

About thirty years ago there was much talk that geologists ought only to observe and not theorise; and I well remember someone saying that at this rate a man might as well go into a gravel pit and count the pebbles and describe the colours. How odd it is that anyone should not see that all observation must be for or against some view if it is to be of any service!

Charles Darwin, in a letter to a friend dated 18 September 1861.

Goethe's Conundrum – Integrating Basalt into the Harmony of Nature

Introduction

Today it is difficult to imagine the interest and attention given to natural philosophy by the educated public towards the end of the 18th and much of the 19th Century. Rocks, minerals, fossils, plants, and animals (dead or alive) were avidly collected by amateurs and professionals throughout Europe, and indeed by explorers and adventurers travelling the seven seas. It was the heyday of natural philosophy. One need only think of Charles Darwin's five year voyage on the *Beagle* (1831-1836), or Alexander von Humboldt's five year exploration of South America (1799-1804).

One aspect of this sudden interest in the world of Nature was that geographers, zoologists, botanists, geognosts (as geologists called themselves at the time) and even philosophers, did not set strict boundaries between their various disciplines. New discoveries and ideas were widely discussed by all, and it was not uncommon for one person to develop their interests in more than one subject, Goethe being a prime example.

Johann Wolfgang von Goethe (1749-1832) is of course best known as poet and playwright, considered by many to be the greatest that ever lived. But he was also a scientist, and would have been unable to imagine a separation between natural science and the humanities, including literature. Goethe was able to unite *Naturwissenschaft* and *Geisteswissenschaft* in his work, and his friends and associates did the same. They were interested in each other's work; expressed their thoughts in long letters, and met whenever they could to discuss and exchange ideas.

Fig. 1 shows Friedrich Schiller (playwright and historian), Wilhelm von Humboldt (philosopher, linguist and diplomat) Alexander von Humboldt (geographer, naturalist and explorer), and Goethe (poet, playwright, zoologist, botanist and geognost) in Schiller's garden in the university town of Jena in 1797. Goethe once commented that one hour of conversation with Alexander covered more ground than eight days of reading.¹

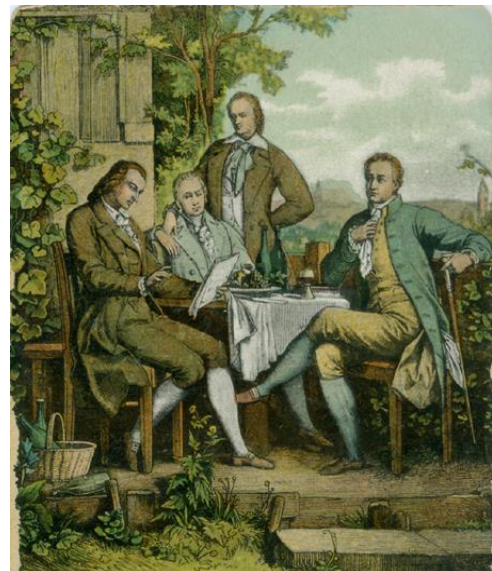


Fig 1 Conversation in Schiller's garden.
Source: Goethezeitportal

It was the age of enlightenment, and concepts of a static unchanging universe were giving way to ideas of a universe in which things could and did change. Goethe in

¹ Draft letter to Duke Karl August, Jena, early March 1797.

Goethe's letters (e.g. for the year 1776) may be found at www.zeno.org/Literatur/M/Goethe,+Johann+Wolfgang/Briefe/1776. Except where stated, all translations from German are my own, and shown in *italics*. Goethe's translated words are in "double quotes", other translations from German are in 'single quotes'.

particular was interested in discovering the processes by which things changed, or metamorphosed. Although Goethe was not the first to use the word metamorphosis, he did introduce the concept of “morphology” in 1796, thereby introducing a new approach to the biological sciences.

In the search for understanding how the rocks making up Earth’s geological features had been formed, there was heated debate about whether the primary agent of geological change was the action of water, or the action of heat. The so-called “Neptunist”² (for water) versus “Vulcanist”³ (for heat) controversy arose during Goethe’s lifetime, and Goethe could not avoid being drawn into the argument. The controversy was only resolved towards the end of his life. By 1820 sufficient evidence had accumulated showing that forces deep within the earth pushed molten magma up towards the surface, where it cooled rapidly to produce the fine grained crystalline structure of basalt. Geognosy had become geology, which together with mineralogy became a science.

Goethe continued to refer to his studies of the mineral kingdom as geognosy, which he considered an empirical science based on observations, as opposed to geology, which he considered a purely speculative science based on theories.

Goethe’s geognostic observations are scattered in a large number of letters, diaries, notebooks and records of conversations. He attempted several times to write down his ideas in a comprehensive monograph, but every attempt remained fragmentary. In 1885 Goethe’s grandson left these manuscripts as part of a much larger legacy to the Grand-Duchess Sophie of Saxe-Weimar, who decided to publish them in a complete edition encompassing both previously and hitherto unpublished works of Goethe (the Weimar or Sophia Edition of Goethe’s collected works). Rudolf Steiner was appointed to bring together and edit the natural scientific manuscripts, a task he worked on from 1890 to 1897.

This article will examine some of the difficulties faced by geognosts in trying to discover the origin of basalt. At the end of the eighteenth century all geognosts were what today might be called Goethean observers. They carefully studied the evidence in front of them, and there was seldom disagreement about what they saw. There was never any question that sandstones, shales, and fossil-rich limestones, are sedimentary rocks that had been deposited in water. Early geognosts had studied these rocks, and mapped them across extensive regions. Occasionally however a different rock was found interbedded with, or lying above, the sedimentary strata. This was basalt. It was therefore natural to consider it of sedimentary origin, as a precipitate from an ancient ocean. But it was also found in regions where there was strong evidence of volcanic activity. The disagreements arose in the various interpretations of what geognosts believed they saw when they saw basalt.

We will meet the main protagonists to the controversy, consider the evidence they studied⁴, and examine whether or not they attempted to integrate their interpretations into predetermined ideas, whether, in Darwin’s words, they theorized.

Goethe’s special rock was of course granite, which he considered as close to the primal rock (*Urgestein*) as it was possible to get. Granite was for Goethe a metaphor for the ground of all Being, and was the subject of two famous essays by him.

2 Neptune was the Roman god of the sea. His Greek counterpart was Poseidon.

3 Vulcan was the Roman god of fire. His Greek counterpart was Hephaistos.

4 Most of this evidence is easily accessible today, courtesy of the relevant tourist boards in Germany and the Czech Republic.

What is basalt?

This is what geologists know today:

Basalt is a dark grey to black, fine-grained, extrusive, igneous rock, derived from magma (molten rock deep within the earth). It is composed mainly of plagioclase and pyroxene minerals. Its low silica content gives it a low viscosity, so that its lava flows easily. (Lava is molten rock on the surface of the earth.) This results in rapid lava flows that can spread over large areas before cooling rapidly and solidifying as very fine crystals invisible to the naked eye.

Extensive lava flows of this nature are called flood basalts. Repeated outpourings form layers, which eventually erode into a stepped landscape, known as a Trapp (from an old Germanic word meaning 'step'). Basalt can also form in small intrusive bodies, such as an igneous dike or a thin sill.



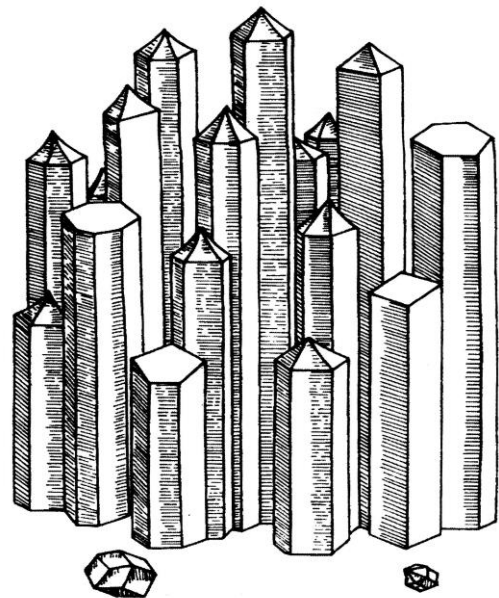
Basalt

Lava is also a basalt, but structurally different. Gases trapped in the magma while congealing makes it spongelike and much lighter.

More than 90% of volcanic rocks are basalt. Basalt underlies the granite continents as well as the water of the oceans. An important difference between basalt and granite is that granite has large clearly visible crystals consisting of quartz, feldspar and mica. Granite crystals are large because granite forms deep underground, where it cools very slowly, so that crystals have time to grow.

This is what geognosts knew about basalt 250 years ago:

Basalt is a dark coloured, homogenous rock, which never contains fossils. It often appears in the form of tall (up to 20 metres or more) massive polygonal (often hexagonal) column. The pattern of polygonal columns visible on the uppermost surface of a basalt formation is reminiscent of cracked mud at the bottom of a dried-out pond. It was assumed that the columns were very large crystals. The illustration shows a drawing first published in 1565 in a book '*for all those interested in the objects of Nature*', emphasizing the supposed crystalline nature of basalt by capping the columns with imagined pyramids, making them appear similar to quartz crystals. This is further reinforced by the addition of two dodecahedral garnet crystals.



*Basalt columns imagined as crystals. From Schminke *Tanz auf dem Vulkan*, p125. See footnote 27.*

Basalt looks a lot like shale or mudstone, but is much harder, and is a distinctly different type of rock. Basalt is often found in the vicinity of what appears to be lava and other volcanic fragments. Trapp basalt formations appear in a variety of settings, and their origin is unknown. It is easily distinguished from granite.

This article will however concentrate on basalt, which caused Goethe more than a few

headaches. He was well aware of the difference between columnar basalt and volcanic products such as lava, and therefore found it difficult to imagine that they were derived from the same source deep within the Earth. In addition the volcanic pipes bringing lava to the surface are quite different from the vast areas covered by flood basalts.

He much preferred order and predictability in Nature, and was put out by the fact that basalt was found in unexpected places; overlying granite in the North of Saxony, and river sediments further South, overlying mica schists and shale in Bohemia, on top of limestone and sandstone, on hilltops and in valleys. No other rock behaves as randomly as this. The reason for this apparently capricious behaviour (we know today) is that in the recent geological past⁵ magmatic basalts poured out of fissures in Earth's crust, and covered different geological terrains. With no extinct volcanic craters visible, geognosts were unable to see the connection between basalt and the more typical volcanic products such as lava, pumice and ash. Goethe regularly corresponded with both professional and amateur geognosts, and it was between their discoveries and opinions that Goethe's struggle took place.

Student Days in Strasbourg

Goethe studied law in Leipzig, but illness forced him to drop out after three years. He returned home to Frankfurt to weather a severe health crisis⁶, making use of his long convalescence to study alchemy, and doing experiments attempting to find the *Mater Materia*, from which he believed all earthly substances were derived. He continued his studies in Strasbourg in April 1770, obtaining his law degree in August 1771. In Strasbourg he met the philosopher, poet and literary critic Johann Gottfried Herder (1744-1803), who introduced him to Shakespeare and exerted a strong influence on his literary style, as well as on his philosophical and geognostic ideas.

His interest in the origin and formation of the earth was rekindled during this time. In his autobiography 'Poetry and Truth' (*Dichtung und Wahrheit*), written forty years later while in his early sixties, he describes an excursion to the nearby Bastberg in Alsace in the summer of 1770: "*This hill, made up entirely from a variety of shells, first drew my attention to such documents of an earlier world. I had never seen them together in such great abundance.*"⁷

Goethe's wide reading while in Strasbourg included Rousseau and Voltaire (1694-1778). Voltaire's complete rejection of biblical and Christian history was too much for the young Goethe. He was searching for order and meaning in Nature. Although not religious in any traditional sense, he began to realise that Voltaire

“. . . in order to undermine the traditional story of the biblical flood, denied all fossil mussels, and considered them merely sports of Nature, and lost all faith in him. For I had seen them with my own eyes on the Bastberg, and realised that I stood on the floor of an ancient ocean amongst the exuviae of its primeval inhabitants. . . the Rhine Valley had once been an immense lagoon, an estuary stretching as far as the eye could see; no one could persuade me otherwise. I therefore made up my mind to extend my

5 The Tertiary geologic Period is the traditional name for the first of two periods (66 to 2.6 million years ago) in the Cenozoic Era; the second is the Quaternary Period (2.6 million years ago to the present).

6 Rudolf Steiner commented on Goethe's illness that it resulted in a loosening or relaxation of his constitution, through which he gained the ability to '*permeate himself with super-sensible imaginations*' (*mit übersinnlichen Vorstellungen sich zu durchdringen*). See GA 172, lecture on 5 Nov. 1916, which describes in detail how Goethe's unusual constitution came about, and the lifelong effects it had on him.

7 *Poetry and Truth*, Book 10,

understanding of landscapes, of rocks and of mountains, wherever the results might lead.”⁸

It is not often that a youthful resolve (Goethe was 21 at the time) is carried out for more than sixty years with the determination with which Goethe followed his deep interest in the origins of rocks and mountains. He was deeply interested in so many things!

Even towards the end of his long life he still found time for his geognostic interests. On the 31 July 1829 the well-known British geologists Adam Sedgwick (1785-1873) and Roderick Murchison (1792-1871) called on the 79 year old Goethe in Weimar. They presented him with a stratigraphic chart drawn up by Henry De la Beche (1796-1855) in 1827, showing the stratigraphy of England from the Jurassic Period up to the present. Goethe hung the chart in his bedroom next to a chart illustrating his ideas of the musical scales⁹.



Fig 2 Goethe's bedroom. The stratigraphic chart is the one on the right.
Wikimedia Commons

Goethe is known above all for his powers of observation, for allowing the phenomena he observed to speak for themselves, and it is therefore ironic that an expedition undertaken while still a student was to lead to one of the few occasions on which his “*intuitive power of judgment*” (*anschauende Urteilskraft*) let him down.



Fig 3 Burning Mountain in Dudweiler.
Source: urlaub.saarland

While in Strasbourg he visited the burning mountain (*Brennender Berg*) near Dudweiler with some friends. An underground coal seam had been burning for more than 100 years (and is still smouldering today). The sight of the smoke and steam, the smell of the sulphurous fumes, all made a deep impression on Goethe. In ‘Poetry and Truth’ he wrote:

“We heard about the abundant Dudweiler coal mines, the iron and alum plants, and even about a burning mountain, and made preparations to see this nearby wonder. We entered a gorge and found ourselves in the vicinity of the burning mountain. We were enveloped by a strong sulphur smell; one side of the cave was almost glowing, and covered with reddish, white-roasted rock. Dense steam arose from the crevices and we could feel the hot



Fig 4 Plaque commemorating Goethe's visit to the Burning Mountain.
Source: wegeundpunkte.de

⁸ *Poetry and Truth*, Book 11,

⁹ Johann Wolfgang Goethe, *Die Metamorphose des Granits*, collected and commented by Dankmar Bosse (1985) Verlag Freies Geistesleben, p. 135.

ground even through the thick soles of our shoes."¹⁰

His experience at Dudweiler, lent support to the then prevalent theory that burning underground coal was hot enough to melt rocks – a theory he initially shared with many other geognosts, but which towards the end of his life had lost all its adherents.

Back home in Frankfurt in 1771 he made a half-hearted attempt to start a career as a lawyer, even though "*no inner tendency urged me to such topics*". Instead he wrote poetry, completed two novels (*Götz von Berlichingen* in 1773, and *The Sorrows of Young Werther* in 1774), and started work on his most famous drama *Faust*, another 60-year project, which he completed just 8 months before his death at the age of 82.

He fell in love several times, was briefly engaged (once), did a *Grand Tour* of Switzerland, and was saved from further heartache by an invitation to spend some time in Weimar.

Responsibilities in Weimar

The invitation came from Karl August, Duke of Saxe-Weimar-Eisenach, after a meeting in Frankfurt, arranged by the tutor¹¹ of his younger brother Prince Frederick Constantin. He moved to Weimar in November 1775, initially intending to spend only a few weeks with his newly found friend. He stayed for the rest of his life. He was first employed, amongst several other duties, as mentor to the 18-year old Duke. In 1776 he used his influence at the court to secure for Herder a position as General Superintendent of the Duchy's Christian evangelical church. In the same year, the young Duke issued a decree entrusting Goethe with the re-opening of an abandoned copper and silver mine at Ilmenau. This was a reminder of the resolution he had made on the Bastberg six years earlier, and reawakened his enthusiasm for investigating the origin and formations of the Earth.

Not long thereafter he worked closely with Herder in writing the geological chapters of Herder's *Outlines of a Philosophy of the History of Man*, first published between 1784 and 1791. Here we read: '*As soon as the core of our Earth, granite, was manifest, light was there, in the dense vapours of our Earthly chaos perhaps still active as fire; it was a coarser, mightier air than we enjoy today, it was a promiscuous, gestating water.*'¹²

Goethe took his new responsibility seriously, and started exploring the area around Ilmenau. In August 1776 he wrote to Herder: "*We are in Ilmenau. For the past three weeks we have been living in the Thüringian Forest, and I'm living my life in ravines, caves, and forests, in ponds and under waterfalls; giving myself over to God's world.*"¹³

He hoped to discover the creative hand of God, and in 1780 he wrote to Frau von Stein: "*We have climbed the high peaks, and crawled into the depths of the earth, hoping to discover traces of the grand forming hand. We have made some really beautiful discoveries, which give inspiration to the soul, and expand it in truth.*"¹⁴

And on the following day: *I am living with body and soul amongst rocks and mountains, and am much pleased with the vistas opening up to me. We have covered a lot of ground, and the world has gained for me a tremendously exciting new aspect.*"¹⁵

10 *Poetry and Truth*, Book 10.

11 Carl Ludwig von Knebel (1744-1834).

12 Johann Gottfried von Herder (1869 edition), *Ideen zur Geschichte der Menschheit*, Vol 1, Book 2, Part 1, p36. Forgotten Books reprint.

13 Letter to Herder, 9 August 1776.

14 Letter to Charlotte von Stein, 7 September 1780.

15 Letter to Charlotte von Stein, 8 September 1780.

Towards the end of his life, looking back on his younger days he told Chancellor Friedrich von Müller: *“I arrived in Weimar highly ignorant in the study of Nature, and only my desire to offer practical advice to the Duke in his enterprise and investments, drove me to study Nature. Ilmenau cost me a great deal of time, toil and money¹⁶ but in exchange I have learnt something, and have gained a perception (Anschauung) of Nature, which I would not exchange at any price.”¹⁷*

In January 1779 he took on further responsibilities. He was informed by the Duke: *‘We have considered the administration of the current Highways Department, have resolved to reorganize, and to appoint you to the directorship.’* Goethe was now in charge of the construction and maintenance of the Duchy’s highways. He didn’t mind; it was another opportunity to practice his phenomenal powers of observation. He soon developed the habit of noting the quality of the rural highways he passed over. Even travelling through Bavaria on his way to Italy, having finally escaped from his responsibilities in Weimar, he could not resist noting: *“. . . splendid Chaussee (paved highway) of quartzite; could not be bettered; granite weathers into gravel and clay, giving a firm base and an excellent binder, making the road smooth as a threshing floor.”¹⁸*

Because his responsibilities now included the procurement of suitable road building materials at a price the duke could afford, he was able to add to his ever-increasing understanding of the geology of the Duchy. Whenever he passed a quarry or excavation, he stopped his carriage, took out his hammer, beckoned to his servant to do likewise, and added rocks and minerals of all kinds to his growing collection. But he did more than this. He was keen to understand the landscape as a whole, and so, whenever he had the opportunity, he would spend days on horseback exploring the forests and the fields of the region. He never lost his all-encompassing, but above all gentle and benign, view of Nature.

In a letter to his friend von Knebel he describes his efforts: *“You will remember with what attention and zeal I roamed through the district in my efforts to get to know the changing variety of the countryside. I know this now, like the back of my hand, and am able to give an account of every hill and meadow. This basic understanding has given me confidence. Now I’ll continue - to discover how Nature uses the soil, and how Man makes it his own.”¹⁹*

In October 1779 he undertook his second journey to the Swiss Alps, where he was faced with a landscape quite unlike that of Saxony, Thuringia, or the Harz mountains. Travelling from Basel up the Birs gorge, he wrote a long letter to Charlotte von Stein in which he first expressed his conviction that Nature always worked harmoniously: *“I developed a deep feeling (for the majesty of the gorge through which he travelled), which added considerably to the enjoyment provided by attentive eyes. One dimly senses the origin and the life of these extraordinary structures. However and whenever it took place, these masses have come into being grandly yet simply. Whatever*

16 Goethe had bought only a single a share in the venture, but he employed an unofficial caretaker, Johann Friedrich Krafft, from his own pocket to keep an eye on things in Ilmenau.

17 In a conversation with Chancellor Friedrich von Müller on 16 March 1824. Quoted in Manfred Wenzel (1987) *Der Ilmenauer Bergbau und sein Einfluß auf Goethe als Dichter und Naturforscher*, *Medizinhistorisches Journal* **22**,1 pp3-27.

18 Goethe *Italian Journey*, From Karlsbad to the Brenner Pass, 3 September 1786. The *Italian Journey* may be found at

<https://www.projekt-gutenberg.org/goethe/italien/ital111.html>

The page numbers run from 111 to 194, then continue from 2111 onwards.

19 Letter to Carl Ludwig von Knebel, 17 April 1782.

*revolution has moved them here, separated them and split them asunder, these would have been only individual shocks. Time, forever bound to eternal laws, has at times worked more, at times worked less, upon these peaks and valleys.”*²⁰

On another occasion he wrote in his notebook: “*By means of peaceful and gradual effects extra-ordinary (results) were achieved.*”

The following month to his friend Merck: “*And now I still have to tell you about my mineralogical research. As part of my official responsibilities I have pursued this science with great zeal. . . Of great assistance has been a young man studying at the Freiberg Academy, where he has learned a great deal about the terminology and classification (of rocks). For the past six months I have given him free rein to travel the length and breadth of the country, and I am not overly concerned whether this or that terrain belongs to the Duke of Weimar or not. As the stag browses where it will, unconcerned about territorial boundaries, so too must the mineralogist be.*”²¹

The young student he sent out on these expeditions was Johann Voigt (about whom more later), a student of Abraham Werner at the Freiberg Mining Academy in Saxony, to whom we turn next.

Abraham Werner and the Mining Academy at Freiberg

Abraham *Gottlob* Werner (1749-1817) was born into a mining family. He started his academic studies at the Mining Academy in Freiberg in Saxony, and continued them in Leipzig. Away from home, possibly because he felt homesick, he became interested in the identification and classification of minerals, but also attended lectures on literature, history, and anthropology. In 1774 he published the first geological textbook ‘*On the External Characteristics of Fossils*’, in which he categorised ores and minerals (also classed as fossils at the time) according to their outer appearance and qualities - how they appeared to sight, touch, taste, smell, and even hearing (phonolite or clinkstone). In spite of having dropped out of the Freiberg Academy without completing his degree some years earlier, his book was widely respected, and he was offered a post as lecturer of mining and mineralogy at the Academy in 1775, the same year Goethe arrived in Weimar.

In his lectures he set out a classification of rocks on the basis of their appearance and age, which in turn was based on the sequence of their strata (youngest on top), rather than by the types of minerals, as had previously been the practice. By 1778 he had written up his lecture notes in an unpublished monograph, but continued to develop and refine his ideas, also in discussion with his students. His *Short Classification and Description of Rocks* was finally published in 1787. It was the first modern textbook on descriptive mineralogy, and gave a framework to mineralogy which has stood the test of time. Definitive names were given to several minerals, for example, augite (from the Greek *αυγή*, *auge*, meaning “shine”, in allusion to its appearance).



Fig 5 Professor Abraham Werner.
Source: britannica.com



Fig 6 Augite Crystals.
Source: mindat.org

20 Letter to Charlotte von Stein, 8 September 1780.

21 Letter to Johann Heinrich Merck, 11 October 1780.

But Werner went beyond mere classification, and sought to integrate the various minerals and rocks into an imagination of the solid, physical Earth as a whole, and beyond that to establish their origins. He was a charismatic and popular teacher, and his ideas had great appeal. He inspired not only a generation of geologists, but also students such as the poet Friedrich von Hardenberg (Novalis, 1772-1801) who enrolled at Freiberg in 1797.

Although poor health in later life prevented field trips further afield, Werner was well acquainted with the sequences of rock strata in his native Saxony, and he had given considerable thought as to why the rock formations were always found in certain specific sequences. It was not long before he proposed a reason for this.

He based his historical sequence of rock formation on the theory, well established at the time²² that the Earth had originally been covered with water; not ordinary water, but a primal water (*Urgewässer*), pregnant with minerals and other substances.²³ He was well aware that granite does not dissolve in water, not even in boiling water. Neither Werner nor Goethe ever claimed that the *Urgewässer* was ordinary water, but many geognosts were unable to make the distinction.

The Swedish chemist Jacob Berzelius (1779-1848) still thought it necessary to explain the obvious as late as 1825, namely, that it was in complete contradiction to all that was known about the solvent properties of water to suppose that it could dissolve the constituents of granite²⁴. Berzelius explained that to suppose that water had different properties in ancient times was in effect to say that it was not water, for a substance is what it is by virtue of its properties. Werner's '*Urgewässer*' was no ordinary water; it was a living water, much like Herder's '*promiscuous, gestating water.*'

As the *Urgewässer* slowly subsided, the chemistry of the ocean changed, and different kinds of rock were laid down in a specific order, with granite being the first, followed by schists, gneisses, and basalts, then limestones, slates, sandstones, and finally surface soil and gravel. The primal materials either crystallized in a process of precipitation, or settled out of suspension in a process of sedimentation, to form the continents as a stratified sequence of layers. Werner believed the oldest and hardest rock to be granite, with basalt following as a precipitate just like granite. In Werner's view basalt was therefore not of volcanic origin.



Fig 7 Basalt outcrop on the Simmelsberg in Thuringia. The harder basalt is more resistant to erosion than the surrounding rocks.

Source: deskline.net

22 Werner was not the originator of the Neptunist theory, but was its last representative, and strongest proponent. The idea itself can be traced back to Nicholas Steno (1638-1686), Benoit de Maillet (1656-1738), Georges Louis Leclerc Comte de Buffon (1707-1788), Jean Louis de Soulavi (1752-1813), and other geognosts.

23 Hebrew תְּהוֹם, *tehom*, "the deep" in Genesis 1:2.

24 The Scottish geologist James Hutton (1726-1797) had already realised this thirty years earlier, by observing the gradual erosion of his fields and pastures into the North Sea. Eroding soil is carried in suspension, not in solution.

Noah's flood played no part in Werner's cosmogony. He was a deist who believed that after God had created the world, there was no longer any need for divine intervention. But his emphasis on the role of water in forming the Earth led to his ideas being referred to as Neptunist.

He did, however, recognise a problem in that he could never adequately explain where the primal water went as it receded. The unproved assumption was that it drained into large underground cavities.²⁵

Basalt rock was also known to occur in thin vertical dykes, which had clearly not been deposited or precipitated from water. This raised another question for the Wernerian school, for which an explanation was at hand. This was based on the assumption that sub-terranean coal seam fires melted deeply buried basalt; the liquid magma would subsequently move up through fractures in the surrounding rock, eventually cooling to produce the basaltic dykes. This 'metamorphosis' did not mean that basalt was not originally a sedimentary rock precipitated on the floor of an ancient ocean.

Volcanic lavas played only a minor role in Werner's scheme. Underground coal seam fires were imagined as hot enough to melt the primary rocks (including the precipitated basalts), which would erupt as lava, slag, and ash, only locally modifying the landscape.

Werner's model may be summarized as shown in Figure 8. Note that whereas sedimentation occurs only on the bottom of a lake or ocean, precipitation of crystals can occur on both the bottom and the sides. The sequence of formations²⁶ is as follows:

1. The primary formations; e.g. granite, gneiss.
2. The transition formations; basalts, greywackes²⁷, and limestones.
3. The secondary (stratified) formations; the obviously sedimentary rocks.
4. The tertiary (alluvial) formations; gravels, sands, and clays.
5. The volcanic formations; lava, ash, slag, and cinders.

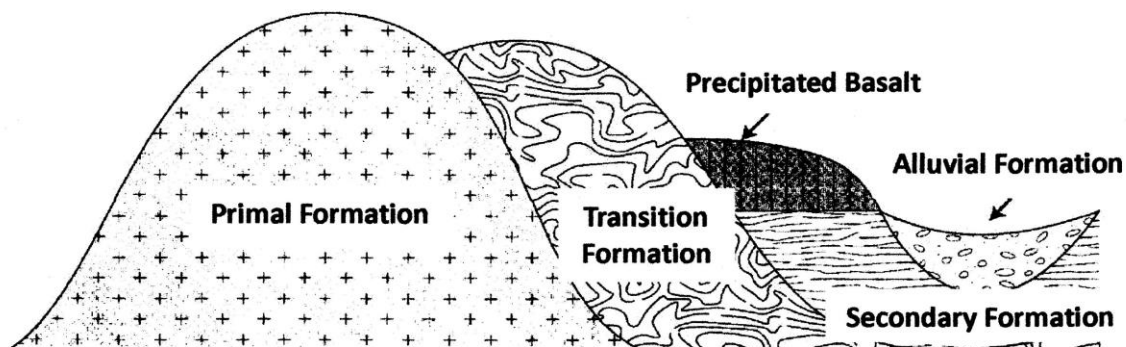


Fig 8 Werner's Neptunist Model, (Vertical scale greatly exaggerated).
Adapted from Schminke (2002). See footnote 27.

25 The supposed underground cavities date back to Plato's *Phaedo*. They were illustrated by Athanasius Kircher in his *Mundus Subterraneus*. See Athanasius Kircher's *Theatre of the World* by Joscelyn Godwin, p135.

26 This is the closest translation into English of the ancient German mining term *Gebirge*, which had a broad range of meanings, from an assembly of rocks to a mountain range.

27 Greywacke is a variety of sandstone characterized by its hardness, dark colour, and poorly sorted angular grains of quartz, feldspar, and small rock fragments set in a compact, fine clay matrix.

The fundamental question faced by geognosts was whether basalt (in particular columnar basalt) had crystallized at low temperatures from a primal ocean, or had formed from hot molten lava welling up from beneath the surface. At Stolpen Castle (about 20 miles East of Dresden in Saxony) Werner thought he had found the answer. Stolpen Castle is built on an outcrop of basalt columns, and was a popular 18th Century tourist attraction. In his *Short Classification* Werner describes his 1776 exploration of the Stolpen basalt:

*‘ . . . that most famous Saxon basalt mountain. Here I found not a trace of volcanic action, not the slightest sign of volcanic origins. In fact, the structure of this mountain proved the exact opposite. This was the first time I dared to proclaim, and prove, openly: not all basalt is of volcanic origin . . . and the Stolpen basalt is definitely not (of volcanic origin). . . and I want to briefly add that all basalts and secondary formations have a wet origin.’*²⁸

Werner interpreted the basalt columns as huge crystals grown from a primal watery solution, and used them as evidence confirming his Neptunist view.

Only a few years later the first chemical analysis of the Stolpen basalt was carried out by J. C. F. Meyer in 1780. Together with Count August Ferdinand von Veltheim (1741-1801) he was among the first to recognize the Stolpen basalt as a volcanic product.



Fig 9 Stolpen Castle with basalt columns.

Stolpen was a key geognostic site, which Goethe visited on 31 July

1790 on a journey to Silesia. Although he remained ambivalent about the origin of the basalt columns, there can be little doubt that Stolpen Castle inspired the giant's castle in his novel 'Wilhelm Meister's Journeyman Years'. In preliminary notes he wrote: "Giant's castle; Basalt on granite; Troglodyte establishment." Chapter four of the first book describes Felix's difficult journey over a jumble of broken black columns before he caught sight of the giant's castle whose columnar walls rose from an isolated mountain peak²⁹.

Werner's revolutionary, systematic, but above all practical system of describing minerals resonated with Goethe's understanding of Nature; in addition, it provided reliable guidance in ordering his own large mineral collection.

To the end of his life Werner defended his idea that all rocks, including basalt and granite originated as oceanic depositions, either as chemical precipitation or as mechanical sedimentation on the floor of a gradually sinking ocean.

Werner's stratigraphic model closely resembled the stratigraphy of central Germany. The landscape where his students did their field studies provided physical evidence

28 Quoted in *Tanz auf dem Vulkan*, an article by Hans Ulrich Schminke, in *Senckenberg, Goethe, und die Naturwissenschaften* (2002), Kleine Senckenberg-Reihe Nr. 44, Schweizerbart'sche Verlagsbuchhandlung, p127.

29 Also reflected in the novel are Goethe's experiences at the Ilmenau mine in the character of Montanus, who is dedicated to geological exploring and research, and in the important role played by mining activities in general.

that his model was basically correct. It was only when, during the course of their professional lives, they travelled further afield, that doubts began to set in.

During the early years of the 19th Century many universities in Europe established departments of mineralogy, forerunners of today's Geology and Earth Science departments. At the time of Werner's death in 1817, no fewer than 23 of his former students held professorships at these universities³⁰, but very few of them would have referred to themselves as Neptunists.

The Vulcanists

Like the Neptunists, the Vulcanists also derived their interpretation from detailed field observations. In the Auvergne region French geologists were able to trace basaltic lava flows to sources which are clearly extinct volcanic craters. Their leading exponent was Nicolas Desmarest (1725-1815) who found in 1765 that columnar basalt had graded into the scoriae³¹ of a lava flow. He noticed that the lava flows in the valleys were very similar to the basalts found capping the surrounding hills. If these too were originally of volcanic origin, lava must have flowed down valleys which have long since disappeared. The hills channelling the lava flows were worn away by weathering and erosion faster than the harder basalt, leaving the latter exposed on the newly sculpted hilltops.

Desmarest also discovered that the volcanoes rested upon solid granite, suggesting that their origin lay below Werner's primitive formation. He found further evidence in the strata underlying the basalt. He showed that these had been strongly heated. He therefore interpreted that basalt had formed by solidification of hot, molten lava rising through vents from beneath the granite, spreading in all directions. This supported the conclusions of Jean-Etienne Guettard (1715-1786) who had claimed eleven years earlier that the conical hills near Volvis in central France were extinct volcanoes.³²

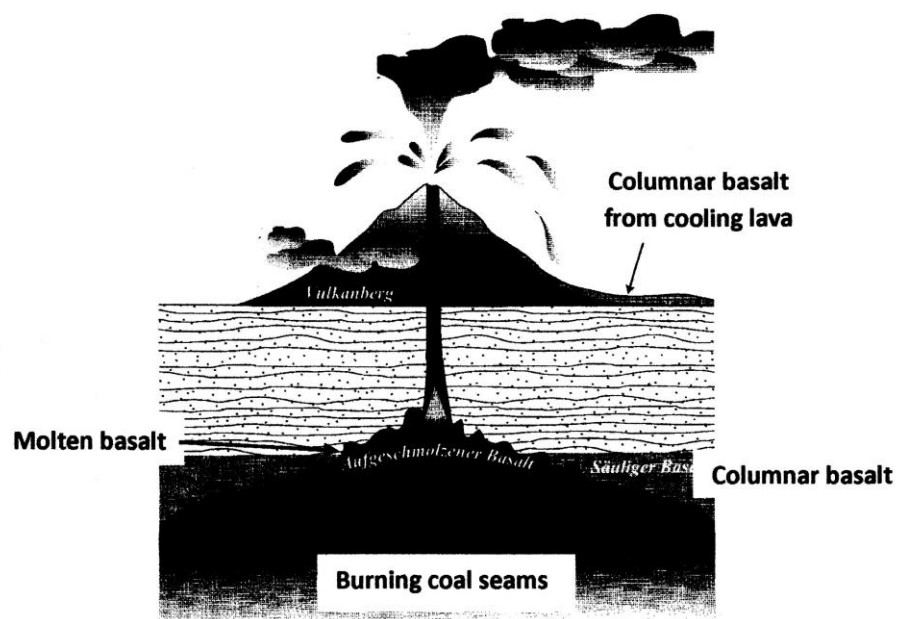


Fig 10 The Vulcanist Model. Adapted from Schminke (2002).

See footnote 27.

Goethe agreed that this evidence was decisive, but only for the basalts of Auvergne. According to notes he made in Karlsbad in 1819 he questioned whether the conclusions drawn from Auvergne could be transferred to Saxony. Here the hilltop

30 Wolf von Engelhardt (2001) *Goethe und Alexander von Humboldt – Bau und Geschichte der Erde*, International Review for Humboldt Studies. https://publishup.uni-potsdam.de/opus4-ubp/frontdoor/deliver/index/docId/3283/file/hin03_21-32.pdf

31 Fragments of basaltic lava ejected from a volcano.

32 Schminke *Tanz auf dem Vulkan*, p128. See footnote 27.

basalts occur as isolated outcrops, and were not associated with extant craters. “*Insofar as an experience can prove anything, it can only prove its own validity*”.³³

Yet, on another occasion he commented that: “*The phenomena of geology with all their variety, display so many correspondences and similarities with each other that one well observed instance can elucidate many others.*”

Desmarest admitted that had he carried out his work in Saxony, he would not have been able to confirm the volcanic origin of basalt, and he chose not take sides in the debate. Later Goethe conceded that had he worked in the Alps or the Andes, he too might have become a Vulcanist.³⁴

Goethe went along with the Vulcanist model only to the extent that basalt erupting as lava had been melted by coal seam fires not far below the surface. He rejected catastrophes of any kind. He found these repulsive. He searched for harmonious and consistent geological processes active in the present, from which he hoped to deduce the past. “*Violent and unpredictable events are abhorrent to me, because they go against Nature.*” His deeply-felt aversion to violent events, including terrestrial violence, often put him in untenable positions.

In fact Vulcanists and Neptunists did agree on two points: that the high temperatures of volcanic eruptions were caused by burning coal seams; and that volcanoes were very recent phenomena in Earth’s history. The geognost who was among the first to realize that both these assumptions were incorrect was Johann Voigt, Werner’s student and Goethe’s colleague on the Ilmenau mine committee.

Johann Carl Wilhelm Voigt

Johann Voigt (1752-1821) was the younger brother of Goethe’s ministerial colleague Christian Gottlob Voigt (1743-1819). On the recommendation of Goethe, he enrolled at the Freiberg Academy where he studied under Werner between 1776 and 1780. After completing his studies, he went to Italy to survey Vesuvius. On his return to Weimar, he assisted Goethe with the geological aspects of his mining and road building projects, and effectively became Goethe’s geology teacher and loyal assistant³⁵. Goethe valued his meticulous work and his exceptional powers of observation. In 1783 Voigt was appointed secretary of the Weimar Mining Commission. From 1789 to 1821, he served as *Bergrat* (councillor of mines) in Ilmenau.



Fig 11 *Bergrat* Johann Voigt.

Goethe immersed himself in Werner’s cosmogony, as well as the available geognostic literature. Voigt made a detailed survey of the regions beyond the Duchy’s borders; an ideal opportunity for Goethe to familiarize himself with the distribution of basalt in Rhön and Hesse, (and to add to his collection of rocks and minerals). In 1780 he wrote a detailed letter to Ernst II, Duke of Gotha about Voigt’s discoveries: “. . . *I would like to add a bit more about the basalt mountains on this southwestern side, and the volcanic products of the Rhön. On the north-eastern side of the Thuringian Forest and in all the regions in our proximity, there is not the slightest trace of basalt, or any other volcanic products. Perhaps the basalt hills near Stolpen are the first to be found in this*

33 In “*A lapsed Neptunist’s final Disclosure*”, notes written in Karlsbad in 1819.

34 See section ‘Final Years’ below.

35 Werner’s textbook was only published in 1787. Goethe owned a “pirate” copy, probably given him by Voigt.

region. Voigt has reconnoitred beyond the Rhön and as far as Fulda, and has discovered craters with all the associated volcanic products. . . If one now assumes that the volcanoes extend to the right as far as Kassel and further left to Frankfurt, yes even to Andernach, it would be a very interesting investigation, whether and how the enormous volcanic fury of this extensive imagined region was broken at the immovable bedrock of the Thuringian Forest, which resisted it like an enormous dyke.”³⁶

In this letter Goethe gave no indication that he would later reject violent events in the formation of the earth – possibly (?) because the volcanic fury he imagined in this instance was held at bay by his beloved Thuringian Forest.

He ended the letter by explaining that he intended to ask von Trebra³⁷ to “. . . trace the strata from the summit of the Brocken, which consists of granite, to the deepest shafts of the mines in the Harz, as I have done. As we then approach each other (Goethe from the SW, von Trebra from the NE), compare the names of the different rocks, and together achieve an overall view, we should be able to carry a sizeable region for *Natural History*.” He included with this letter a sketch of the local stratigraphy which Voigt had drawn.

Voigt travelled a great deal more than his erstwhile teacher. In 1789 he undertook a study of the Eifel region of Germany. He concluded that the water filled maars (lakes) were of volcanic origin³⁸. He visited the Auvergne volcanic region in France in 1802. He soon became a strong proponent of the volcanic origin of basalt, thereby becoming an opponent of Werner and his school.

But he went further. He came to the conclusion that the basalts he had studied arose from deep within the Earth, and did not originate from shallow rooted volcanoes, as the Vulcanists believed. He was also one of the first (in Germany) to realise the effect of erosion on forming the landscape; there had indeed been volcanoes in Saxony, but these had been completely eroded away. He was able to draw the revolutionary conclusion that such erosive processes required vast amounts of time. In England James Hutton (1726-1797) had realised this some years earlier, devising the memorable and much quoted phrase ‘no vestige of a beginning, no prospect of an end’. Hutton also believed that basalts originated deep within the Earth, thereby establishing a third party to the controversy, the Plutonists³⁹, which Voigt now joined.

Neptunists	Vulcanists	Plutonists
Basalts originate as precipitates from a primal ocean.	Basalts originate under volcanoes not very far below the surface.	Basalts originate deep within the earth from molten magma.

Dispute at the *Scheibenberg*

The *Scheibenberg* basalt outcrop lies in the foothills of the *Erzgebirge* (Ore Mountains) in Saxony, close to the Czech border. It consists of basalt columns up to 20 meter high, resting vertically on recent (Tertiary Period) sediments consisting mainly of clay,

36 Letter to Duke Ernst II of Sachsen-Gotha 27 December 1780. Gotha is about 30 miles West of Weimar

37 Friedrich Wilhelm Heinrich von Trebra (1740-1819) was at the time Inspector of Mines in the Harz mountains.

38 The term “maar” is taken from the Latin “mare” (sea) and is used to describe the funnel-shaped volcanic craters created from superheated water vapour eruptions (several hundred degrees Centigrade) which have exploded into the landscape, and subsequently filled with water.

39 Pluto is the Roman god of the underworld. His Greek counterpart is Hades. The distinction between Plutonists and Vulcanists only became clear many years later.

sand, and greywacke; a typical riverbed deposition sequence. For Werner, the *Scheibenberg* was another key exhibit supporting his Neptunist theory. Because the basalt forms the upper-most layer it was naturally assumed by Werner (and other geognosts at the time), that it had precipitated from water after deposition of the underlying sediments, which were undoubtedly sedimentary. See Figure 8.

Unfortunately for Werner, his conclusion was soon challenged by Voigt, one of his most able students, who insisted that the *Scheibenberg* basalt was an ancient lava, and therefore of volcanic origin. That the *Scheibenberg* is actually the remains of an outpouring of flood basalts on river sediments 30 million years ago, would have been unimaginable, even to the most radical Vulcanist.

Werner had studied the *Scheibenberg* basalt, especially the embedded augite crystals, and took issue with this challenge from his former student. He responded with an angry letter, insisting on an apology. Voigt wrote a half-hearted apology, stating that he had not intended to criticize Werner's observations at the *Scheibenberg*, but only wanted to correct his conclusions. This did not please Werner; the dispute became personal, and several angry letters were exchanged. In an attempt at reconciliation several face to face meetings were arranged, which proved unsuccessful.⁴⁰



Fig 12 The Scheibenberg basalt. Extensive quarrying during earlier centuries exposed the impressive face of the columns.

Wikimedia Commons

No one at the time could conceive the idea widely accepted today, namely that lavas poured out of hillside vents into valleys, where they solidified into hard resistant basalt. The hillsides were subsequently eroded, with the resistant basalt remaining behind.⁴¹

Goethe Intervenes

Although they were the same age, the auto-didact Goethe stood in awe of the academic Werner, and always treated him with the greatest respect. Goethe admired Werner's formal classic education, an education that he, self-taught, had picked up informally. Their relationship was always cordial and respectful. He would not be drawn into discussions with Werner where he knew that their opinions would clash. Although he had been introduced to Werner's ideas by Johann Voigt, Goethe was not a strict follower of the Wernerian school. In his opinions he was often ambivalent, although

⁴⁰ After the first meeting Voigt wrote: *'Privy Councillor von Goethe has told me that he understands quite well your theory about basalt. I am expecting him daily, and as soon as he arrives here a formal meeting will be arranged to discuss the matter. He hopes to unite both ideas, and I hope for it as well. . . .*

I must confess that after meeting you our conflict has now become doubly unpleasant. I believed that in responding to your objections I had done everything to be less harsh to you. But now it appears as if not a word was right. But its printed and already in Leipzig. My dear sir, shall we call it quits? And take on a more sober tone. If I have anything to add in future I shall do so. Not to prove that I'm right, but to resolve and contribute to a question without which geology could not exist.' Ilmenau, 7 October 1789.

⁴¹ One is reminded of Isaiah 40:4. "Every valley shall be raised up, every mountain and hill made low."

he tended to side with Werner's position. He trusted Werner's ideas, because Werner's approach resonated with his absolute conviction of the harmony and wholeness of Nature. The ordered and gentle appearance of geologic formations deposited from the *Urgewässer* appealed to Goethe. He even went so far as to revise his original opinion that granite had existed even before the primal ocean began to recede. By 1785 he agreed with Werner's conception that granite too had precipitated from the *Urgewässer*: "*From this general solution therefore, granite was deposited first, crystalized first.*"⁴²

The first meeting between Werner and Goethe took place in Jena in September 1789, the year after Goethe's return from Italy. Werner spent two days in the university town on a return journey from Paris. There is no record of their conversation(s), but Goethe would undoubtedly have used the opportunity to describe his volcanic experiences in Italy, and to gain a clearer understanding of Werner's views on volcanoes.

In a letter he composed two days later to Christian Gottlob Voigt, his colleague on the privy council, and Johann Voigt's older brother, Goethe wrote: "*We spent several congenial hours together, and I now understand his opinion about volcanoes. He has thought about the matter thoroughly, and marshalled the evidence for his (Neptunist) ideas with great care. He is sure to find more and more support for his ideas. We should now support your brother in framing a suitable retraction, and give assistance in finding an honourable settlement.*"⁴³

It is likely that Goethe helped set up the meeting between Voigt junior and Werner mentioned earlier. In a further attempt at moderation, he composed a document entitled "*Suggestions; an attempt to unite the Vulcanists and Neptunists about the Origin of Basalt*". Based on his own observations and ideas, he creates a synthesis of the conflicting opinions. It was never published in his lifetime, probably because his imagined underwater volcanic eruptions failed to convince either side. Key points are:

- Basalts and lavas are very similar in appearance and in their components. This has led to the conviction that basalts are volcanic in origin. Upon closer examination, difficulties arise. No craters have been discovered from which liquid basalt is supposed to have erupted, and basalt does have a relationship with some uncontested water products. Neptunists recognise lava as previously molten basalt, so on this point at least there should be agreement.
- The primal ocean had already deposited the primary formations when it reverted to a seething condition (*siedende Zustand*). The materials were freer and able to work more forcefully; in this heated epoch the basalts were deposited (*setzten sich die Basalte nieder*). At the same time so much combustible material had settled (*niedergeschlagen*) that to this day volcanoes continue to burn near the ocean.
- "*Thus basalts were the products of a universal volcanic ocean. Here no craters were necessary, nor any effluvium- only a vast, hot, burnt-out (ausgebrannte) deposit. The basaltic material not yet neutralized continued its ceaseless activity beneath the water. It produced incrustations, its forces worked in caverns below the surface it heaped up layer upon layer of crust, and tore them apart again. Parts of the interior became molten and expanded; thus volcanic islands and oceanic mountains arose, enormous ocean gulfs were filled, and entire ranges of volcanoes appeared along the coast.*"

42 From *Epochen der Gesteinsbildung* (1785), an essay found amongst his geognostic writings.

43 Letter to Christian Gottlob Voigt, 19 September 1789.

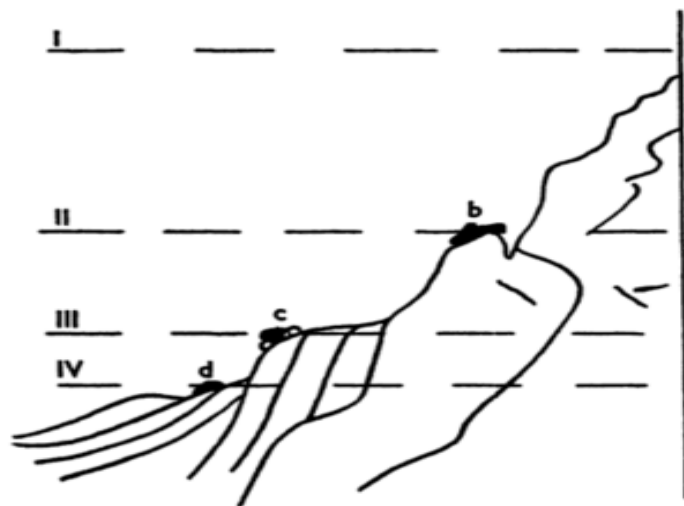
- *“It is here that the relationship is to be found between basalts and volcanoes. . . It is unnecessary to assume tremendous revolutionary changes which eliminated the craters leaving only their basaltic cores. Instead the above hypothesis meets the demand of the Neptunists by making the basalts a major type of rock formation, more closely related to the primary rock formations in some cases, and to the stratified formations in others, according to their different circumstances.”⁴⁴*

This description is not that far from what geologists now describe as the outpouring of flood basalts during the Tertiary Period, as well as at the mid-oceanic ridges still observed today.

Many years later Goethe tried to remove some of the contradictions inherent in Neptunism, in particular the draining of the primal ocean into underground cavities, and its reappearance whenever needed to explain the appearance of almost identical rocks at different levels and at different times. He called this a “sad makeshift answer” to one of Nature’s questions. *“One has to look for simpler ways. The latest discoveries in chemistry will certainly come to assistance, so that the question is solved with a single sinking of the waters.”*

In 1817 (the year Werner died) he made a sketch of how he imagined the formation of basalt near the surface of a receding primal ocean.

Although formed under similar physical and chemical conditions, their different levels indicated that the formations had precipitated in different geological epochs. Between periods of deposition chemical “infusions” eroded from the continents (and which chemistry would help to explain) were washed into the ocean, and caused a new underwater precipitate to form. *“The Trapp formations are everywhere similar; derived from one and the same chemical infusion under identical circumstances at the different heights.”*



*Fig 13 Goethe’s sketch from 1817 (with a greatly exaggerated vertical scale) illustrating how Trapp formation basalt can be deposited near the surface of a receding ocean. Granite makes up the oldest and highest mountain, along the side of which basalt is precipitated. Roman numerals – receding water levels. **b** Trapp basalt on transition formation. **c** Trapp basalt on stratified formation. **d** Trapp basalt on alluvial formation.*

This neatly explained the different elevations at which the Trapp basalts appear, their superposition on different types of sedimentary rocks, as well as their appearance on isolated hilltops.

Italian Journey

Goethe’s main interest during his travels in Italy concerned the development of his ideas on art, and improving his drawing and painting skills. But he did not neglect the study of Nature, and often compared the two.

⁴⁴ From Schminke, *Tanz auf dem Vulkan*, pp141-142. See footnote 27. Translation from Douglas Miller, editor and translator (1988) *Goethe’s Scientific Studies*, pp135-136.

“Here I cannot remain silent about a conclusion I have come to; that it is more convenient and easier to observe and appreciate Nature than Art. The slightest product of Nature has the circle of its perfection within itself, and if I only have eyes to see, I can discover the relationships. I am sure that within a small compass an entire true existence is enclosed. A work of Art, on the other hand, has its perfection outside itself. The ‘best’ in the Idea of the artist, which he seldom or never achieves, follows certain adopted laws derived from the nature of art and craft, but are not as easy to understand and decipher as the laws of living Nature. In works of Art there is a great deal of tradition. Works of Nature are always like a first-spoken word of God.”⁴⁵

He also did what tourist down the ages have always done, visiting St Peter’s basilica in the Vatican several times, and writing home about his experiences. On one occasion he wrote to Prince Constantin in Weimar: *“We recently went to St Peters church and nearly tripped over the Pope (as one is wont to say). After lunch we wandered about in the church and admired the beautiful stone slabs with which everything is decorated. Tischbein was just showing me an exquisitely patterned alabaster (actually calcite) on a tomb, when I whispered in his ear ‘There is the Pope’. His holiness really did kneel at a pillar in a long white vestment with a red cord, and prayed.”⁴⁶*

During his travels in Italy (1786-1788) Goethe witnessed several eruptions of Vesuvius and explored the volcano on three occasions. On 13 March 1787 he wrote in his journal that he had made a thorough study of the *“... Vesuvian products. Everything appears different when one sees the connections. Actually, I should spend the rest of my life making observations; I would make one or the other discovery that would increase human knowledge.”⁴⁷*

On his third ascent he witnessed a lava stream flowing down the slope in its self-created bed⁴⁸: *“Even though one has heard of a phenomenon a thousand times, its uniqueness only speaks to us from direct observation. The lava was narrow, perhaps no wider than ten feet, but the way it flowed down a gentle, fairly flat surface was striking enough. As it flows, it cools down on its sides and surface, so that a canal is formed, which continuously increases in height because the molten material underneath is also solidifying; the floating chunks of slag are thrown off to left and right;*



Fig 14 Uncovering the Ruins of the Temple of Isis at Pompeii. Coloured etching by Pietro Fabris.

45 Letter to the Duchess Louise (Karl August’s wife), Rome, 23 December 1786.

46 Letter to Gottlob Friedrich Constantin von Stein (Charlotte von Stein’s youngest son, ‘Fritz’), Rome, 6 January 1787. Johann Heinrich Wilhelm Tischbein (1751-1829) was a German artist living in Rome on a grant from Duke Ernst II of Gotha, (the Duchy bordering Weimar) arranged for him by Goethe, who was a friend of Duke Ernst. He introduced Goethe to the Roman art circles, and accompanied him to Naples even, rather unwillingly, hiking up Vesuvius with him.

47 Goethe *Italian Journey*, Naples, 13 March 1787. The *Italian Journey* is a detailed report of his experiences written up in 1816 and 1817 based on his journal and letters to friends at home. <https://www.projekt-gutenberg.org/goethe/italien/ital175.html>

48 Flowing lave creates for itself a natural conduit formed by a hardening of the lava where it is in contact with a cold surface.

by which means embankments are raised between which the fiery lava flows peacefully, as in a mill stream."⁴⁹

Goethe also visited Pompeii, where excavations of the more than three metres of volcanic debris which engulfed the town during the 79 CE eruption of Vesuvius had recently commenced. He wrote in his journal: "*Mindful of the distance between this place and Vesuvius, it seems impossible that the erupted material could have been driven here by wind or simply hurled across. One should rather imagine that these stones and ashes were suspended, cloudlike, in the air for a time, until they dropped down on this unfortunate place. If one wants to visualize this even stronger, picture a snowed-in mountain village.*"⁵⁰

A picturesque catastrophe! Goethe has forgotten the volcanic fury he had imagined in his letter to Duke Ernst II, and no longer accepts violent events of any kind in his conception of earth's physical evolution.

Sir William Hamilton

In Naples Goethe soon became acquainted with the British ambassador to the Kingdom of Naples, Sir William Hamilton (1730-1803). He had sought a position in a warmer climate because of the poor health of his wife Catherine, and he arrived in Naples in 1764. His official duties left him plenty of time to pursue his interest in art, music and antiquities, and as it turned out, volcanoes.

Two years after his arrival, Vesuvius erupted. Hamilton wrote a detailed report, and sent it to the Royal Society in London, together with sketches and lava specimens. The Society members were so impressed by this unexpected contribution, that he was elected a Fellow. Four years later he was awarded the Copley Medal for 'outstanding achievement'. He hiked up Vesuvius more than 50 times, and made numerous drawings of his observations. He wrote several books, German translations of which were available before 1786. During his 36 years in Naples he did not limit his interest to the local volcanoes, but also studied volcanic regions in other parts of Europe, including Germany.

In 1772 Hamilton published *Observations on Mount Vesuvius, Mount Etna, and other Volcanoes*, which was strongly criticised not only by fellow geognosts, but also by Anglican vicars. Here Hamilton expressed his opinion, based on the enormous amount of material deposited by Vesuvius over the centuries, that volcanoes played a significant role in the construction of Earth's surface, and are not just local phenomena. Furthermore, he estimated, by examining the transitions between the various layers of ash, slag, and other volcanic debris, that between 15,000 and 20,000 years would be required for these deposits to form – in stark contradiction to the prevailing view (particularly in Britain) that the Earth was no more than 6000 years old.



Fig 15 Phlegrean Fields after Eruption of Vesuvius 1760-1761. Illustration by Pietro Fabris.

49 Goethe *Italian Journey*, Naples, 20 March 1787.
<https://www.projekt-gutenberg.org/goethe/italien/ital177.html>

50 Goethe *Italian Journey*, Naples, 11 March 1787.
<https://www.projekt-gutenberg.org/goethe/italien/ital174.html>

This was followed in 1776 by a collection of his letters on volcanoes entitled *Campi Phlegraei (Flaming Fields)*, the traditional name of the area around Naples), illustrated by Pietro Fabris (1740-1792) with 54 hand coloured illustrations of volcanic landscapes.⁵¹ This was a work of love, a connoisseur's masterpiece, which was later used by Goethe in Weimar. See Figure 15. Hamilton visited Calabria and Messina after the earthquake of 1783, and wrote another paper describing his observations and conclusions for the Royal Society.

According to Hamilton volcanoes arose deep within the earth. By counting the alternating sequences of weathered soils and lava strata he was able to deduce the number of past eruptions. The fire of a volcano is not in the crater itself, but lies considerably deeper. If the enormous masses of lava and ash originated near the surface, the resulting hollow would be so great that the crater would collapse into it. He also pointed out that the 'volcanic fires' did not burst asunder the Phlegrean Fields, but pushed them up by pressure from below.

Another idea first suggested by Hamilton, was that the high explosivity of some volcanoes was caused by contact of magma with water (actually superheated steam) deep in the bowels of the Earth, a stark contrast to Goethe's peaceful mill stream. It remains an open question whether Hamilton was aware of Hutton's work in Scotland, but however that may be, his ideas and the evidence he provided for them made significant contributions to the Plutonist cause.

Goethe visited Hamilton on several occasions. It seems surprising that Hamilton and Goethe did not discuss the Neptunism-Vulcanism debate then at its height.⁵² If they did, then neither Hamilton nor Goethe left any trace of the discussion. Goethe's three ascents of Vesuvius were either alone or with the artist Tischbein. It seems likely that he thought Hamilton's views incompatible with his own, and that he preferred to discuss their shared interest in art, especially Hamilton's collection of Greek vases. He might also have been distracted by Emma Hart, Hamilton's fiancé at the time (see text box). In addition, he had a major botanical project on his mind.

In the journal entry of 13 March already quoted he wrote: "*Please inform Herder that my botanical understanding is making good progress. It is always the same principle, but it would require a lifetime to carry it out. Perhaps I am still able to describe the main outlines.*"

Four weeks later he was in the botanical garden in Palermo, and wrote; "*Seeing such a variety of new and renewed forms, my old fancy suddenly came back to mind: among this multitude might I not discover the archetypal plant (Urpflanze)? There certainly must be one. Otherwise how could I recognise that this or that form was a plant, if all were not built on the same basic model. I attempted to examine how it might be possible to distinguish between the many divergent forms. And I always found them more alike than unlike. If I wanted to apply my botanical terminology, it was possible, but led nowhere; it made me restless without helping me forward. My good poetic intentions were disturbed. Gone was the garden of Alcinous.*"⁵³ A world garden opened

51 Fabris also painted concert parties organised by Hamilton, including one that shows Mozart at the harpsichord.

52 While in Naples Goethe had received news of the stand-off between Werner and Voigt.

53 Goethe had planned that day to continue with his drama *Nausikaa* in the botanical garden. *Nausikaa* is the daughter of Alcinous, king of Phaeacia, the island on whose shore the shipwrecked Odysseus was cast on the third day of his near death experience battling the wrath of Poseidon, and where he relives his past adventures in a kind of panoramic vision. A close reading of this chapter of the *Odyssey* reveals that the gardens are an Imagination of the life sphere of the earth, but that unlike the gardens of Calypso, those of Alcinous are cultivated. The drama was never completed, but the surviving fragment contains beautiful

up before me.”⁵⁴ Goethe’s powers of Imagination had perceived the “*archetypal plant*” (*Urpflanze*).

On his last evening in Naples Vesuvius again erupted. As chance would have it, he was staying with a German aristocrat, Duchess von Giovane, an aspiring author, whose villa overlooked the bay. She had an interest in minerology, but their main topic of conversation that evening was literature, in particular Herder. Goethe wrote of this last evening:

*“Twilight had already fallen, and no candles had been brought yet. We paced up and down the room, and she, approaching the shuttered windows, pushed one open. I caught sight of what one sees only once in a lifetime. If she did it intentionally to surprise me, she achieved her purpose perfectly. We stood at a window on the upper floor, Vesuvius directly in front of us. With the sun having already set, the steadily flowing lava, whose glowing flames were clearly visible, and whose accompanying smoke began to show a golden hue; the mountain violently rumbling, above an immense cloud of steam whose separate masses lit up by each glowing ejection as if by lightning. From there down to the sea, a swathe of glowing lava and vapours; land and sea, rocks and shrubs clearly visible in the evening twilight, tranquil, in a magical peace.”*⁵⁵



Fig 16 Goethe’s 1787 drawing of Vesuvius erupting.

Stiftung Weimarer Klassik

At other times he considered the eruption of Vesuvius as “*hideous*” and “*dangerous*” (see Figure 16), but in 1823 he nevertheless felt able to write: “*When faced with the violence of a volcano, it appeared to me merely as an ongoing, but superficial late work of Nature.*” He felt the same about the cinder cone crater known as ‘Monte Nuovo’ (New Mountain), rising from the Phlegrean Fields in a matter of days at the end of September 1538, completely burying the ancient village of Triepole.

It remains a surprising fact that neither his meetings with Hamilton, nor the direct observations he made in Naples and Sicily, did anything to change his understanding of volcanic activity. On the contrary, the ash cloud which had enveloped and suffocated Pompeii, and the “*peacefully flowing*” red hot molten lava stream which he observed, were for him evidence that vulcanism is not a result of violent activity deep within the earth, but rather of something harmonious and peaceful: “. . . *that the cause of volcanic activity does not lie very deep. I would consider as deep anything below sea level.*”⁵⁶ This note in his Italian journal is yet another example of his belief in a local cause for a local phenomenon, and how he was able to integrate violent events into his benevolent view of Nature to his own satisfaction.

verse, evocative of the Greek islands and classical antiquity. It has often been commented that Goethe discovered classical Greece in Sicily.

54 Goethe *Italian Journey*, Palermo, 17 April 1787.

55 Goethe *Italian Journey*, Naples, 2 June 1787.

56 Goethe *Italian Journey*, Pozzuoli, 19 May 1787, note in journal.

Emma Hart (1765-1815), Lady Hamilton from 1791

The poses which so impressed Goethe were developed by her as “attitudes”, evoking figures from Greek and Roman mythology, and according to Goethe, a great deal more besides. Her “attitudes” were a kind of early charades, and were in fact first shown publicly during Goethe’s visit to Sir Hamilton in March 1787.

“If one likes to study in Rome, one only needs to experience life here. One forgets oneself and the world, and for me it is a wonderful feeling to live among people who enjoy life. The knight Hamilton, who still lives here as the English ambassador, is an art lover, and has studied nature for many years. He has now found the pinnacle of the delights of nature and art in a beautiful girl.

She lives with him, an English woman of about twenty years. She is very beautiful and well built. He has had made for her a Greek garment, which suits her perfectly. She loosens her hair, picks up a few shawls, and takes on a variety of positions, gestures, facial expressions etc., so that one really imagines oneself in a dream. One sees before one what so many thousands of artists would have liked to achieve in movement and with a surprising variety. Standing, kneeling, sitting, lying, serious, sad, teasing, sensuous, repenting, enticing, threatening, anxious etc., one pose following the other and merging into the next. She knows how to arrange and change the folds of the veil for each expression, and makes herself a hundred types of head dress with the same cloths. The old knight holds the light and surrenders himself to this display with all his soul. He finds in it all the antiquities, all the beautiful profiles on Sicilian coins, even the Apollo Belvedere itself. This much is certain, the pleasure is unique! We have already enjoyed it on two evenings. Early this morning Tischbein is painting her.”

From Goethe, *Italian Journey*, Naples, 16 March 1787.

Tischbein painted Emma Hart several times in various poses, including as Iphigenia.

The Eifel

Goethe visited the Eifel volcanic region in July 1815 together with Baron von Stein.⁵⁷ The Eifel hills lie to the West of the Rhine, not far from his birthplace Frankfurt. The landscape is dominated by volcanic craters, and thick pumice and basalt layers. More than a dozen craters are filled with water, forming the so-called maars (crater lakes) originally caused by explosive eruptions. Best known is the *Laacher See* (Lake Laach). There is also abundant evidence of tephra⁵⁸ and lava streams. Yet Goethe appears to have completely forgotten all the evidence of volcanic activity he had seen in Italy.

After his tour of the Eifel Goethe stayed in nearby Wiesbaden with the amateur German art historian Sulpiz Boisserées⁵⁹ (1783-1854), whom he had first met in 1811. Boisserées kept an extensive journal, and on August 2 he gave details about a conversation with Goethe in which the latter expressed his thoughts and feelings as follows:

“It would have to be forcibly wrung from me if I



Fig 17 gives an idea of the amount of tephra ejected by the Eifel volcanoes. The distinct layers reminded Goethe of sedimentary strata deposited in water.
de.wikipedia.org

57 Heinrich Friedrich Karl vom und zum Stein (1757-1831), was a Prussian statesman and adviser to the Russian Tsar, who retired from public life after the signing of the treaty of Vienna on 25 March 1815.

58 Solid matter, such as ash, dust, and cinders, that is ejected into the air by an explosively erupting volcano.

59 Boisserées was the main driving force behind the completion of Cologne cathedral.

should ever recognise anything as volcanic. I cannot get outside my Neptunism. That was most striking about the Laacher See and Mendig.⁶⁰ You see, it left me completely at peace; the lake with its gentle hills and beech groves; and why shouldn't water make porous stones such as pumice and the Mendig tuff? That the water before it finally settled made one more major movement, as at the very beginning, why not?⁶¹ It would be more difficult for Vulcanism to present Mendig tuff as lava, and explain how it flowed and arrived in its present location. Yes, when we're talking about volcanoes, as at Nemi in Italy⁶², then I'm necessarily overcome and convinced, then I believe, and it means something if I once recognize a volcano and defend it; just like in Bohemia where I proved how I could embrace a volcano. But here (in the Eifel region) Hamilton saw more than there was to see, and the unfortunate de Luc⁶³, who really doesn't understand anything about it, merely chatters after him."

"The different ways in which we imagine things, that's why we humans, with only a limited amount of knowledge, cannot clear things up between us; instead we merely repeat old truths and errors in a new way; that's why we cannot come to an understanding about so many things, and why I often have to tell myself: about this or that matter in Nature, you can only speak with God; of what further concern is it to the world. It either accepts my way of seeing things (Vorstellungsart) or not, and in the latter case, humanity is of no use to me. So, about many things I can only speak with God."⁶⁴

There is no evidence that Sulpiz Boisserées had any interest in geology, and it is not clear what emotional trigger moved Goethe to this outburst. Goethe had agreed some years earlier to assist Sulpiz and his younger brother Melchior arrange an exhibition of early Flemish art in Heidelberg⁶⁵, a project he did not altogether agree with, but which he had felt drawn into against his will. He had also promised a pamphlet describing the exhibition, but which in August 1815 he had not yet begun. Perhaps Goethe was under pressure, held hostage to an earlier promise he had made. Whatever the reason, it left the brothers in no doubt about his Neptunist views.

Bohemian Summers

Between 1785 and 1823 Goethe escaped courtly life to visit the spas in Northern Bohemia (today part of the Czech Republic). During these years he took 17 Bohemian holidays, always during summer or autumn, and he spent a total of more than 3 years there (longer than he spent in Italy). He 'took the waters' for his health, and to socialize. There were no courtly protocols at the spas, and it was possible for the

60 A nearby town well known for its volcanic tuff, already quarried by the Romans.

61 This statement is all the more surprising, because Goethe had seen the ash, tuff, tephra etc ejected by Vesuvius with his own eyes.

62 Lake Nemi, near Rome, is a volcanic crater lake, which Goethe saw on his Italian journey.

63 Jean-André de Luc (1727-1817) was a Swiss natural scientist and geologist who between 1778 and 1780 wrote a six volume work entitled *Physical and Moral Letters about Mountains and the History of the Earth and Man*.

64 From an August 2 journal entry by Sulpiz Boisserées. Quoted in Schminke, *Tanz auf dem Vulkan*, p148. Also in *Goethe – Begegnungen und Gespräche* (2018) which reveals that Boisserées used quotation marks to indicate that this is not his paraphrase of what Goethe said, but were his actual words. It must be born in mind though that Goethe's polemics against people he disagreed with often took place in the evenings after several glasses of wine with friends in a lively and congenial atmosphere. Though often quoted, they are more a reflection of his state of mind than his powers of judgement (*Urteilkraft*), and should probably not have been recorded for posterity.

65 See E. H. Gombrich (1987) *A Documentary History of Goethe's Response to the Boisserée Collection*. <https://gombricharchive.files.wordpress.com/2011/04/showdoc23.pdf>.

nobility to mingle with the untitled civilian middle classes relatively informally. Goethe the politician and administrator benefited as much from this informal approach as did the author, the artist, the music lover, and the geologist.

Goethe first visited Karlsbad during the summer of 1785. Duchess Louise and her entourage were there, and important friends such as Charlotte von Stein and Herder had also arrived from Weimar. On the last day of this first visit he wrote to Karl August: “*Some of the rust stains that too persistent a solitude brings over us are best removed here. From granite, through the whole of creation right up to the women, everything has contributed to make my sojourn pleasant and interesting.*”⁶⁶

The spas in this part of Bohemia were established over a major fault line (the Egergraben Fault) in Earth’s crust, through which hot mineral rich water reaches the surface. In the early years Goethe stayed at Karlsbad, Eger and Teplitz. In later years, after they had opened or become more accessible, he also visited the spas at Franzensbad and Marienbad.

During his stay in Karlsbad in 1807 Goethe wrote a booklet “*Compilation to assist in the Understanding of the Geology in and around Karlsbad*”, to accompany the mineral collection he had assembled. Werner was there too that summer, and Goethe reports that they met daily, and had many discussions on a range of subjects, including geognosy. He recalled their geognostic conversations as “*harmonising, more out of mutual respect than agreement on basic principles.*”⁶⁷ He carefully avoided the question of the heat source of the spa’s thermal waters, because he knew his opinion differed from that of Werner, who held to the coal fire seam theory. Goethe’s view was that the source of heat was a result of chemical reactions released by contact of subsurface water with granite. Nevertheless, Goethe enjoyed discussing his ideas with Werner. “*I was sincere and open about other matters, and he, with truly exemplary courtesy, took pleasure in discussing my dynamic theories, even though he thought them mere fancies, and offering advice based on his rich experience.*”⁶⁸

Goethe often acted as geognostic tour guide. In a letter from September 1808 to her friend Karoline Schelling, Pauline Gotter wrote that Goethe was friendly and informative on their hikes through ‘*the enchanting area; there isn’t a rocky outcrop within three hours of Karlsbad which we haven’t climbed with Goethe.*’⁶⁹

In September 1807 he approached Carl Cäsar von Leonhard, professor of geology at Heidelberg university, who published of a popular geological magazine read by both amateurs and professionals. He offered von Leonard his Karlsbad “*Compilation*” for publication, and this was accepted. Goethe however, was aware that he was an outsider in the natural scientific field, and that his method of working was but poorly understood. His discovery of the intermaxillary bone in 1784, and his realisation that there was after all an archetypal plant in 1787, had been coolly received not only by sceptics, but also by his friends. In an effort to prevent more misunderstanding, he wrote to von Leonard in October, outlining his approach to his geognostic work.

“In order to avoid misunderstanding, I should first of all explain that my way of looking at and approaching the objects of Nature proceeds from the whole to the particular, from the total impression to the observation of the parts, and that I am quite

66 Letter to Duke Karl August, 15 August 1785.

67 From the *1897 Tag und Jahreshefte* (Journals and Annals). These autobiographical memoirs were written between 1817 and 1823, and published in 1830.

68 Op. Cit.

69 Quoted in Gerd-Rainer Riedel, Jochen Klauß, Horst Feiler (2009) *Der Neptunistenstreit; Goethes Suche nach Erkenntnis in Böhmen*, Schibri-Verlag, www.schibri.de, p30.

well aware how this kind of natural research, as well as its opposite, is subject to certain peculiarities, yes, even to certain prejudices. . .

Certainly, according to my convictions, one would argue much less about objects of knowledge, their derivation and explanation, if everyone first and foremost knew themselves, knew to which side they belonged, and were aware of the mindset most appropriate to their nature. We would then declare the maxims that dominate us quite unequivocally, and calmly share our experiences and opinions accordingly, without getting involved in any dispute. For in the end, disputes result in nothing more than that opposing, incompatible ways of imagining things express themselves plainly and clearly, and that each insists all the more rigidly on their own mental images. Therefore, if people cannot agree with my geological comments, they should consider the basis from which I start and to which I return.”⁷⁰

The Kammerbühl

Of particular interest to Goethe during his sojourns in Franzenbad⁷¹ were two low hills in the area, which could possibly be seen as resembling volcanic craters, the Kammerbühl and the Eisenbühl, where both basalt and volcanic ash had been found.

The *Kammerbühl*⁷² is a low hill between Franzenbad and Eger. Basalt was quarried for use as building stone, and ash and cinders for road construction. Goethe often walked up the hill to enjoy the view, which he captured in his drawings. Fig. 18 dates from his first visit to Franzenbad in 1808. Already in 1773 geognosts had debated the volcanic character of the hill, and its similarity to the Auvergne volcanoes. Fig 19 shows the hill as seen today.

The *Kammerbühl* held a particular fascination for him, and over the years he made eleven excursions in an effort to solve his conundrum. He wanted to know whether the hill was a remnant of an extinct volcano, or whether its origin could be explained by the Neptunist worldview. The quarry which can be seen in Goethe’s drawing shows clearly layered deposits - to Goethe a sure indication of their sedimentary origin. Yet these deposits consisted of volcanic products, of ash and small rock fragments known as lapilli⁷³, and there was plenty of basalt to be seen, which he believed was precipitated (or reprecipitated) from the primal ocean.



Fig 18 One of Goethe’s many drawings of the Kammerbühl, graced with an imagined Greek temple.



Fig 19 The Kammerbühl as it appears today.

⁷⁰ Letter to Carl Cäsar von Leonhard, 1 October 1807. Von Leonard published both the “*Compilation*” and the letter early in 1808. After this introduction he corresponded regularly not only with Goethe, but also with von Buch, Werner and Voigt.

⁷¹ See map on final page.

⁷² *Bühl* is a local word for ‘hill’; Goethe also refers to the hill as the *Kammerberg*.

⁷³ Lapilli (from Italian) are rock fragments between 2 and 64 mm, ejected by a volcano.

In July 1808 he wrote a short treatise summarizing his impressions. He speculated that the hill might be of volcanic origin. *“But although we’re speaking here of naturally occurring warming events, we also note that we are touching upon a hotly debated theoretical topic; namely where the dispute between Vulcanists and Neptunists hasn’t quite cooled down yet.”*⁷⁴ In the end he came down on the side of a volcanic origin. He was unable to explain the complete absence of a crater, and conjectured that the eruption might have taken place under water. He encouraged all those interested to go and see for themselves, to *“practice their acumen”*. (*Scharfsinn*)

In an attempt to establish whether re-melting of a primal rock would result in volcanic rocks, he carried out experiments in porcelain and pottery kilns with rocks and minerals brought home from the *Kammerbühl*. He was assisted in this by Döbereiner, a chemist in Jena. The experiments did not provide the expected results⁷⁵ and thus failed to explain the formation of the mysterious hill. He was probably not surprised because back in 1796 he had written in his *Xenien*: *“Poor basaltic columns! Supposedly born in fire; yet no man has ever seen you rise from the flames.”*

Similar experiments had been made in England by Gregory Watt (1777-1804), the son of James Watt. He too was intrigued by the much-debated question of the origin of basalt, and was undecided as to whether to side with the Neptunists or the Vulcanists. Like Goethe, he had spent time in Italy studying the volcanoes. On his return home he carried out experiments melting basalt, and was able to produce the characteristic prismatic columns as the melt solidified⁷⁶ Goethe commented that such experimental work did not prove that all columnar basalts are lavas, because Nature often achieves the same ends by entirely different means.

In 1819, while in Karlsbad, Goethe attempted to write down the impressions he had gathered in Bohemia; *“A lapsed Neptunist’s Final Disclosure. Farewell to Geology”*⁷⁷. He was resigned to concluding that a lifetime of observations had only been able to prove themselves. The crux of the problem appeared to be whether conclusions reached in Auvergne were also valid in Thuringia, and by implication in Bohemia, where he had recently discovered columnar basalt. He described these in the third volume of *Zur Naturwissenschaft*, and concludes his description as follows:

*“As we have no explanation as to where these things (Basalt) might come from, it is of no consequence whether we receive them from above (i.e. water), or from below (i.e. fire), as long as they always provoke (reizen) us to observation, motivate (veranlassen) us to think about them, and oblige (nötigen) us to exercise modesty.”*⁷⁸

Fortunately, his *“farewell”* lasted less than 24 hours. Goethe was not about to give up. The very next day, on 19 September 1819, he wrote to Carl von Leonhard. Leonhard had written to Goethe earlier that year that he was tending *‘with moderation’* towards *‘fire’*. He had recommended that Goethe read a lecture about the possible origin of basalt, which Leopold von Buch had given at the Berlin Academy in May 1818, and

74 Quoted in Fritz Krafft (2009) *Goethe zwischen Neptun und Vulkan*, https://www.researchgate.net/publication/256455032_Fritz_Krafft_Goethe_zwischen_Neptun_und_Vulkan, p.10.

75 *“Obviously fires in Nature aren’t quite the same as those in a potter’s kiln”*, he wrote on 14 August to J. H. Meyer.

76 R. A. Wells (1959) *Goethe and the Development of Science 1750-1900*, p65. The Scottish geologist James Hall (1761-1832) successfully performed similar experiments.

77 In German *„Eines verjährten Neptunisten Schlussbekenntnis. Abschied von der Geologie“*. Karlsbad, 18 September 1819.

78 Quoted in Johann Wolfgang Goethe, *Die Metamorphose des Granits*, collected and commented by Dankmar Bosse (1985) Verlag Freies Geistesleben, p. 145.

which he (von Leonhard) had published in his magazine.⁷⁹ Goethe thanked him for his letter and the lecture in which he expressed a strong interest and asked him to “*do me the favour of drawing my attention to everything happening in this regard. Although a lapsed Neptunist, I have never considered the case to be closed.*”

And so he continued his investigations into the origins of earth’s rocky surface. In May 1820 Goethe wrote to his friend Carl von Schreibers in Vienna: “*The geology of my present surroundings has interested me for many years; because, as the doctors tell me I should neither read nor write, in effect not even think, peaceful contemplations of Nature continue to entertain and refresh me. Here it is above all crags and rocks which attract our attention; oldest, younger and the most recent enclosed in the depths of earlier worlds, in contrast to what is produced on a daily basis; through which one is always led from the effect to the cause, and from the cause to a higher (purpose). In this sense I have visited Karlsbad for thirty-five years, and always discovered something new and admirable*”.⁸⁰

He made another field trip to the Kammerbühl that summer and wrote a second treatise “*Der Kammerberg Bei Eger*”, this time as a confident Neptunist.

A like-minded Colleague at last: Karl Nose

In July 1820 Goethe came across a book by the medical doctor and natural scientist Karl Friedrich Nose (1753-1835), in which he found his geognostic ideas confirmed.⁸¹ He immediately set to work studying it, and in August he summarized it in an essay (“*kurzen geordneten Auszug*”), simply entitled “*Karl Wilhelm Nose*”, which he published in Volume 1, Part 3 of “*Zur Naturwissenschaft überhaupt*”, his first collection of natural scientific writings.

Nose believed that volcanic rocks were indeed produced by subterranean heat resulting from coal fire seams, or, he suggested, by some still unknown process of ‘fermentation’ (*Gärung*). In addition, he conjectured that for each type of volcanic rock there existed a specific primordial parent rock. But for basalt there was no obvious parent rock, because, according to Nose, although it appears in a variety of contexts, it always has the same characteristics. This was in full agreement with conclusions Goethe had drawn.⁸² Basalt itself was therefore a primordial rock, the formation of which derived from unfathomable primeval causes. For Goethe this meant that the debate on whether basalt had a ‘Neptunist’ or a ‘Vulcanist’ origin was no longer of any great importance. Columnar basalt (imagined as very large crystals) was a result of a “*wet*” transformation of the primordial parent rock; volcanic products of “*fiery*” changes to the same. See textbox for excerpts from Goethe’s summary.

In conclusion Nose asks whether something not yet researched should be declared unresearchable. This was for Goethe the most important question, and he (Goethe) explains his belief that there are no limits to human knowledge, but that nevertheless, when we are face to face with a primal phenomenon (“*Urphenomen*”), there is no need to do any more. This was the only occasion when he used the word “*Urphenomen*” in his geognostic writings. He had used the concept only sparingly in his scientific writings, applying it to only two other natural phenomena: often when describing light passing through a turbid medium, and once when writing about magnetism.

79 Letter to Carl Cäsar von Leonhard, 19 September 1819.

80 Draft of letter to Carl Franz Anton von Schreibers, dated 23 May 1820. Von Schreibers was an Austrian naturalist and director of the Natural History Collections in Vienna.

81 ‘*Historic Symbols, Concerning the Genesis of Basalt, offered as a Reconciliation of the Factions*’.

82 See Goethe’s ideas on the Trapp formations and Figure 13 above.

Goethe's response to Karl Wilhelm Nose's book

“The previous essays do not deny the influence that these few pages exerted on me; I dared to speak more freely about certain natural phenomena and conditions than hitherto, yes, even as such a valued predecessor and collaborator (i.e. Karl Nose), who, as is easy to see, fearing the onrushing lavas of the latest Vulcanism, wanted to flee to reliable primordial bedrock (Urfelsboden) in order to communicate his opinion from there to the specialist and to the sympathetic, without exposing himself to an unpleasant controversy.” . . .

Nose describes the problems posed by basalt, explaining that neither Neptunism nor Vulcanism can answer deeper questions about the origins of the earth, and suggests other possibilities similar to the ones Goethe had discussed with Herder in the early 1780's.

“He divided this science (geognosy) into two sections: the oldest mountain species were assumed to have originated along the wet path, the newer ones, which are not alluvial and are therefore definitely characterised by violence, had to be counted as the products of underground fire. If however Vulcanism is not completely based on coal and inflammable materials, not on an underground inferno, but still producing heat and fermentation, combustible beings (Wesen) blazing up into flames, then one also wants to defend oneself against a gross Neptunism, and not suggest a storm tossed ocean, but rather point to a denser atmosphere, where manifold types of gas, impregnated with mineral parts, act on the formation of the surface of our planet by electrical-magnetic stimulation.”

Goethe considers a long section from Nose's book so important that he quotes it directly.

“But let us be more determined and tread more directly where alone salvation is to be found. The finger of history points clearly enough to the need, to the inescapable imperative, to seek for and name for every volcanic product an original parent rock; without this bedrock (Substrat) everything remains dark and enigmatic.”

And continues, following Nose, with the example that fossil plants and animals must once have been living organisms assimilated into the mineral kingdom. Every secondary appearance must have been preceded by a primary phenomenon.

“Therefore, if basalt as such, and as a leading rock in certain formations, is also recognized as an original bedrock (ursprünglichen Gebirgsart), then every other formation can also be supposed to arise through a general primordial cause - which, after all, may be unfathomable to us, and may remain so - in one or more earth epochs. Then one is on firm ground, one can tread more securely than with any contrary (ideas) and roam in full, pure light.”

Nose then explains that in doubtful cases it is always possible to conduct experiments in a furnace (“Pyrotechniques”), and comparing the end products with examples in the field.

At the end of his essay Goethe poses the question whether it is permissible in science to consider, as Nose did, basalt as unresearchable. His answer is ambivalent. Even though we may deem something as unresearchable, we should therefore not set a limit to human knowledge.

“The most important question now arises: to what extent can we declare something not yet researched to be unresearchable, and how far man is allowed to progress before he has cause to step back from the incomprehensible, or to stand silent before it. Our opinion is that it is quite fitting for man to assume that something cannot be researched, but that he does not therefore need to set a limit to his research. For even if Nature does have an advantage over man and appears to conceal many things from him, he on the other hand has an advantage over Nature, in that even if he cannot think through her, he can think beyond her. We have already advanced far enough against her, when we attain to the primal phenomena (Urphänomenen), which we behold face to face in their unexplored glory, and then turn back again to the world of appearances, where the incomprehensible in its simplicity reveals itself in thousands and thousands of varying aspects, yet invariant amidst manifold variation.”

Quotations translated from

<https://www.gedichteundzitatefüralle.de/2020/02/jwvgoethe-karl-wilhelm-nose-geo.html>

For Goethe a primal phenomenon was not accessible to rational explanation. It therefore required a different consciousness to ‘understand’ basalt, a consciousness which Goethe describes as being face to face with an unresearchable glory (*Herrlichkeit*). Goethe is using the language of religion to describe at least the possibility of a spiritual experience, and suggests that in the face of such an experience, there is really nothing left to say. Insofar as it is possible to tell, Goethe did have one such experience in December 1777, when the 28 year old stood on the summit of the Brocken. But in summing up his feelings (in *Maxims and Reflections*), he keeps his feet firmly on the ground: “*The highest happiness of our contemplations is to have researched what is researchable, and to quietly honour the unresearchable.*”

In his first letter to the Corinthians (13;12), St Paul described such an experience as follows. ‘For now we see only a reflection as in a mirror, then we shall see face to face. Now I know only in part, then I shall know fully, even as I am fully known.’

Back to the *Kammerbühl*

In July 1822 Goethe was back for what turned out to be his last visit. He made a third attempt at reaching clarity; in a treatise simply called “*Kammerbühl*”, he again appeared undecided. On 13 July he wrote: “*The Kammerbühl is remarkable because it consists of volcanic products; whether these are real or pseudo-volcanic⁸³ is the question. But whatever point of view one takes, because of the unusual circumstances (in which the hill was formed), some aspects remain problematic.*”



Fig 20 The *Kammerbühl* excursion. From left to right: Goethe, Count von Sternberg, Joseph Grüner, Berzelius, and Johann Pohl. From Hans Ulrich Schminke (2002) *Tanz auf dem Vulkan*. Aquarelle by Pavel Major (Czech illustrator) 1998.

Two weeks later, on July 30, Goethe met the Swedish scientist Jacob Berzelius who was staying at the spa in Eger. Berzelius introduced Goethe to a technique he had invented to quickly identify a mineral in the field.⁸⁴ After lunching together, Goethe invited Berzelius to explore the *Kammerbühl*. They were joined by Count von Sternberg⁸⁵, police superintendent Joseph Grüner (1780-1864), and naturalist Johann

83 In other words, not ejected from a volcano, but showing evidence of being strongly heated by burning coal seams underground.

84 A blowpipe test uses the colour of a flame passing over a small rock fragment to identify certain metals specific to certain minerals.

85 Count Kaspar Maria von Sternberg (1761-1838) was another allrounder. He initially studied theology, then extended his interests into a mineralogy, geognosy, botany and entomology. He established the botanical garden in Regensburg, as well as the Bohemian National Museum in Prague, donating his collection of minerals, fossils and plant specimens to form the core collection of the Museum. He is widely regarded as the founding father of palaeobotany. He first met Goethe in 1820, from which point on they engaged in an extensive correspondence until Goethe’s death in 1832. For more on Goethe’s friendship with von Sternberg see: C. Schweizer *Johann Wolfgang von Goethe and Caspar Maria Count Sternberg* (2007) Geological Society, London, Special Publications, 287, pp 63-72.

Emanuel Pohl (1782-1834), who was a professor of medicine from Vienna. According to Berzelius, Goethe beckoned his servant to clear a small area of undergrowth and moss, exposing some rock. Berzelius took his hammer, knocked a piece off and found olivine, clearly a sign of its volcanic origin⁸⁶. Goethe was delighted. The hill has a strongly asymmetric shape, which Berzelius put down to strong Westerly winds which caused the ashes and cinders to be deposited on the East side of the hill. The problem appeared to be solved.

But in a separate essay, “*Marvellous Event*” (*Wunderbares Ereignis*) Goethe describes a discussion he had that same evening with a “*young and lively spa guest*” who advocated a pseudo-volcanic origin. Goethe pointed out the difficulties which a pseudo-volcanic origin left unanswered, which the guest countered with even more questions. No agreement could be reached: “*And so we stood there, separated by a ravine which neither knew how to cross. I, for my part, believed myself to recognise that it depended more on impulse than on coercion whether we choose to take one side or the other.*”⁸⁷ The lively spa guest has never been identified, and at least one author considers him or her fictitious.⁸⁸

However that may be, the essay closes with his reflections on the incident, which prompted him to attempt to “. . . engender a milder, more versatile mood, which would give one the pleasant feeling of rocking between two opposing opinions, and perhaps persevering with neither. Thereby we double our personality.” Reading the whole essay, in particular this concluding remark, it seems likely that Goethe was having second thoughts. The olivine had not convinced him, and he was describing an inner debate.

The following day Goethe commented to Sternberg that the hill would continue to pose problems until a tunnel was excavated through the base of the hill to the suspected crater. More than 10 years later, between 1834 and 1837, Sternberg did indeed excavate a 300 m long horizontal tunnel to the eruption vent (the first tunnel dug for purely scientific reasons), leaving no doubts about the hill’s origins. A commemorative plaque has been placed next to the tunnel entrance. See Figure 21.

The *Kammerbühl* basalt (technically known as an olivine nephelinite) resulted from one of the last volcanic outbreaks in the Egergraben fault zone, about 720 thousand years ago.⁸⁹ The magma carried up a large number of xenoliths, (rock fragments that become enveloped in a larger rock during the latter’s development and solidification), and the size of the lapilli and volcanic bombs, which often enclose mica schist and quartz, indicate a strong underground explosion caused by steam or water.

Given that Goethe had made detailed explorations of Vesuvius and Etna, we may be surprised by his hesitation to consider the



Fig 21 Plaque at the tunnel entrance commemorating Goethe’s *Kammerbühl* expeditions.

86 Olivine is a common mineral (magnesium-iron silicate) in basalt, originating in earth’s upper mantle, and carried to the surface by rising magma, where it weathers quickly. It is usually green in colour.

87 „*Wunderbares Ereignis*“, essay in „*Zur Naturwissenschaft überhaupt, Vol II, Part 1*“ (1823).

88 Goethe Handbuch, Supplemente 2. pp192-193.

89 About the same (geologic) time as the second stage of the volcanic eruptions in the Eifel, which Goethe had toured in 1815.

Kammerbühl of volcanic origin. The absence of a cone or a crater tended to trump the actual evidence, such as slag, ashes and the presence of olivine. Many geognosts at the time were equally uncertain as to whether the *Kammerbühl* had been a genuine volcano. Chemical analysis of minerals was in its infancy, and thin section microscope identification had not yet been developed. Whether Goethe would have accepted conclusions drawn from such modern techniques is an open question. He trusted only his eyes and his highly developed but uncanny intuition. It was simply impossible to imagine that volcanoes could be eroded away over time without leaving a trace. Here Voigt (and Hutton in England) pioneered a decisive change in thinking about the earth.

But Goethe was losing interest in the Neptunist-Vulcanist controversy. Werner had died in 1817, Neptunism had been abandoned, and the Vulcanists were becoming Plutonists. It was to them that Goethe now turned his attention.

The Conversation that never happened - Leopold von Buch

Christian Leopold von Buch (1774-1853) studied at the mining academy in Freiberg together with Alexander von Humboldt. A family income enabled him to become a full-time researcher at the age of 23. He visited the Alps and travelled through Italy, journeys he followed up with a travel book dedicated to Werner, in which he is quite definite about his Neptunist views: *‘Every country and every district where basalt is found provides evidence directly opposed to any idea that this remarkable rock (basalt) has been erupted in a molten condition, or still more that each basalt hill marks the site of a volcano.’*⁹⁰ In 1795 he named the Jurassic geologic Period after the Jura Mountains running between France and Switzerland.



Fig 22 Leopold von Buch, Goethe’s Ultra-opponent.

His first doubts started in Italy when he visited Vesuvius, and where he sought in vain for evidence of combustible matter - coal or sulphur - that according to Werner, was necessary for volcanic action, but he kept his doubts to himself.

Like Goethe, von Buch was an outstanding observer. Both in Auvergne and elsewhere he recorded hundreds of observations with impressive objectivity, irrespective of the hypothesis that each might support or reject. Although he

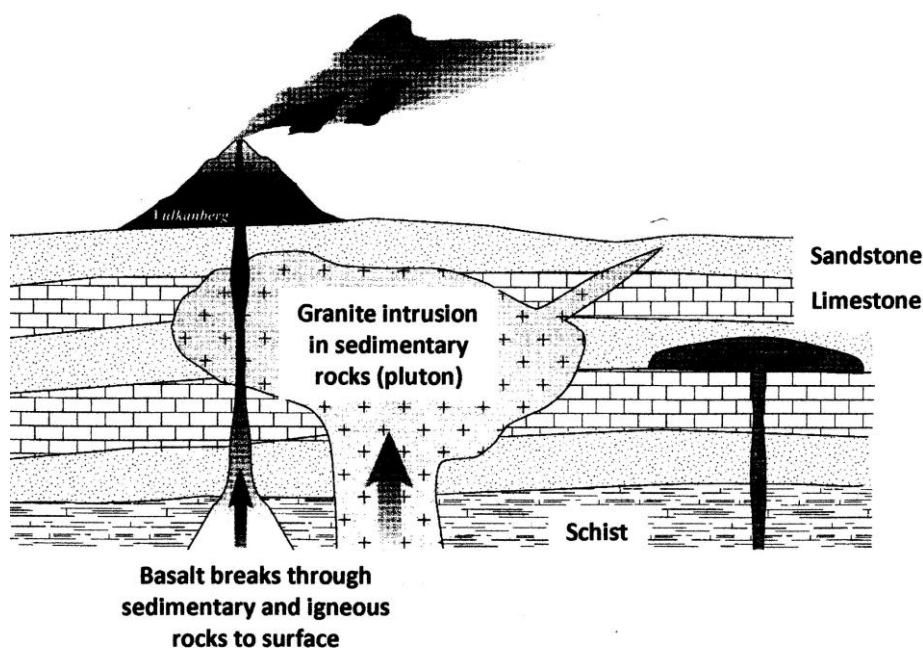


Fig 23 The Plutonist Model. Adapted from Schminke (2002). See footnote 27.

90 From *Geognostischen Beobachtungen auf Reisen durch Deutschland und Italien*, Sir Archibald Geikie’s translation.

recognized the volcanic origin of the basalts in Auvergne in 1802, he did not yet fully abandon Werner's cosmogony. He still considered the Saxon basalts, interlayered as they were between sedimentary deposits, to be of aqueous origin. He reasoned that the enormous masses of Saxon basalt would have been the product of correspondingly large volcanoes. Because, unlike Voigt, he discounted the effects of erosion, the absence of volcanoes (which had in reality long since eroded) compelled him to reject a volcanic origin of basalt.⁹¹

In 1806 Von Buch did research in Scandinavia. Here he was able to prove that Sweden is slowly rising⁹². This first indication of tectonic (large scale earth building processes over long periods of time) was the beginning of a new geology in Germany – Plutonism.⁹³ He also established that the hitherto unexplained granite 'erratics', on the North German plain derived from Scandinavia⁹⁴. He published his discoveries in another travel book '*Travels through Norway and Lapland*' in 1810.

He continued his search for the origins of basalt, and in 1821 he published his theory that entire volcanic regions were uplifted by the enormous pressure of magma within the Earth. Along with Voigt, von Buch now recognised the intrusive character of magmatic rocks. He realized that not only volcanoes, but also mountains are raised by the enormous pressure of large quantities of slowly rising magma from deep within the Earth (called plutons today). And so, with Voigt, he became a Plutonist.

In 1842 he was honoured with the Wollaston Medal, the highest award of the London Geological Society, and in 1849 he was elected a member of the American Academy of Arts and Sciences.

Goethe first met von Buch at the Marienbad spa on 1 July 1822. This meeting did not go well. Both men were fully aware of each other's opposing views, and von Buch, in an attempt to break the ice with a self-ironic joke, introduced himself as an 'ultra-Vulcanist'.⁹⁵ In Goethe's ear 'ultra' was a word used to describe an extreme position (particularly during the political upheavals of the French Revolution). The attempt failed, and Goethe was offended. Next day he wrote to his son August: "*I must not forget a strange meeting. Herr von Buch, the globetrotter, immediately introduced himself as an ultra-Vulcanist, and attempted, diplomatically enough, to draw me into a conversation; but in vain. And so not a geological word was exchanged with Germany's leading geologist.*"⁹⁶

A week later on 8 July, they did manage to strike up a conversation of sorts, with von Buch talking about his most recent expedition. In his journal Goethe reported "*a pleasant and informative, if one sided conversation*" (*Einsprechen*).

91 Werner himself was more tolerant regarding erosion, and did not object to the idea of an original continuous deposit of basalt that later came to be separated by erosional valleys.

92 A phenomenon known as post-glacial rebound, it is the very gradual rise of land masses which had been pressed down by the huge weight of ice sheets during the last Ice Age.

93 The theory of Plutonism was first developed in Scotland by the self-taught geologist James Hutton (1726-1797) in 1788, and brought to a wider audience by his student John Playfair in 1802. The anthropologist and anatomist Johann Friedrich Blumenbach drew Goethe's attention to Hutton's work in 1808, and even gave him a piece of Scottish granite which Hutton had used to demonstrate his conviction that granite had once been molten rock which slowly cooled deep below the surface before being exposed. (Goethe Handbuch, Supplemente 2, p470).

94 Now known to have been carried there by Ice Age glaciers.

95 He would have been more correct if he had introduced himself as a Plutonist.

96 Letter to Goethe's son August, dated 29 June 1822, in a postscript dated 2 July.

Three weeks later he reported to August: “*Von Buch will soon be gone. I politely managed to avoid a confrontation. It is simply not possible to converse with a Vulcanist. Fortunately Count Sternberg thinks as we do, and so progress will be (made) with just a few.*”⁹⁷

In September 1822 Goethe received news from Count von Sternberg that von Buch had found more evidence for his uplift theory in the Tirolian Alps, evidence that had been published in July, just after the ill-fated encounter at Marienbad. Von Buch had shown that the Tirolian Alps had been pushed up by magma slowly rising from deep within the Earth. His evidence was that the same magma had penetrated the cracks and fissures of the overlying strata of sandstone, limestone and dolomite.

For reasons which remain unexplained even today Goethe found it impossible, or simply refused to imagine, that mountain ranges could be pushed up from below. He had after all asked the readers of von Leonhard’s geological magazine to make allowances for the “*peculiarities*” in his own “*way of looking at and approaching the objects of Nature*”. Why was he unable to accept von Buch’s approach to geology?

After his death, a note was found among Goethe’s papers (possibly the draft of a reply to von Sternberg) in which he stated that he “*cannot live on such wild, haphazard ground, or at least won’t consider it. For what would it look like in my head when I torture myself thinking and imagining that over large areas mountains are lifted many miles from the ocean, that continents sink into the sea; when the earth herself gapes and yawns to lift up and disgorge readymade mountain masses; when sturdy Tirol ruptures, porphyry rises from the depths, chasms appear and dolomite crumbles.*”⁹⁸

He had a high regard for von Buch’s observational skills, and never called them into question. In his summary of Karl Nose’s book he appears to agree wholeheartedly with Nose’s comment that “*Men like von Humboldt and von Buch deserve our gratitude for choosing to travel the world in order to spare us such journeys.*”⁹⁹ But he was unable to formulate ideas interpreting von Buch’s observations from his own point of view. He preferred to let the riddle stand – a riddle which was only finally solved when a new concept of time had evolved in human consciousness.

In another letter to von Sternberg from this time he refers to von Buch as a “*geological adventurer*”, and repeats the belief he expressed so strongly in the Karl Nose essay, to proceed and research as far as possible, and then stand in awe before the primal phenomenon: “*When another (he means von Buch) attempts to understand a phenomenon which we would rather leave as one of Nature’s mysteries, breaks through Earth’s crust, and in order to explain the unknown, seeks refuge in unknown regions, common sense starts to mistrust itself. . . The reason for this is that people want a detailed explanation of Nature; they don’t understand that it is possible to proceed with certainty only up to a certain point, then one must make the decision to let the riddle stand, and leave the answer to others, perhaps ourselves in some future time.*”¹⁰⁰

In 1823 he began work on a series of geognostic essays, in several of which he takes von Buch (and other geologists) to task. “*Nothing is stranger in the world than the opinion that, in order to explain phenomena, one calls for the help of violent means, instead of, by careful consideration, having the most natural thing at hand. Just as a mighty geologist (von Buch), who has supernatural levers at his disposal, without hesitation raises Sweden and Norway from the depths into the heights, and by these*

97 Letter to August, dated 29 July 1822. Goethe continued to refer to Plutonists as Vulcanists.

98 Quoted in Johann Wolfgang Goethe, *Die Metamorphose des Granits*, p. 147. See footnote 9.

99 In *Karl Wilhelm Nose*, essay in *Zur Naturwissenschaft überhaupt*, Vol I, Part 3, 1820.

100 Letter to Count Kaspar von Sternberg, 12 January 1823.

desperate means attempts to free himself from a certain embarrassment, so another appears, piercing the mightiest dam, so that for a period of time the shores of the Mediterranean Sea are submerged thirty feet. The temple of Pozzuoli is supposed to be evidence of this."¹⁰¹

He was absolutely convinced that von Buch was wrong and remained unwavering in his conviction that "*Nature has no need to apply violent means in order to bring forth such phenomena mechanically; instead, she is predisposed from the beginning to bring to bear eternal but quiescent forces; which, called forth in time, with sufficient preparation are capable of giving form to the most formidable and the most tender (phenomena).*"¹⁰²

This was Goethe's lifelong conviction, but it in no way contradicted the ideas proposed by von Buch, and further developed (and corrected)¹⁰³ by geologists after him, once it was realised that 'mechanically' does not necessarily mean 'violently', and that the "*grand formative hand*"¹⁰⁴ has been active for a very long time indeed. But for Goethe the "*tumultuous*" uplift of distant mountains was an attempt to explain a natural phenomenon as resulting from an exception to the existing laws of Nature as they were understood at the time.

Leopold von Buch looked down upon Goethe as an amateur. In 1845, many years after Goethe's death, he told a friend about his first meeting with Goethe in Karlsbad. He explained that Goethe's ideas had meant little to him, and that he had told Goethe that he did not measure up to the demands of the subject. Most of von Buch's ideas were published in von Leonhard's magazine, and Goethe studied his work closely. In his writing von Buch came across as dogmatic and unyielding, and perhaps it should come as no surprise if two giants in their respective fields did not get on personally.

In spite of Goethe's rejection of von Buch's theories of mountain building, he agreed with von Buch about the Scandinavian origin of the erratic blocks of granite in North Germany. But whereas von Buch was unable to explain how they had been transported there, Goethe assumed that all of the North German plain had once been covered by a body of water over 1000 m deep, that much of it had been frozen, and that the erratic rocks had been left stranded by the melting ice, a theory he formulated in November 1829. Even though he did not see this happening with his own eyes, he saw nothing unnatural in this.¹⁰⁵

In 1825 von Buch sent Goethe a copy of his most recent book 'Physical Description of the Canary Islands', which describes the natural history of the Canary Islands.

101 "*Tempel zu Pozzuoli*", essay in in „*Zur Naturwissenschaft überhaupt*, Vol II, part 1“ (1823). The "*mightiest dam*" is a reference to a theory circulating at the time that a sudden opening of the Bosphorus before the Straits of Gibraltar existed, allowed the waters of the Black Sea to pour into the Mediterranean Sea. Leonhard Franz *Goethe und die Küstenveränderungen bei Neapel*. <https://gh.copernicus.org/articles/4/206/1949/gh-4-206-1949.pdf>

102 "*Gebirgs gestalten im Ganzen und Einzelnen*", essay in „*Zur Naturwissenschaft überhaupt*, Vol II, part 2“ (1824).

103 For example by the Austrian geologist Eduard Suess (1831-1914), who corrected some of von Buch's extreme generalisations, thereby justifying Goethe's misgivings about drawing hasty conclusions.

104 Letter to Charlotte von Stein, 7 September 1780.

105 See for example Wolf von Engelhardt (1999) *Did Goethe discover the Ice Age?*, <https://www.e-periodica.ch/digbib/view?pid=egh-001:1999:92::593#132>, p123-128, and Dorothy Cameron (2017) *Early Discoverers XXII. Goethe – Discoverer of the Ice Age*, file:///C:/Users/Owner.DESKTOP-0EP3EQB/Downloads/early-discoverers-xxii-goethediscoverer-of-the-ice-age.pdf.

Goethe's Urphenomen

Goethe's concept of a primal phenomenon is described in the didactic section of his *Theory of Colours* in §175:

“What we become aware of in experience are usually only individual cases which can be brought, with due regard, under general empirical headings. These again subordinate themselves under scientific headings, which are more comprehensive and point further up, whereby certain indispensable conditions of the appearance become known to us. From now on, everything gradually submits to higher rules and laws, which, however, do not reveal themselves by words and hypotheses to the mind, but to examination (Anschauung) as phenomena. We call these primal phenomena, because there is nothing perceptible to the senses beyond them. But they are perfectly suited for a gradual descent, similar to our earlier ascent, to the most common cases of daily experience.

Such a primal phenomenon is the one we have presented so far. We see on the one hand light, brightness, on the other hand dark, blackness. We bring turbidity (Trübe) between the two, and from these opposites, with help of thought mediation, the colors develop, also in a contrast, but immediately point back again to a common (origin) by their reciprocal relationship.”

When we see a phenomenon in Nature, what we see is dependent on a range of external conditions. Changing one or more of these conditions also changes the phenomenon. The change might be a minor or a major change.

A phenomenon which changes only insignificantly when external conditions change, and therefore show closely related characteristics, indicates a primal phenomenon. It underlies and determines the other, secondary phenomena, thereby revealing a natural law. No natural explanation can go beyond a primal phenomenon. Primal phenomena cannot be proved or explained further.

Primal phenomenon can be perceived in the physical world in their essential nature, but they present a boundary which natural science is unable to cross. They are real concrete phenomena, not abstract ideas. They indicate a region not accessible to human knowledge, and demand reverence.

In the physical world a primal phenomenon reveals a higher law, which may be intuited, rather than understood, as a not further researchable fundamental appearance.

Goethe used his geologic collections to place a sequence of phenomena (rocks) in such a relationship with each other that each phenomenon (rock) could be seen as a modification - brought about by a change in the conditions of its formation - of its essential appearance, i.e. the primal phenomenon.

*“Furthermore, a primal phenomenon should not be regarded as a principle from which many consequences appear, but must be regarded as a fundamental appearance within which the manifold must be seen. Looking, knowing, guessing, believing, whatever all those feelers are called with which we explore the universe, must actually work together if we want to fulfill our important, albeit difficult profession.”**

In a conversation with Eckermann on 13 February 1829 Goethe explains that the Godhead, the ground of all being, reveals itself in primal phenomena behind which it holds itself back.

“The intellect (Verstand) does not reach up to Nature. Humans must be able to rise to the highest reason (Vernunft) in order to touch the Godhead, which reveals itself in primal phenomena, both physical and moral, behind which it holds itself, and which emanate from it.”

And five days later on 18 February 1829 he says to Eckermann:

““The highest that the human mind can achieve,” said Goethe on this occasion (when discussing his colour theory), “is amazement (das Erstaunen), and if the primal phenomenon amazes him, he ought to be satisfied. It cannot grant him anything higher, and he should not seek for anything else beyond it; here is the limit. But the sight of a primal phenomenon is usually not enough for human beings; they think they can go further, and they are like children, who, when they look into a mirror, immediately turn it around to see what is on the other side.””

* From a letter to Christian Dietrich von Buttell, 3 May 1827. Von Buttell was a lawyer, and founder the *Physikalischen Gesellschaft* in Jever, in the North of Germany. He had sent a letter of support for Goethe's *Colour Theory*, which Goethe greatly appreciated.

According to his diary, Goethe studied this with great interest. But his relationship with von Buch remained distant and “correct”. Von Buch paid a last visit to Goethe in April 1829. Goethe’s secretary merely noted in his diary; ‘*The subject of minerology was avoided.*’

A Lifelong Friendship – Alexander von Humboldt

Friedrich Wilhelm Heinrich Alexander von Humboldt (1769-1859) was born in Berlin, and initially studied at Göttingen University. He studied under Werner between 1790 and 1792, and while still a student undertook an exploratory excursion on the Rhine, together with the seasoned explorer George Forster,¹⁰⁶ and reported his findings in a 1790 monograph, “Mineralogic Observations on Several Basalts on the River Rhine”, which he sent to Werner in Freiberg.



Fig 25 Basalt columns protruding from the waters of the river Rhine

Source: <https://vulcan.lindahall.org/rhine.shtml>

In the accompanying letter he wrote: ‘*I found nothing which made it necessary to presuppose the existence of volcanoes, but everywhere grounds for the Neptunist origin of basalt.*’ He had come across the basalt formations at Unkel, which extend into the river, and protruded above the water surface. See Fig. 25. His discovery of similar basalts near the volcanoes of the Andes eventually caused him to change his mind.

After completing his studies in Freiberg he worked for the Prussian government as a mining inspector for the next five years. During this time, he invented a method of safely using a flame light in underground coal mines.¹⁰⁷ Following the death of his mother, he inherited a considerable fortune, which enabled him to devote all his time to his scientific work and global explorations. Throughout his life he encouraged aspiring natural scientists, offering financial support as well as introductions into the scientific community.

In 1793 he published *Flora Fribergensis*, a detailed description of the plants around Freiberg. This brought him to Goethe’s attention, who wanted to discuss his own botanical studies, especially plant metamorphism, with him. They were introduced in 1794 by his brother Wilhelm, who lived in nearby Jena. Goethe and Alexander immediately became friends and met regularly in Weimar and Jena,



Fig 24 Alexander von Humboldt shortly after his return from South America. Source:

https://cvc.cervantes.es/ciencia/humboldt/cronologia_01.htm

¹⁰⁶ Forster had published an unofficial account of Captain Cook’s second voyage in 1777 in ‘A Voyage round the World’.

¹⁰⁷ Davy’s safety lamp was only invented in 1815.

where amongst other pursuits, they conducted experiments exploring electric and magnetic effects. They attended anatomy lectures together, and dissected not only frogs, but also the bodies of a farmer and his wife who had been struck by lightning.¹⁰⁸ Comparative anatomy, geognosy, primal rocks, and primal forms (*Urgestalten*) were discussed on long walks in the countryside.

Between 1799 and 1804, Humboldt travelled widely in Central and South America, exploring and for the first time describing what he saw from a modern scientific viewpoint. He ascended the enormous volcanoes (Chimborazo and Pichincha), but held on to his Neptunist ideas, believing that they drew in air between eruptions to keep the necessary underground fires going. On his return to Europe, shortly before disembarking in Bordeaux, he wrote to a friend: '*Greet Werner, for whom my high regard grows year on year, and whose system my travels in the southern hemisphere have confirmed.*'¹⁰⁹

He wrote up his description of the journey in a large number of volumes, collectively titled "*Kosmos*".¹¹⁰ In "*Kosmos*" he brought together different branches of knowledge, and developed what would today be called a holistic concept of the biosphere. He is considered by many to be the first ecologist. It was while writing up the various volumes that he gradually began to change his mind about his initial ideas about volcanoes.

Goethe made a determined effort to understand von Humboldt's reasoning, and made detailed extracts of von Humboldt's volumes, but when it came to geognosy he concluded: "*Everyone has different premises, and even the same premises are used differently in different arguments. Just listen in on a scientific discussion.*"¹¹¹

Von Humboldt was an excellent writer and speaker, and enjoyed the intellectual cut and thrust of scientific debate. He thought that the dispute over the origin of basalt would serve as a '*glorious memorial to human ingenuity in the history of geognosy*'.¹¹²

His approach to Nature was based on his conviction that all the forces of nature are related to each other. With Goethe, he realised that everything in Nature underwent continuous change; specifically, that plants were influenced by their environments, and that as environments changed, so did plants. Goethe greatly admired him because his integrated approach to Nature brought the arts and the sciences together. Notwithstanding the fact that, unlike Goethe, he included in his observations exact measurements, for which he used the most accurate instruments available, he was driven by a sense of wonder for the natural world.

In 1807 von Humboldt published '*Ideas on a Geography of Plants*' in which he expressed the possibility that Africa and South America had once been joined, and that the cause of their separation lay deep within the Earth. Goethe was mortified, but their friendship was unaffected:

"What a man! I've known him for so long, yet he always manages to amaze me. He is unrivalled in his acquaintance with the facts, and in his lively knowledge. His

108 Andrea Wulf (2015) *The Invention of Nature. The Adventures of Alexander von Humboldt*, John Murray, London, p54.

109 Quoted in Wolf Engelhardt (2001) *Goethe und Alexander von Humboldt – Bau und Geschichte der Erde*. More details about von Humboldt's conversion may be found in this paper. See footnote 29.

110 An ancient Greek word meaning both 'order' and 'world'. Like von Humboldt and Goethe, the Greeks believed the world to be perfectly harmonious and flawlessly ordered.

111 Quoted in Johann Wolfgang Goethe, *Die Metamorphose des Granits*, collected and commented by Dankmar Bosse (1985) Verlag Freies Geistesleben, p. 142.

112 In *Mineralogische Beobachtungen einige Basalte am Rhein*, published in 1790.

versatility . . . is like a spring with many ducts; one has only to hold vessels underneath, and invigorating and unfailing (inspiration) streams towards one."¹¹³

Goethe paid homage to von Humboldt in a special way when he used his name in his novel *Elective Affinities*, the only occasion he used the name of a living person in his works of fiction. On 5 October 1809, he sent von Humboldt a copy of the newly published novel, together with a letter in which he expressed his admiration for von Humboldt, and his hope that he would welcome the fact that: "*your name is spoken by beautiful lips*"¹¹⁴. *What you have accomplished for us goes so far beyond prose that poetry may well presume to receive you among her heroes during your lifetime.*"

Von Humboldt's Lecture in Berlin and the Tumult in Goethe's Soul

The resolution Goethe had made after the Kammerbühl expedition in July 1822 ("*to engender a milder, more versatile mood*") was severely put to the test by von Humboldt only six months later. In January 1823 von Humboldt was in Berlin where he gave a lecture which has become a milestone in volcanology.¹¹⁵ He sent Goethe a printed copy of his lecture with the dedication '*For his excellency Privy Councillor von Goethe as a small token of the most heartfelt admiration and gratitude.*' In the lecture he described for the first time the global distribution of volcanoes and their origins. Based on his own work on the Canary Islands and in South America, as well as that of Leopold von Buch and other geologists, he showed that volcanoes fall naturally into groups, and he presented evidence that such groups corresponded with large subterranean faults and fissures. He was able to prove that volcanoes do not originate from just below the surface of the earth, but come about when molten magma rises from deep below the crust, and break through to the surface, to appear as lava. Von Humboldt had established beyond doubt the igneous origin of basalt, thereby putting a final nail in the coffin of Neptunism:

'This concentration of volcanoes, sometimes in groups, sometimes in linear chains, proves conclusively that volcanic effects don't depend on local causes close to the surface, but that they are (a result) of much deeper, more substantial phenomena'. Like Voigt and von Buch before him, von Humboldt now spoke as a Plutonist.

Goethe was suffering from angina, and in February 1823 he experienced a life-threatening heart attack. The enforced rest gave him time to reflect on his life and work. But he was soon making plans to return to Marienbad that summer, where he formally proposed marriage to 19 year old Ulrike von Levetzow, whom he had met there in the summer of 1821.

On 16 March he summed up his initial reaction to von Humboldt's lecture, which he had not yet studied in detail, as follows:

"No greater embarrassment can be imagined as that in which a student of Werner for fifty years, and a faithful follower of his well-founded and universally known teachings, must find himself when, startled out of his peaceful convictions, he is informed from all sides that these have been in error all along.

113 Conversations with Eckermann, 11 December 1826. Johann Peter Eckermann (1792-1854) was Goethe's secretary from 1823 onwards.

114 'Pen' would be more accurate. Von Humboldt is only mentioned in Ottilie's journal. See http://www.scielo.br/scielo.php?pid=S0103-40142010000200012&script=sci_arttext&tlng=en.

115 'Concerning the Structure and Impact of Volcanoes in various Regions of the Earth', '*Über den Bau und die Wirkungsart der Vulkane in den verschiedenen Erdstrichen*' (Berlin 1823).

“Hitherto granite has been for him the firm indestructible foundation on which the whole of Earth’s surface rested; he searched to discover the formations and the variations of this important rock; he walked over shale and limestone, occasionally finding porphyry, and red sandstone, and examined there many a sedimentary bed, as the appearances seemed to indicate. Thus he passed over terrains formerly covered by water, then gradually drained, in consistent reassurance. If he came across the mighty violence of volcanos, these appeared to him as still ongoing, but superficial, belated works of Nature.

“Now everything appears to be happening quite differently. He learned that Sweden and Norway from time to time have lifted themselves from the ocean to a considerable height; that the Hungarian mines should thank their treasures to effects flowing up from below; and that the porphyry of Tirol has burst through limestone taking with it into the heights the Dolomites; admittedly effects from a distant past which no eye has witnessed, nor ear has heard the tumult thus stirred up. What does a member of the old school see here? A transfer of one phenomenon to another, inductions and analogies haphazardly applied, assertions which one is expected to accept in good faith.

“When now our friend of Nature, almost driven to despair, wants to escape into another subject, if only he knew how to leave behind and avoid the inherited firm ground to which he has hitherto directed his contemplations, he would desire, and accept with gratitude, an inspired publication such as one bearing the title ‘Concerning the Structure and Impact of Volcanoes in various Regions of the Earth’ by Alexander von Humboldt.

“Things which formerly have appeared as arbitrarily accepted, show themselves here as well founded; random indications gain coherence; and a wealth of experience allows one to hope for a well-rounded conclusion. It would therefore be irresponsible if we did not study these comprehensive paragraphs with all our energy. . . . When we have done this, we need not be ashamed, but rather feel honoured, when we openly admit our change of mind, and trustingly present our new credo to an excellent and much tried friend.”¹¹⁶

This letter was never sent. After he had studied von Humboldt’s lecture in more detail, Goethe was more circumspect. He drew up a list enumerating the different ways to think about the causes of volcanic activity; tried to think as Humboldt did; and on 3 April wrote a second draft:

“I am thankful for the printed lecture, which could not have arrived at a more convenient time. A man with a profound understanding, who also has his objective approach (Gegenständlichkeit) to the phenomena, indeed an unbounded one, constantly in mind, gives here from a lofty position an opinion as to how one should convince oneself of the extended Vulcanist teachings.

“Earnest study of these few pages will assist me in fulfilling an important task, will lend support in my attempts to think as such a man; which however will only be possible when his approach to the phenomena (his Gegenständliches) becomes my approach to the phenomena (my Gegenständliches), and I must strive for this with all my might!”¹¹⁷

He set to work immediately. On the same day that he dictated his second response to von Humboldt’s lecture he also wrote an essay with the intriguing title ‘*Significant*

116 Quoted in Fritz Krafft (2009) *Goethe zwischen Neptun und Vulkan*, https://www.researchgate.net/publication/256455032_Fritz_Krafft_Goethe_zwischen_Neptun_und_Vulkan, p. 16.

117 *Über den Bau und die Wirkungsart der Vulkane in den verschiedenen Erdstrichen von Alexander von Humboldt*, essay in *Zur Naturwissenschaft überhaupt* Vol II, part 1 (1823).

Encouragement by Means of a single Ingenious Word. The essay explains how the “ingenious word” supported his worldview, and how it separated him from his opponents.

The “ingenious word” was *Gegenständliches*, a new word in the German language, but not coined by Goethe. He had found it in a book on anthropology by Johann Christian Heinroth (1773-1843), which had been published the previous year. He used it for the first time in the draft letter quoted above. Goethe nowhere explains its meaning, but fortunately Heinroth did.¹¹⁸

Beyond the obvious meaning that Goethe thought about the objects (the *Gegenstände*) he observed, Heinroth explained that Goethe’s thinking was not separated from the objects, but that his perceptions of the objects entered into his thinking.¹¹⁹ Goethe felt understood. He had at last found a reason for his inability to accept apparently violent geologic processes; namely, that he would have to change the way he thought about his observations.¹²⁰

The Single Ingenious Word

“If I now turn to the objective thinking (gegenständliches Denken) which has been attributed to me, I find that I was compelled to observe the same procedure even with natural objects. What multitudes of views and reflections did I not pursue before the idea of plant metamorphosis came to me! It was the same with the concept that the skull consists of vertebral bones.”

“For a few years now, I have been trying to revise my geognostic studies, especially in view of the extent to which I could bring them, and the conviction gained from them, closer to the new, and the now commonly promulgated Fire Theory (i.e. Plutonism), which until now was impossible for me. But now, by the term objective thinking (gegenständliches Denken), I was suddenly enlightened, seeing clearly in front of me that all the objects that I had looked at and examined for fifty years had to awake in me precisely the ideas and convictions, which I cannot now abandon. Although I am able to take the point of view (of Plutonism) for a short time, I must always return to my old way of thinking if I am to be reasonably comfortable.”

Goethe makes it quite clear: The “Fire Theory” and everything in Nature implied by it could never become his *Gegenständliches*, because it was not part of his nature. He was unable to accept the new ideas in geology because they took him out of his comfort zone.

“Excited by these very considerations, I continued to examine myself, and found that my entire procedure was based on deduction (Ableiten); I did not rest until I found a succinct point from which much can be deduced, or rather which voluntarily brings much forth from itself towards me, because I set to work carefully and faithfully in my efforts and in the reception (of what is brought). If in the experience I find any phenomenon that I do not know how to deduce, I leave it as a problem. I have found this manner of proceeding very advantageous in a long life: for even if I could not unravel the origin and connections of a phenomenon, but had to leave it aside, after years of waiting everything would suddenly be made clear in the most beautiful context. I shall therefore take the liberty of presenting in these pages (of his theoretical writings), in chronological order, the experiences, the comments, and the interpretations that have arisen from them. At the very least what I would hope for is to outline a distinctive belief for the purpose of bringing insight to opponents, encouragement to the like-minded, knowledge to posterity, and, if successful, reconciliation (to opposing views)”.

From *Theoretische Schriften* (1823) “*Bedeutende Fördernis durch ein einziges geistreiches Wort*”, <http://www.zeno.org/nid/20004856147>

118 In Wolf von Engelhardt (2007) *Goethe im Gespräch mit der Erde*, p312.

119 Or, we might say today, into his uncanny powers of Imagination.

120 Had Goethe been able to Imagine the millions of years of earth’s geologic history, this would have been a great deal easier for him. From today’s earth science point of view, the uplift of mountains such as the Alps and the Himalayas, is a very slow process, measuring a few centimetres per year.

Goethe never did accept the ideas of von Buch and von Humboldt, which by the middle of the 1820's had replaced those of both Neptunism and Vulcanism. Yet he never lost his deep interest and enthusiasm for the subject. In August 1823, having recovered from his heart attack, and approaching his 74th birthday, he was again in Marienbad, and we find him on an excursion to the *Eisenbühl*.

The *Eisenbühl* - Goethe's last Geognostic Excursion

What is now known to be the remnant of an extinct volcano is formed by a small hill, 25m high and 100–150m wide. It originated on the same fault line as the *Kammerbühl* less than 15 km away.

Eisenbühl served as an occasional source of natural slag for road construction projects in the region. Goethe inspected the loose volcanic deposits on the face of the now abandoned gravel pit. It shows a layer of pyroclastic basaltic lavas (scoriae) containing fragments of shale and schist (xenoliths) dragged up by rising magma from below, followed by a layer of bedded tuff deposited by a subsequent eruption phase at an angle of 30–40°. The unconformity between the layers shows that there were at least two eruptions separated by some considerable length of time. As at the *Kammerbühl*, the volcanic material consists mostly of porous congealed lava of olivine nephelinite composition.



Fig 26 Exposed outcrop on the *Eisenbühl* showing layered scoriae and unconformity.

Source: ringelfelsen.de

After his visit in August 1823 he wrote the first geological description of the site, “*Ancient, newly discovered Traces of Natural Fire and Embers*”. He noted “. . . traces of volcanism, as well as layers of original and altered rocks.” His conclusion was identical to what he had deduced from his extended research into the *Kammerbühl*, i.e. the deposits were pseudo-volcanic.

Final Years

Alas, the summer of 1823 turned out to be his final Bohemian summer. His marriage proposal had been rejected, but his active interest in Earth's origins continued unabated. He renewed his efforts to complete the second part of *Faust*, and in August 1830 he was able to resolve the dispute between Neptunists, Vulcanists and Plutonists in a convincing artistic manner in the classical Walpurgis-night scenes on the shore of the Aegean Sea, where fire and water meet to create new life.¹²¹

But the geognost unable or unwilling “to think as such a man” persisted. Von Humboldt visited Goethe in January 1829, and discussed with him the discoveries he had made on his expedition to Russia, among others that the Caucasus, the Altai mountains, and the Himalayas had been forced up by pressure from below, and that the Caspian and Aral inland seas had sunk down below sea level. This was too much for Goethe. On 15 February 1829 he discussed von Humboldt's discoveries with his friend Riemer, head librarian in Weimar. Riemer requested that Goethe make a note

121 In the guise of Thales, Anaxagoras, and Seismos. See *New View*, Winter 2017.

of his comments, which he dictated to his scrivener the following day.¹²² The notes are incomplete, but left Riemer in no doubt about Goethe's opinion of von Humboldt's findings:

Goethe's last field trip

Goethe was accompanied on this excursion by police superintendent Joseph Grüner, whom he had first met in 1820 when Goethe had sent his passport to the Eger police station for certification. Grüner knew and admired Goethe's work, and so he decided to personally return the passport to the inn 'Zur goldenen Sonne', where Goethe was staying. A conversation developed about local customs, history, and language. Grüner had lived in the area since 1807, and his answers to Goethe's questions, including questions about the local geology, greatly impressed the poet. A warm friendship developed. Grüner visited Goethe in Weimar in 1825, and their exchange of letters only ended with Goethe's death. This is how Grüner remembered Goethe's last expedition in Bohemia on 23 August.



The Eisenbühl as seen today.

'While Goethe remained seated, sipping wine from a silver bowl, I went to reconnoitre. I returned to report that the hill consisted of clay schists. *"Have you investigated the Southern flank?"* Goethe asked, and I admitted that I hadn't. He replied: *"You young people often allow yourselves to be deceived by passion. It is incorrect to conclude that because a certain mineral appears in the East, the West, and the North of the hill, it also occurs on the South, and perhaps even inside the hill. Likewise, it is not correct that if a girl kisses me on the first and the third day, she hasn't kissed someone else on the second. A fervent zeal usually misleads people to such incorrect conclusions."* I sat down and we shared our victuals, after which I went to explore the Southern flank. Almost immediately I returned with a striking piece of basalt, with olivine even fresher than on the Kammerberg.'

"Where, my friend did you find this beautiful specimen?" Goethe asked, jumping up with surprising agility. *"We must immediately investigate."* We found more specimens, and with the help of the footman carried them to the coach. *"We have made an important discovery"*, Goethe remarked, *"which will lead to further enquiries."*

'As we looked back on the day that evening, he said: *"We have done our work today. Now we must rest. I would very much like to explore this region further with you if your responsibilities at work allow it"*, and he named three more localities where he hoped to find confirmation of his conjectures.'

My shortened paraphrase, except for Goethe's (translated) words in italics.

<http://www.zeno.org/Literatur/M/Goethe,+Johann+Wolfgang/Gespr%C3%A4che/%5BZu+den+Gespr%C3%A4chen%5D/1823>. Also in in Otto Krätz, p. 62.

122 Johann August Friedrich John (1794-1854), Goethe's personal assistant. See Wolf von Engelhardt (2007) *Goethe im Gespräch mit der Erde*, p341.

*“Be that as it may, it needs to be said that I curse this damned clutter of the new creation of the world; and doubtless some young man with his wits still about him will have the courage to oppose this crazy consensus. For what is this heaving of mountains, other than a mechanical agent, without giving common sense any possibility, imagination any means (of grasping it). It’s just words, wicked words, which provide neither concept nor image. Enough said, if not too much.”*¹²³

This was another of Goethe’s polemic outbursts, encouraged by several glasses of wine with a good friend. It is all the more surprising that he agreed to commit it to writing given the more dispassionate assessment he would write just a few months later. After all, he had met several of the young men *“with their wits still about them”*, indeed, one of them was a highly respected friend.

The more reasoned approach took the form of a *“confession”*, one of several he wrote later that year.¹²⁴ In it he explained that *“where someone comes from in life, the direction from which they enter a subject, leaves a lasting impression, gives a certain direction to what follows, with consequences which are natural and necessary.”*

He described how he became friends with geognosy, motivated by the needs of the mine in Ilmenau. He devoted several years of his life to the study of the interlayered rock strata in Thuringia. The geology here was favourable to Werner’s theories, and so he held onto them, although he felt strongly that it left some problems unresolved.

The Marienbad Elegy

The *Marienbad Elegy* is named after the spa town of Marienbad where Goethe, 72 years old, spent the summer of 1821. There he fell in love with 17-year-old Ulrike von Levetzow. Goethe returned to Marienbad in the summer of 1823. On the occasion of his 74th birthday on 30 August, he formally asked, via his friend, Grand Duke Carl August, for her hand in marriage. She discussed the proposal with her mother, and declined.



Ulrike von Levetzow, 1821

This poem, considered one of Goethe's finest and most personal, reflects the devastation he experienced when his proposal was declined. He started writing the poem on 5 September 1823 in the coach which carried him back home to Weimar, and completed it on 12 September, the day of his arrival. He showed it only to his closest friends. The final stanza reads:

Mir ist das All, ich bin mir selbst verloren,
Der ich noch erst den Göttern Liebling war;
Sie prüften mich, verliehen mir Pandoren,
So reich an Gütern, reicher an Gefahr;
Sie drängten mich zum gabeselligen Munde,
Sie trennen mich, und richten mich zugrunde.

*“To me my all, I to myself am lost,
Who the immortals' darling once was thought;
They tested me, bestowed Pandoras to my cost,
So rich in wealth, with danger far more fraught;
They urged me to those gifts, those blessed lips with rapture crowned,
Then severed me, and cast me to the ground.”*

Translation with help from Edgar Alfred Bowering, whose translation of the complete poem may be found at https://en.wikisource.org/wiki/The_Works_of_J._W._von_Goethe/Volume_9/Trilogy_of_Passion#Elegy.

¹²³ In *Geologische Probleme und Versuch ihrer Auflösung*. .

¹²⁴ Handwritten notes from the last years of his life. <https://www.xn--gedichteundzitatefralle-tpc.de/2020/02/jwvgoethe-verschiedene-bekanntnisse-geo.html>

His attention had recently been drawn to the proposals of Élie de Beaumont¹²⁵, whose warm reception at the French Academy of his theory of the “*heaving and thrusting*” of Europe’s mountains appears to him as if some Christian bishop had declared the ‘Vedas’ for canonical.

“As I am only writing down confessions, I am only referring to my own way of thinking. I do not want to identify myself as an opponent of the modern theories, but merely to assert here the rights of my objective thinking (Gegenständliches Denken), although I would want to admit that had I always, like the younger (geologists) who assert their theories with such remarkable agreement, gained my views from Auvergne, or even from the Andes, and had that which now seems to me to be an exception in Nature impressed itself upon me as a rule, I would probably have found myself in complete agreement with the currently feasible theories.”

His conciliatory tone here goes even further than in his letter to von Leonhard (1 October 1807). Goethe admits that had he commenced his geognostic studies in an area with a different geologic history, he would have come to different conclusions. Although in this “*milder, more versatile mood*” he accepts that the theories of other geologists might well be correct, it is only his confidence in his own way of seeing things, in his “*Gegenständliches Denken*”, which he considers absolutely reliable.

On 5 April 1829 Eckermann recorded the following ‘conversation’. Goethe had just taken delivery of a petrified log, which prompted the following comment: “*Such petrified logs*” he said, “*are found below the 51st degree of latitude all over the world as far as America, like a belt around the earth. One becomes more and more astonished. No one has any idea about the earlier constitution of the earth, and I cannot blame Herr von Buch when he indoctrinates people in order to broadcast his hypotheses. He knows nothing, but nobody knows more, and so at the end of the day what is taught doesn’t really matter, as long as it has a semblance of reason.*”

He made known his misgivings about the direction geology was taking to anyone whom he believed would give him a sympathetic ear: “*I have received and reviewed the two volumes: ‘Fragments de Géologie par Alexandre de Humboldt’.* In doing so I made an amazing discovery which I want to share with you. The extraordinary talent of this extraordinary man is expressed in his lectures, and to be precise: the purpose of every lecture is to persuade and to make the listener believe he is convinced. Few people are capable of being convinced; most are merely persuaded.

And so the treatises presented to us here are true orations, presented with great competence, so that one would finally like to imagine that one understands the impossible. That the Himalayan Mountains were hoisted to 25,000 feet from the ground, and are yet as rigid and proud, soaring to the heavens as if nothing had happened, is beyond the confines of my head, in the gloomy regions where the transubstantiation etc. etc. is located, and my cerebral system would have to be completely re-organized – which would be a pity – if spaces were to be found for these miracles. . .

Presenting such a paradox with skill and energy has a great effect. It is for this reason that many of our most impartial naturalists imagine that they are able think the impossible; I on the other hand, appear to them as the most stubborn heretic, - which God will mercifully keep and endorse. Sela!”¹²⁶

125 Léonce Élie de Beaumont (1798-1874) was a French geologist and professor at the École des mines in Paris. His theory of the origin of mountain ranges was first proposed in a lecture at the French Academy in 1829.

126 Letter to Carl Friedrich Zelter Weimar, 5 October 1831. Zelter (1758-1832) was a composer, conductor, and director of the *Sing-Akademie* in Berlin. He set several of Goethe’s poems to music. Musically self-taught, he initially worked in his father’s

It was Goethe's tragedy that he was not only unable to follow the next generation of geologists on their journey to a greater understanding of the earth, but that he also turned his back on them.

Resolution, or Resignation?

Reflecting on his life in 1827, Goethe said to Eckermann: "*Mineralogy had for me a double interest; firstly because of its great practical use, and secondly, to find therein a record of the formation of the primeval world for which Werner's teachings gave me hope. But since the death of this admirable man everything in this science has been turned upside down, and I am no longer following the debate publicly. . . I have tried to explore the natural sciences in many directions, always concentrating on those objects which surrounded me physically, and which could be observed directly by the senses. That's why I never took up astronomy, because here the senses are no longer sufficient, and one is in need of instruments, calculations, and mechanical devices, which demand their own life, and which were not my concern.*"¹²⁷

Goethe sought for the unity underlying diversity, and he expected to find it in all three kingdoms of Nature. He succeeded in the plant kingdom, was partially successful in the animal kingdom, but in the mineral kingdom his search for the underlying principle, the "primal rock" (*Urgestein*) proved elusive.

He believed that all organic forms are prefigured by super-sensible archetypes ("*Urformen*"), which live within the forms; invisible 'ideals' enter into physical manifestation, thereby becoming perceptible to the senses. Inorganic objects are also prefigured by super-sensible archetypes which give them their forms, but do not live within them. The 'ideals' do not enter into physical manifestation, and remain imperceptible to the senses.

As he had written from Italy to the Duchess Louise, "*The slightest product of Nature has the circle of its perfection within itself, and if I only have eyes to see, I can discover the relationships. . . Works of Nature are always like a first-spoken word of God.*"¹²⁸

This belief enabled him to have a deeper than usual insight into Earth's origins. He would have agreed with James Hutton: 'A theory therefore, which is limited to the actual constitution of the earth, cannot be allowed to proceed one step beyond the present order of things . . . We must not ask the industrious inhabitant for the end or origin of this earth: he sees the present, and he looks no further into the works of time than his experience can supply his reason.'¹²⁹ Hutton believed that all geologic changes, whether "*tumultuous*" or not, contributed to make the earth a habitable abode for humankind. But the experiences which supplied Goethe's reason, bordering on the super-sensible, were of a different nature than those of his contemporaries. He rejected explanations which from his point of view broke through the natural order. The uplifting of mountains contradicted his sense for a unified view of Nature. He was unable to integrate them into the natural order of things.

Unable to penetrate the mystery of time in spite of his experience on the Bastberg, Goethe reached an impasse in his geognostic work. Von Humboldt, von Buch, and other geologists simply left the question of time out of their considerations, or accepted

engineering business to earn a living. He was a great admirer of the music of J S Bach, a love which he passed on to his pupil Felix Mendelssohn. Mendelssohn's 1829 revival of Bach's St Matthew Passion was sponsored by Zelter and the *Sing-Akademie*, and was a milestone in the history of music.

127 Conversations with Eckermann, 1 February 1827.

128 Letter to the Duchess Louise, Rome, 23 December 1786.

129 James Hutton (1795) *Theory of the Earth, with Proofs and Illustrations*.

that the uplift of a mountain range was indeed a violent event. Goethe, face to face with archetypal phenomena, sensed that there was much more to the formation of the earth, but that further 'geognostic' work would have to wait for a new understanding of time to arise in the evolution of human consciousness.

He had also come to realise that it was not possible to experience the super sensible archetypes in the mineral kingdom, archetypes which he believed he saw as living processes in the plant kingdom, and explained this to Eckermann (on 13 February 1829): "*Geology is a science for the intellect, for practical life, because the objects of its study are dead, no longer part of a living process, and it is not possible to think of a synthesis.*"

Contemplating a collection of minerals and ores sent by August von Herder¹³⁰ in 1831, he wrote to Count von Sternberg that he had occupied himself with this collection for almost a year, and that "*A dim insight, which I have long followed, as one approaches a distant light in dark night, in the hope that it will not be a will-o'-the-wisp, seems to be leading me on here as well. The most wonderful thing about it is that the best of our convictions cannot be put into words. Language is not equipped to deal with everything, and we (humans) even less so; in the end often not quite knowing whether we see, think, remember, fantasize or believe. That's what sometimes saddens me, especially since I don't have any dialogue at present. Also wishing the next instalment a friendly reception.*"¹³¹

"Theories are usually overhasty (interpretations) by an impatient mind which would like to get rid of the phenomena, and in their place insert images, concepts, yes, often mere words."

Postscript

In Britain the Neptunist-Vulcanist-Plutonist debate had been decided much earlier, and Charles Lyell (1797-1875), the most influential geologist of the 19th Century, was able to pursue his geological studies unhindered by the controversy. He published the first volume of his three-volume work 'Principles of Geology' in 1830. It bore the subtitle: 'An attempt to explain the former changes of the Earth's surface by reference to causes now in operation', which would no doubt have pleased Goethe. The central argument of the work, 'The present is the key to the past', although informed by a materialistic outlook on life, would also have engaged his full attention. Mountains were uplifted, not tumultuously or catastrophically, but slowly, gently, over long periods of time. Lyell's 'Principles of Geology' has on the title page a quotation from James Hutton's work:

'Amid all the revolutions of the globe, the economy of nature has been uniform, and her laws are the only thing that have resisted the general movement. The rivers and the rocks, the seas and the continents, have been changed in all their parts, but the laws which direct those changes, and the rules to which they are subject, have remained invariably the same.'

In his autobiography Goethe commented:

"Nature works according to laws that are eternal, necessary, and so divine that even the Divinity Himself could change nothing about them."

The first German translation of Lyell's 'Principles of Geology' was published in 1832; Goethe did not live to see it.

130 Siegmund August Wolfgang von Herder (1776-1838) was chief mining engineer in Freiberg, and Johann Gottfried Herder's son.

131 Letter to Count Kaspar von Sternberg, 15 March 1832. Goethe died the following week.

"Our senses do not deceive, our judgement does.

It is therefore best that when observing, we are conscious as much as possible of the object of our observations, and when thinking about what we have observed, of ourselves."

Johann Wolfgang von Goethe, in *Maximen und Reflexion*, published posthumously in 1833.

Owen Barfield on Goethe's *Urphänomen*

To understand Goethe's view of nature one thing is needful and that is, to understand what he meant by *Urphänomen*. These archetypal ideas or phenomena, which realise themselves, he held, in the ever-changing forms of organic nature, are indeed the heart of the matter. They are the 'inside' of nature of which I spoke earlier; but – and this is all-important – they are as much inside man as they are inside nature. If therefore you call them, as Schiller did, ideas, you must remember that Goethe insists they are objective ideas. If you say, 'Well then, they are not ideas but real entities', then you must not forget that nevertheless they are subjective. *Sinnlich – über sinnlich* he said they were, and he insisted that they were perceived rather than thought about, but perceived by the mind instead of by the senses. And this perception which depended on love and a devoted self-surrender as well as on accurate observation was a kind of communion.

It is not an easy notion and many people have regarded it as nonsense. I do not think so myself, and that is why I was at such pains to try to set before you the pure idea of evolution – or, as we had now better call it – metamorphosis. Because, if we have managed to hold in our minds the pure idea, or mental image, of metamorphosis itself, as distinct from the theories that have been woven round it, we have, I believe, taken the first step towards perceiving one of Goethe's *Urphänomene*. For metamorphosis, so apprehended, is really the *Urphänomen*, the archetypal phenomenon, of the whole of organic nature, of life itself.

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