

# Rediscovery of the Elements

## Thorium–Løvøya, Langesundfjord, Norway

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About 100 kilometers to the southwest of Oslo (Figure 1) lies the Langesund, one of the beautiful fjords that encircle the coast of Norway (Figure 2). This area was home to Henrik Ibsen, the well-known nineteenth century playwright who lived in Skien at the northernmost reaches of this fjord. Hundreds of islands dot this inlet—measuring in size from a square kilometer to a mere boulder poking out of the water—rendering a boat necessary for a local traveler (Figure 3).

One fateful day in early 1829, the pastor of Brevik was rowing around the rocky islands of the Langesundfjord, hunting for ducks.<sup>1</sup> As he drifted around Løvøya Island (see Figure 4), he noticed a black mineral in the pegmatite boulders. Curious, he eased his boat by the craggy shore and scrambled ashore. He chipped off some of the crystals and took them back to his parish. The glimmering mineral that the pastor collected would later be known as thorite,  $\text{ThSiO}_4$  (Figure 5), and thereby begins the story of the discovery of a new element.

The curious pastor was Hans Morten Thrane Esmark (1801–1882), a true Renaissance Man, who like Reverend William Gregor<sup>2</sup> probed Nature in all disciplines to learn Her secrets. In addition to being a learned mineralogist, Esmark performed chemical analyses; he was an expert in potato diseases; he made a limestone kiln for the production of cement; he invented the exploding harpoon (but didn't get credit for it), and became the first mayor of Brevik.<sup>3</sup> And as a man of the cloth he cared for his flock at the Brevik church (Figure 6).

Esmark showed the interesting mineral to his father, Jens Esmark, who earlier had been Professor at the famed Kongsberg Mining Academy. The mineral appeared unlike any-

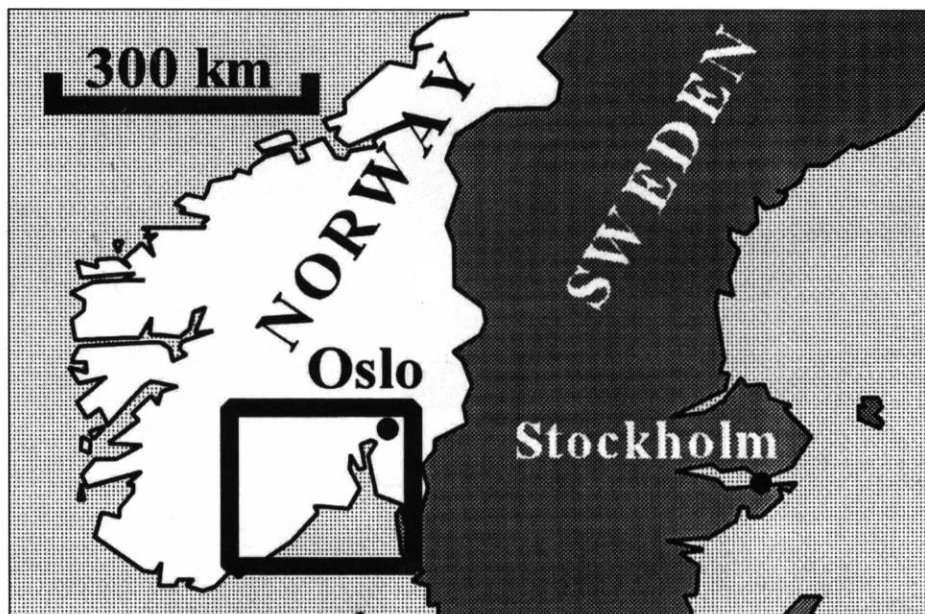


Figure 1. The southeast part of Norway (identified by the tessera, expanded in the next figure) played an important part in the discovery of some of the more unusual elements.

thing they had seen before, and the two Esmarks realized this might be something new. Esmark senior sent a sample to Jöns Jakob Berzelius, the famous chemist in Stockholm, for a more complete analysis, who later that year discovered thorium in the mineral (note 1).

The Kongsberg Mining Academy (Kongelige Norske Bergseminarium), the accompanying Norwegian Mining Museum (Norsk Bergverksmuseum), and Kongsberg silver mines can be visited at Kongsberg (Figure 2). The Academy where Jens Esmark taught still stands (note 2). In 1813 when the University of Christiania (note 3) was created, Jens Esmark joined that new university and the Kongsberg Mining Academy shut down. Jens Esmark in the 1820's suggested that Scandinavia had once been covered with ice, but he was not taken seriously by his col-

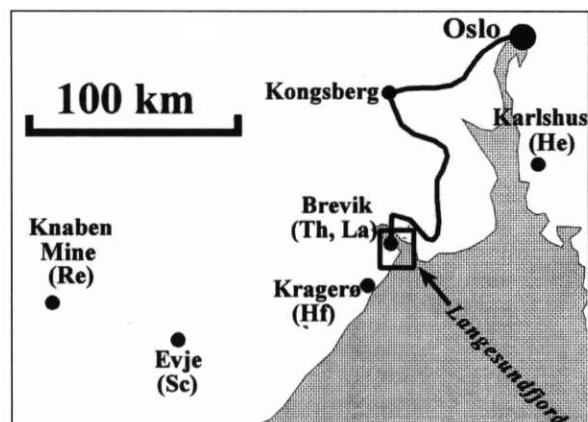


Figure 2. Several elements were originally found in southeast Norway. All of these sites have been visited by the authors, but only the Brevik area (Langesundfjord) is covered in the present article. Brevik may be reached by automobile from Oslo by means of Kongsberg, where a historical silver mining museum may be visited and where the old academy resides (where Hans Esmark's father was a professor).

leagues—extensive global glaciation was not recognized until Louis Agassiz's work in Switzerland twenty years later.

Mr. Alf Olav Larsen (Figure 7), the leading mineralogist of the Langesundfjord area, was

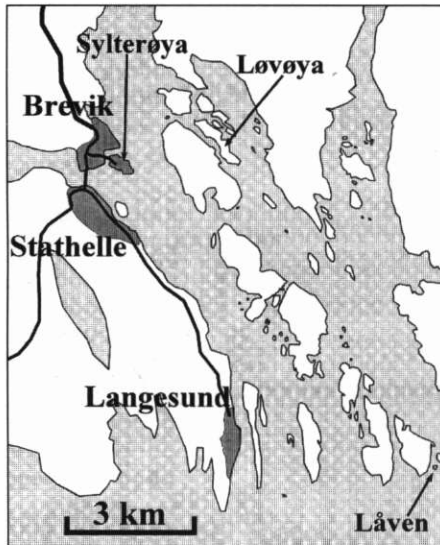


Figure 3. Map of the Langesundfjord area. The main cities are linked by highways, but the swarm of islands in the fjord are accessible only by boat. The three islands of main interest are Løvøya, the discovery site of thorite by vicar Esmark; Låven, the historic source of mosandrite, a source of lanthanum; and Sylterøya, the location of vicar Esmark's church. About 15 kilometers north is Skien (not shown), the home of the playwright Henrik Ibsen.

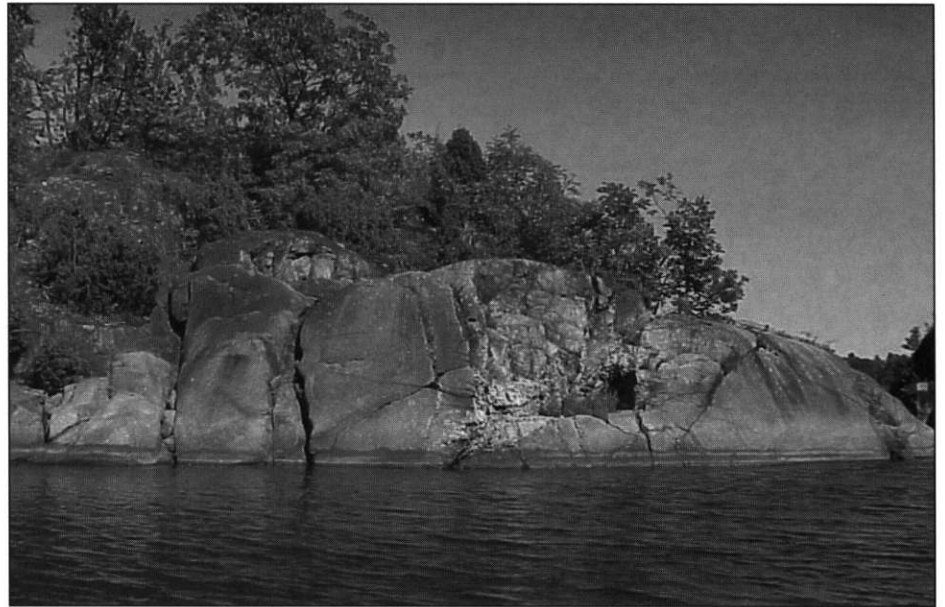


Figure 4. The exact location of the "thorite hole," where vicar Esmark discovered the original thorium mineral, is not known. This is a possible location (N 59° 03.45, E 09° 44.08) identified by Alf Olav Larsen, the foremost mineralogist of the Langesundfjord area.

Figure 5. This 20-cm specimen is from the Langesundfjord area. The dark thorite ( $\text{ThSiO}_4$ ) is in a matrix of syenite pegmatite, an alkali feldspar rock mixed with hornblende and other minerals but lacking quartz.



our host for our visit to Norway and led us on a retracing of Esmark's discovery. There is no routine ferry service to Løvøya, and Alf took us in his outboard for a tour of the islands in the fjord. He headed from his home in Stathelle (Figure 8), through the Brevik harbor, and then straight to Løvøya (Figure 4). "Today we do not know exactly where Esmark discovered the mineral, Alf was telling us as we cruised through Brevik harbor." Esmark mentioned in a letter to Berzelius that when he returned after the winter thaw, he assumed that ice had weathered out some of the minerals. That means it was close to the shore. "Alf told us that he had scoured the whole of Løvøya and had

found only a few candidates, close to the shore where the ice would have formed. In the old days the locality was called the 'thorite hole' (Figure 9)." As Alf maneuvered the boat to dock at a mineralized headland, an eider hen scurried away with her brood.

Unfortunately no more thorite can be found: "After Auer von Welsbach invented his incandescent mantle which uses the refractory thorium oxide, there was a 'gold rush' in 1895-1896, which essentially cleaned out the thorite in the Langesundfjord islands." (note 4).

In his boat, Alf toured us across the open water of the fjord to gain a larger view. The scenery in Langesundfjord displayed an ancient

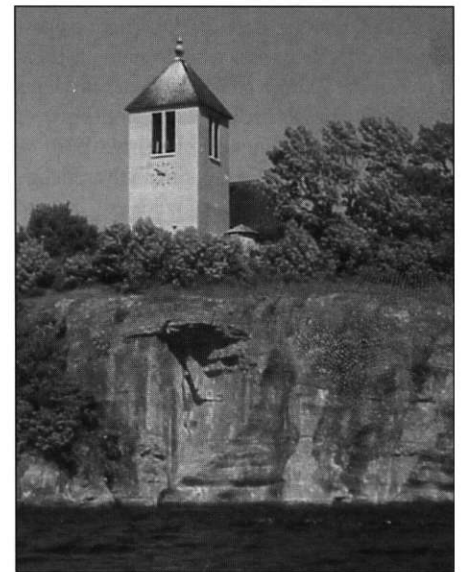


Figure 6. Brevik kirke (N 59° 03.16, E 09° 42.15) on Sylterøya, an island linked to the mainland part of Brevik by a bridge. This stone church replaces two earlier wooden churches, demolished in 1879 and burnt down in 1960, respectively.

panorama of geological variety. From the middle of the fjord, we scanned the horizon and viewed almost a billion years of history, from preCambrian to Permian. The thorite itself was found in Permian pegmatites. To one side of the fjord an Ordovician limestone quarry lay, marked by a smokestack of an accompanying cement factory; to the other side a Permian cliff of blue syenite loomed over the horizon. "This is the famous blue schillerizing larvikite used in so many buildings of the world." Alf told us (note 5).

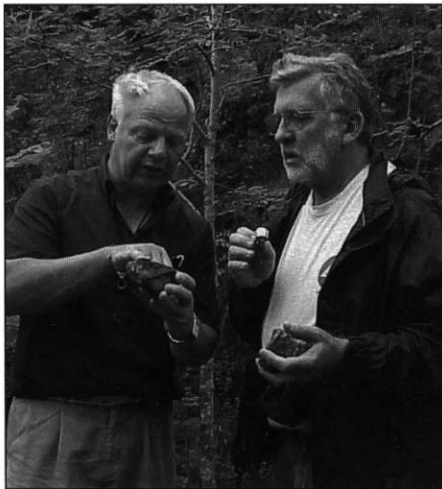


Figure 7. Mr. Alf Olav Larsen (left) is showing a specimen of alvite (hafnium-rich sample of zircon) to one of the authors Jim Marshall (right). This photograph is taken at the Tangen Mine near Kragerø, another site visited by Dr. Larsen and the authors.

Esmark wanted to call the new mineral 'berzelite,' but the ever gracious and modest Berzelius declined, preferring to name it 'thorite,' after the Viking's god of thunder.<sup>4</sup> Berzelius and Esmark developed a strong friendship over the years, well documented by a series of letters between the two.<sup>4</sup> As one peruses the exchange of correspondence, one is saddened by late developments in Esmark's life. He solicited the aid of Berzelius to write a letter of recommendation for a post as vicar of Eidanger, the parish adjacent to Brevik, so that he could remain in the district and also earn more money, since Esmark's life "is difficult and it is increasingly difficult to feed a family on a meager pastor's salary" (Esmark had seven children). Other clergymen complained to his superiors that he spent too much time on natural sciences and too little on theology, and Esmark left his

beloved Brevik in 1850 to move to Ramnes, 40 km north-east of Brevik, where he served as vicar until retirement in 1870.

The case of Esmark exemplifies the large network always responsible for important advances. Time blurs details, and history celebrates the discoverer but forgets the supporting cast. Hans Esmark, the pastor, was well known throughout Europe and supplied mineral samples to many scientists in other countries for their researches. He was the only amateur who has been granted honorary fellowship in the Mineralogical Society of England. A mineral species, esmarkite, was named in his honor (note 6). Upon his death his mineral collection was donated to the University of Tromsø, Norway.

The Brevik Bymuseum (City Museum) resides in the old city hall, about 100 meters downhill from Esmark's old church (Figure 10). Inside are beautiful montages, antiques, paintings, and photographs that describe the history of the area. And on the wall are the past thirty mayors of Brevik—the first, at the top, being Hans Morten Thrane Esmark (Figure 11). Loved by his people, his memory lives on with his community, which celebrated his 200th birthday on August 21, 2001. ◉

## Acknowledgments

Gratitude is extended to Alf Olav Larsen of Stathelle, Norway, recognized as the foremost mineralogist of the Langesundfjord area, who extended his hospitality and expertise to the authors—not only for the Langesundfjord area, but also Kragerø (original source of hafnium), Knaben (first major source of rhenium), Karlshus (original source of helium-bearing cleveite), and Evje (original source of the first naturally occurring scandium mineral). We are also grateful to Alf for helping with the translations of various references.

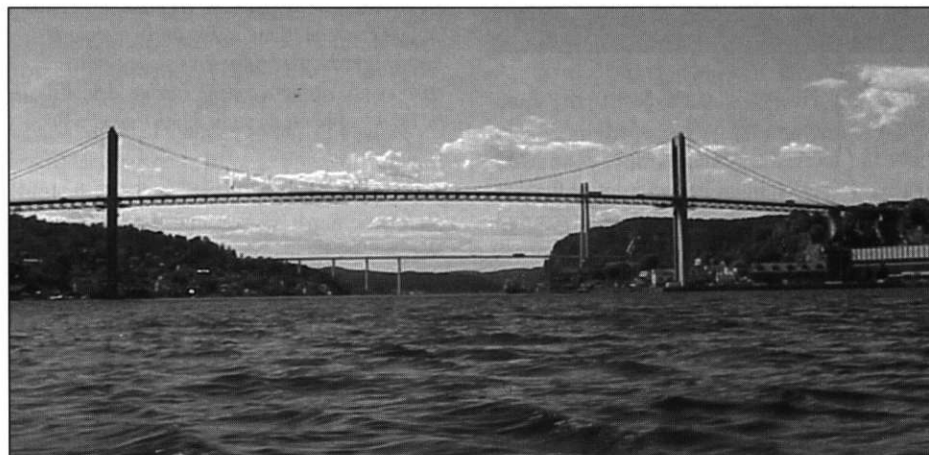


Figure 8. The modern view from the middle of the Langesundfjord shows the huge suspension bridge linking Brevik (Esmark's home) with Stathelle (the residence of Mr. Larsen).



(Figure 9) Jenny Marshall, one of the authors, poses in Alf Olav's boat beside what is suspected to be the original "thorite hole" where vicar Esmark discovered thorite. In the foreground to the right can be seen a rich myriad of embedded minerals, including zircon ( $ZrSiO_4$ ), magnetite ( $FeFe_2O_4$ ), aegirine ( $NaFeSi_2O_6$ ), and molybdenite ( $MoS_2$ ).

## Notes

1. Berzelius analyzed the mineral by using his classical procedures and established its composition as a new earth silicate; his analysis revealed small amounts of known elements (Ca, Fe, Mn, U, Pb, Sn, K, Al, Na) but an abundance of a new earth (58%, thorium oxide), as well as silica (19%).<sup>5</sup> He subsequently prepared metallic thorium by reacting the tetrachloride with elemental potassium. In a subsequent article we shall deal more fully with this "Father of Modern Chemistry" when we vicariously visit Sweden.

2. These attractions of Kongsberg may be found by leaving the main highway E134 from Oslo, crossing the Lågen River at the waterfall in Kongsberg (intersection is N 59° 39.95, E 09° 39.24). The Academy stands in the Kirktorvet (N 59° 39.95, E 09° 38.72). Within 250 meters, the museum (N 59° 39.97, E 09° 38.97) highlights the silver mining history of the area, including elaborate exhibits on old mining methods and an elegant silver coin collection. Interestingly, the crossed hammers of Germany which were described in a previous Rediscovery article<sup>6</sup> were seen here. Whereas Sweden devel-



oped its own mining technology, Norway imported German expertise with the accompanying traditions. Whereas the crossed hammers were called "Eisen und Schlägel" in Germany, in Norway they are named "hammer og bergsjern." The crossed hammers can be seen on Norwegian coins as the trade mark for the Kongsberg Norwegian Coinage.

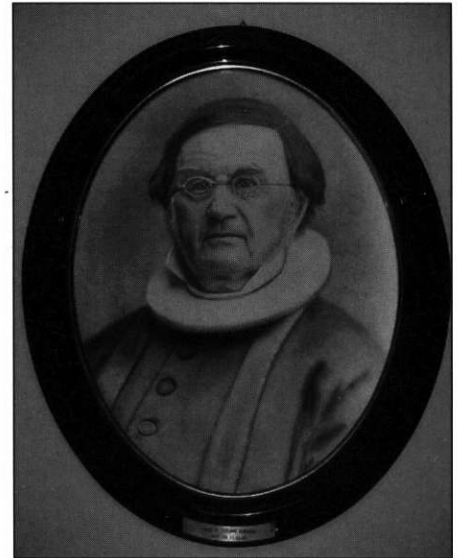
3. The original name of the university was "Det Kongelige Norske Frederiks Universitet"

(The Royal Norwegian Frederik University - Frederik being the name of the contemporary Danish-Norwegian king). The cognomen of the university became "Universitet i Christiana" (University of Christiana)—Christiania being the name of Oslo until 1924. The modern name is "Universitet i Oslo" (University of Oslo).

4. A new museum in Althofen, Austria, is devoted totally to Auer von Welsbach (discoverer of praseodymium, neodymium, and casseopeium), and includes beautiful exhibits and displays. A trip to this site will be the subject of the next Rediscovery article.

5. "Schillerizing" refers to a metallic luster caused by microinclusions in feldspar. Buildings made of larvikite include Liberty Place in Philadelphia, PA, the Corporex Office Building of Atlanta, GA, and the Canterra Tower of Calgary, Canada. In Larvik (15 kilometers west of Brevik) stands a larvikite statue of Thor Heyerdahl, the famous scientist and explorer, who was born and reared in Larvik. The statue exhibits the long, tapered motif of the Moai of Easter Island, and like the Moai his statue faces inland toward the village.

6. "Esmarkite" is now recognized as a modification of cordierite. A crystal of cordierite ( $Mg_2Al_4Si_5O_{18}$ ) was known as "Norsemen's compass," because of its ability to tell the sun's position when below the horizon; this was accomplished by its different transparent colors, varying from violet to gray, as the angle of the crystal was rotated through the polarizing light of the sky. A modern use of cordierite is as a refractory ceramic, because of its low expansion coefficient and its thermal shock resistance.<sup>8</sup>



(Figure) The portrait of Hans Morten Thrane Esmark (1801-1882) hangs in the Bymuseum (the old city hall, 4 Kirkevegen) of Brevik on the island of Sylterøya (N 59° 03.18, E 09° 42.12).

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Figure 10. This view is from the environs of the church on Sylterøya, looking across to the mainland and Brevik. This historical harbor used to teem with boats loading timber and ice. Today the harbor is the site where a visitor may hire a boat to tour the various islands on the Langesundfjord.