologic phenomena without violent and tumultuary events. But he did not participate in the discourse of the scientific community. He defended his idea not as a serious theory in a scientific journal, but pronounced it in the framework of a novel as a mere possibility among other more or less fictitious geologic suppositions. On these reasons, Goethe’s ice age hypothesis has probably not influenced the development of geologic ideas in the 19th century.

The present essay supplements, corrects and improves results of earlier publications²⁶ which were based on the uncommented and not always reliable edition of Goethe’s geologic and mineralogical writings in volumes II 9, 10, 11 and 13 (Weimar 1892–1904) of the Weimar Edition of Goethe’s works (WA) and earlier editions.

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