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JACOB BERZELIUS AND ANTIQUARIAN RESEARCH

The work of the famous Swedish chemist Jacob Berzelius (1779–1848) at least twice touched upon archaeology. First, he examined the metal content of a number of Bronze Age objects from Denmark, determining that they lay within the expected range of c. 15 parts tin to 85 parts copper. Second, his 1836 examination of the supposed long runic inscription about King Harald Hildetand on the rock-face in Runamo, Blekinge, revealed only natural rock-formation processes. Other scientists soon supported him and the reiterated claims by Copenhagen geologist Forchhammer and philologist Finn Magnussen to the contrary were finally crushed by Danish archaeologist Jens Jacob Worsaae in 1844.

Introduction

In 1990 the Berzelius Society was founded in Stockholm, its initiator being the former President and Secretary of the Royal Swedish Academy of Sciences, Carl Gustaf Bernhard, a neurophysiologist of international standing. From its inception, the Society has acquired numerous members, primarily chemists and those interested in the history of science. The reason for founding the Society seemed self-evident, indeed. Together with Linnæus, Berzelius (1779–1848) (fig. 1) remains the most important representative of the natural sciences in Sweden: a towering figure in the field of chemistry, he presented the theory of electrochemistry, determined the chemical proportions, created the chemical signs still in use, discovered several elements, and accomplished much else.

The Society's annual meeting is held on 20 August, Berzelius' birthday, and when Professor Bernhard requested that I give a lecture at the 1993 meeting, I realized that while I am not particularly knowledgeable about chemistry, in my youth I had studied north European archaeology, a field I still attempt to keep abreast of. It therefore seemed to me worth investigating whether Berzelius, a man of many interests, was at all involved in knowledge of the past, an area that admittedly lay outside his usual range of activities.

One indication of such an interest was his election in 1829 as an honorary member of the Royal Swedish Academy of Letters, History and Antiquities, then the central institution for Swedish antiquarian research. I also discovered that in his monumental work about the history of ideas, *C. J. Thomsen and his Learned Connections in*

Sweden 1816–1837 (B. Hildebrand 1937–38), Professor Bengt Hildebrand touched upon Berzelius' activities in this respect. Much of what will be mentioned below stems from research by Hildebrand. This is particularly the case as regards Berzelius' intervention in the inflamed contemporary controversy about the supposed runic inscription in Runamo, Blekinge.

Analysis of objects from the Bronze Age

During the period Berzelius was active, from around 1800 to his death in 1848, scholars' concept of Scandinavian prehistory underwent a radical reassessment, this being further accentuated during the latter part of the century by the work of the Swedes Hans Hildebrand and Oscar Montelius, and the Dane Sophus Müller. The idea of dividing prehistory into periods based on the materials used for everyday objects had begun to take shape. Above all, it was the growing knowledge of the 18th century about new countries and their primitive populations that provided the impulse for viewpoints that Scandinavians had once been ignorant of metals and their refinement. In his *Clues to Scandinavian Antiquity* (Thomsen et al. 1836), the Dane Christian Jürgensen Thomsen (1788–1865) had in 1836 provided the empirical evidence for the tripartite archaeological system of stone, bronze and iron. Before that, Swedes such as Jacob Adlerbeth, Jacob Rutström and Johan Gustaf Liljegren (1791–1837) had played with such thoughts, but not until Bror Emil Hildebrand (1806–84), a disciple of Thomsen, and the Royal Antiquarian from 1837 to 1884, did Swedish archaeological research and administration



Fig. 1. Berzelius at the age of 65. Daguerreotype by J. W. Bergström 1844. The Berzelius Museum. Royal Academy of Sciences.

of its ancient monuments come to rest on a firm scientific foundation.

Berzelius had become attached to young Hildebrand after the latter had moved from Lund to Stockholm, where he began helping Liljegren. As Secretary of the Royal Academy of Sciences, Berzelius had "open house with a simple but hearty meal" every Monday evening during the cold months of the year; held in his home in the Academy's house on Drottninggatan, it was primarily for members of the Academy, but also open to other scientists. Hildebrand entered this circle from the start of his activities in Stockholm, by in 1836 writing to Thomsen that the lofty position Berzelius occupied in his own field did not hinder him from "seeing into others' fields of knowledge... and what will eternally preserve his memory is the love with which he embraces all research". The ground was thus well prepared for a meeting between Berzelius and Thomsen when the latter arrived in Stockholm and was entertained at a dinner. Hildebrand was present, as well.

In 1812, Jacob Adlerbeth had contributed an article to the journal *Iduna*, entitled "Chemical examination of an object for Scandinavian antiquarian scholarship" (Adlerbeth 1812). The excavation of a burial mound had produced an unknown dark-coloured substance among the bones and charcoal. Berzelius had analysed the find and determined that it was a quartz-like substance, an "aromatic gum mixture". Bengt Hildebrand notes that

this is the first known example of a field archaeologist calling in a specialist on ores (B. Hildebrand 1937-38:184).

But a previous scientific finding by Anders Celsius concerning the lowering of water levels, misunderstood as a land elevation, caused Olof von Dalin (1708-63) to claim that Sweden could not have supported people until the time of Christ, since previous calculations had indicated that it stood under water until then.

The father of archaeological metal analyses is regarded as one of the chemists of his time, Martin Heinrich Klaproth (1743-1817), a professor at the University of Berlin, and discoverer of several elements. He presented the results of his research in 1807 in the Prussian Academy of Sciences, under the title "Chemical investigations of the metal material of bronze weapons and implements from Antiquity. Contributions to the chemical knowledge of mineral bodies" (Klaproth 1815). Klaproth cited classical authors such as Herodotus and Homer, who spoke of weapons and tools of copper. Pure copper was out of the question, as it is far too soft and pliable; rather, it was alloyed with tin, which was known during the third millennium BC. Whence, then, came this element necessary to provide the required hardness of bronze? Klaproth cited the Cassiterides, the islands where the Phoenicians and the Carthaginians traded pottery and salt for tin - the name *Kassiteros* (Κασσιτερος) means "tin" in Greek. The Phoenicians were anxious not to reveal where these "tin islands" lay. After the fall of Carthage, this traffic lay open to the Romans, who of course had long had access to iron for their weapons, but where bronze nevertheless remained a necessity. Klaproth suggested the area now known as Cornwall, with its tin deposits. This question has also been discussed in the *Swedish Antiquarian Journal*, where Hans Hildebrand claimed in his article "The Cassiterides and tin in Antiquity" (H. Hildebrand 1873-95) that the tin islands are to be sought in Galicia in northwest Spain. The label "islands" stems from a confusion frequent in classical authors, namely that of islands and mainland areas nearly surrounded by water.

The group of objects, mostly of bronze, discovered in the excavations in Brandenburg, some of which were investigated by Klaproth, consisted of spearheads and knives, as well as two swords. In his laboratory, Klaproth had polished the blade of one of the swords, revealing the beautiful golden yellow colour and the lustre that indicated the hardness of the object. After chemical analysis Klaproth had determined the mixture as consisting of 89 parts copper and 11 parts tin. From other areas of Germany Klaproth had investigated bronze sickle-like objects, including one from Rügen, and found ratios such as 85 to 15 and 87 to 13. Among the other objects he analysed with approximately the same results were a bronze ring from the Rhine and fragments of armour from a grave on Sicily. Klaproth chose instead to refer to previous analyses presented by Antoine Mongez in

Mémoires de l'Institut National (Mongez 1804), where several analyses produced roughly the same results as those of Klaproth. They involved three swords from the area around Abbeville in Picardy, found together with skeletons of people and horses.

The versatile Swedish chemist Peter Jacob Hjelm (1746–1813), who isolated the new metal molybdenum and was particularly gifted at blowpipe analysis, was also interested in matters of archaeology. In the summer of 1796 Professor Anders Jahan Retzius of Lund sent him a piece of a double-edged sword blade that (together with several stone knives) had been excavated from a mound on the plains of Skåne. In an article in the *Annals of the Royal Academy of Sciences* (Hjelm 1797) Hjelm presented a careful discussion of his analysis of the object, finding that it consisted of 84 parts copper and 16 parts tin. In addition, Hjelm himself experimented with bronze alloys: assuming that the amount of tin could be increased somewhat, he produced a knife blade consisting of 20% tin and 80% copper. The knife blade thus produced was, according to Hjelm, “much whiter and harder, but to the same extent brittle, so that if sharpened carelessly, it immediately broke off. The edge was so sharp that it could be used to make pens. It did not take long, however, before fine shards broke off with each cut. When tin comprised 25% of the mixture, it was more red than white, and quite brittle.” If the percentage of tin is increased still further, the result becomes even more obvious, and the mixture becomes useful to astronomers in telescope mirrors. The approximate percentage of tin for producing bronze is thus 16; it could also be replaced by zinc or brass. At the same time Hjelm attacked the view that “arsenic was added to the copper of antiquity” to harden it. He also noted that the famous French archaeologist and art historian Count de Caylus (1692–1765), in his monumental work *Recueil d'Antiquités, Égyptiennes, Etrusques, Grecques et Romains* (de Caylus 1752–67), speculated and experimented with copper, but instead of growing hard, it was found to become softer and more malleable than before. Summing up, Hjelm concluded: “the bronzes of antiquity provide thorough witnesses to both their knowledge of metal mixtures, their art of modelling according to nature, and their skill at casting.”

Hjelm should thus be seen as one of the very first – actually before Klaproth – who clearly established the structure of bronze and its role in prehistory. Nor is that all: Bengt Hildebrand is clearly correct when he emphasizes that Hjelm at this early stage provided a sketch of a three-period system, even if he of course could not realize the details of the chronological and archaeological relations involved.

This was the state of scientific affairs when, three decades after the discoveries of Hjelm and Klaproth, Jacob Berzelius entered the arena of archaeological discussions.

Carl Christian Rafn (1795–1864), a Danish scholar, was an eager supporter of the Scandinavian Early Text

Society (Da. *Nordiske Oldskriftselskab*), which he had founded in 1825, as well as editor for its journal, *Annals for Scandinavian Antiquities*. In July 1834 Rafn wrote a prolix letter to Berzelius, presenting the Society and requesting that “the most eminent chemist of Scandinavia and our times might analyse certain bronze objects from the heathen Scandinavian era, and that the results could (in Swedish) be entered into the *Annals for Scandinavian Antiquities*. Should Berzelius be willing to do so, Rafn could have a collection of bronze objects found in burial mounds from the heathen period sent up to him. The objects could in that case be sent with Bror Emil Hildebrand to Stockholm for further transport to Berzelius’ laboratory. On 23 June, 1835, Berzelius finished his studies, according to a letter of 10 September to Rafn, who in turn thanked him and stated that, due to Berzelius’ travels abroad, the investigation could wait for publication until the *Annals for 1836–37*. In addition, at its meeting of 28 July, 1835, the Society had decided to include Berzelius’ “famous name” among those of its permanent members. Given his investigation of the bronze objects, they would waive the inaugural speech demanded of new members. Rafn subsequently continued to send bronze objects to Berzelius, such as a little piece of bronze he sent to Stockholm for analysis, as none of the Society’s members had such skills.

Analysis of Rafn’s bronze objects

Berzelius received 22 bronze objects, but he did not think it worth the effort to analyse all of them, since his experiments did not differ from the previous results of Klaproth in 1807, i.e. that “our ancestors’ weapons” were of copper mixed with various amounts of tin. He had therefore limited his research to 10 selected objects. He had eliminated several of the objects from the start, because they were heavily oxidized. An analysis of them would have cost a great deal of effort compared to the results.

Berzelius removed the outer layer of oxidized material from the bronze objects. The pure metal was then dissolved in chloride-free nitric acid. A residue of tin oxide containing tiny amounts of copper remained, but the amount of copper was so small as to have minimal effect on the final result. The acidic solution was tested with hydrochloric acid for silver (AgCl) and with sulphuric acid for lead (PbSO₄). “I have found only doubtful traces of both,” noted Berzelius.

The next phase in his analysis was to precipitate the copper with hydrogen sulphide (sulphurated hydrogen, hepatic gas, H₂S). The solution was saturated with hydrogen sulphide, then allowed to stand 24 hours before it was filtered and evaporated. The remaining part was then treated with soda. The mixture was dried and heated white-hot in a platinum crucible. The salt thus formed was extracted and the undissolved oxide collected, heated and weighed. This final oxide product weighed around 1% of the original bronze object, but could also

Table 1. Berzelius' list of his bronze object analyses.

	Cu (%)	Sn (%)
1. A short sword or large dagger	88.02	11.98
2. Sword with semi-circular embossm.	88.75	11.25
3. Sword with semi-circular embossm.	87.44	12.56
4. Knife blade	92.75	7.25
5. Knife blade	97.94	2.06
6. Blade from tweezers	90.30	9.70
7. Casing of wooden shaft (celt)	94.49	5.51
8. Ring	88.81	10.00
		+ Ni 0.59
9. Narrow semi-circular blade	88.88	11.12
10. The same, triangular	90.35	9.65

be much less. The oxide consisted of the other metals not reduced when the copper was refined, and which had been in the raw ores before smelting. This oxide mass could consist primarily of nickel oxide, but it also contained cobalt oxide, iron oxide, manganese oxide and zink oxide. Berzelius had found each oxide individually, but he did not think that it was worth attempting to establish their relative weight.

In conclusion Berzelius noted that if his investigations had revealed anything new it was that "our ancestors" refined their copper more poorly than we do, which could also have been expected from the first. It was determined that prehistoric bronze casters had not used pure tin: it contained arsenic. The tin oxide that the analysis produced smelled strongly of arsenic at the moment of reduction. It should in this respect be remembered that arsenic was still to be found in the tin being imported from England in Berzelius' day.

Berzelius attempted to reduce the oxidized samples by heating them in porcelain tubes in a stream of pure hydrogen. It was a success of sorts, but the reduced matter could not be used for analysis. Together with the water, a significant quantity of the volatile tin chloride disappeared during the heating, which considerably diminished the amount of tin in the reduced residue. Berzelius found it remarkable that the metal mass could absorb chlorine in such a form as would combine with tin. Results of the analyses are listed in table 1.

Berzelius added that on the whole his analyses agreed with those of Klaproth. Finally, he noted that these shifting proportions between copper and tin doubtless stemmed from the fact that "our ancestors" did not have reliable methods for determining the proportions for their metal mixtures or for preventing changes in the mixture during the metallurgic process. They probably resmelted old tin-rich copper from broken objects whose tin had not been extracted, so that when new tin was added to this copper, "the remaining [tin] was not included in their calculations". Berzelius' analyses were, as noted above, published in the Danish journal (Berzelius 1836–37). He also announced his findings in a speech in June 1835 at the Academy of Letters in Stock-

holm, under the heading "Metal analysis in ancient objects".

I was eager to know whether the bronze objects that Rafn sent Berzelius were still preserved in the National Museum in Copenhagen or if they perhaps had been destroyed during the analysis in Stockholm. Curator Lars Jørgensen of the National Museum has been so kind as to investigate the matter. Hitherto it has not been possible to locate the objects, which have probably gone astray. Berzelius also subsequently received other requests from Rafn. In one case he sent him an object from a burial mound, which turned out to be an ivory button. Bror Emil Hildebrand also employed Berzelius' analyses: he sent a lump of mortar with coins stuck together. Berzelius found that the coins were so fragile that they could not successfully be separated, "but if they are heated thoroughly, they will regain their consistency and can be cleaned". In the letter to Hildebrand, Berzelius added a drawing of a coin: cross on shield and lion rampant.

The Runamo controversy

At about this time, the mid-1830s, Berzelius became involved in an archaeological controversy that for a decade aroused considerable interest and produced strong feelings and antagonisms. During the summer of 1834 a letter arrived for the Royal Antiquarian, Johan Gustaf Liljegren. The author was the *Geheimarkivar*, or Privy Archivist, Finn Magnusen (born Finnur Magnússon on Iceland, 1781–1847), a well-known Scandinavian philologist. He asked – and the letter reeks of disappointment – why Liljegren had paid no attention to the well-known runic inscription from a flat rock in Runamo in Blekinge. Liljegren, it will be recalled, had attempted to collect all known Swedish runic inscriptions in a major codex. The first edition of *Runic Inscriptions* (Liljegren 1833) came in 1833, and a second edition the following year. In spite of its lacunae – the subject was still in the infancy of what we might regard as modern scholarly treatment – Liljegren's work has been characterized by the twentieth-century philologist Elias Wessén as useful, "a handy and practical reference work, one still indispensable as an aid for runology".

Finn Magnusen had, he wrote, recently interpreted the previously unreadable inscription and described it in *The Danish Weekly* (Magnusen 1834). And so we enter upon what is assuredly the most lamentable episode in the history of Scandinavian antiquarian scholarship, where Berzelius stands for criticism and reason – nor did he stand alone.

The issue, if one may call it that, had its roots in the 12th century, during the reign of the Danish king Valdemar the Great. Saxo Grammaticus, the first historian of Denmark, lived around the turn of that century. His *Gesta Danorum*, printed numerous times (most recently by Olrik & Ræder 1931), includes a passage in the



Fig. 2. The runic inscription on the Runamo rock-face, according to Jonas Skonvig's drawing in Ole Worm, *Liber sex Danicorum monumentorum* (Copenhagen, 1643). The runes ᚠᚠᚦ LUND are at the end of the inscription, and were regarded as referring to the Swedish city of Lund. The same illustration appears in Stephan Hansen Stephanius' commentary on Saxo (Copenhagen, 1645).

præfatio 2:5 where, while Saxo is describing Blekinge (then a part of Denmark), he mentions that from the Baltic in the south up to the uninhabited tracts around Varend, a trail runs over the mountains, and all along the way traces of runes are to be seen. King Valdemar, who was greatly interested in what these signs might mean, sent learned men to examine this trail and copy onto wooden staves the runes to be seen on the rocks. They could find no meaning in the text, however, since the runes were so worn from people wandering, riding or driving carts along the path. Strangely enough Saxo notes in *Liber Septimus IX:30* (Olrik & Ræder 1931:206) that the [mythical] Danish king Harald Hildetand had an inscription cut into a cliff in Blekinge, about his father Rørik and maternal grandfather Ivar Vidfamne: "Idem in monumentum pateis eius res gestas apud Blekyngiam rupi cuius memini, per artifices mandare curæ habuit".

Ole Worm and his successors

After this, nothing happens for some five hundred years. The Danish antiquarian Ole Worm (1588–1654) was intrigued by Saxo's statements and sent his assistant Jonas Skonvig to Blekinge to attempt to locate the rune-covered rocks and copy the text. Skonvig thought that he had found the runic inscription on a flat rock in Bräkne-Hoby, not far from Ronneby in Blekinge. Like King Valdemar's emissaries, Skonvig found the runes extremely difficult to read. He thought however that he could read a single word, namely: ᚠᚠᚦ , i.e. a place-name *Lund*. In the drawing published by Worm (fig. 2), which is presumably derived from a sketch by Skonvig, one sees a curved runic inscription in which these runes can be read at the far right. Worm published his meager results in *Danicorum monumentorum libri sex* (Worm

1643). From this volume the Runamo inscription was to work its way through runic literature.

In a thesis published in Lund in 1708, called *Dissertatio academica de antiqua urbe Lund* (Stobæus 1708), the supervisor Andreas Stobæus (1642–1714) or his student Anders Grimzæus († 1741), vicar of Gråmanstorp – as in the case of most older dissertations in Sweden, it is unclear whether the *præses* (the supervisor) or the *respondens* (the student) actually wrote the work – was clearly under the influence of Olof Rudbeck's historical fantasies about Sweden's glorious past. Concerning Runamo, the author follows Saxo and his commentator, the Danish Royal Historian Stephen Hansen Stephanius (1599–1650), as well as Skonvig's reading as reported by Worm: "Quamvis mentio hujus urbis apud scriptores antiquissimæ expressio verbis non occurat attamen ex loco Saxonis lit VII ...cum inscriptione rupis *Runamo* collato cujus rupis figuram Stephanius...ex libet, facile apparet urbem nome *Lund*..." (Stobæus 1708:§8). In his work (1645) Stephanius reproduces the same sketch as that published by Worm two years earlier.

When printing was begun on Eric Dahlbergh's famous work *Svecia antiqua et hodierna* (Dahlbergh 1716), the



Fig. 3. Frontispiece for the section on Blekinge in Erik Dahlbergh, *Svecia antiqua et hodierna* (1714). Copperplate by Johan van den Aveleen (1712). It is the same runic inscription with *LUND* at the end, as in Worm.



Fig. 4. Magnusen and Forchhammer studying the Runamo rock-face. Drawing by Christian Christensen. Steel engraving by S. M. Petersen.

frontispiece for the section on Blekinge (fig. 3) shows a curved “scroll” of runes running across a cliff in the forest, a clear echo of the Runamo tradition. The runes also show practically the same sequence as that originally published by Worm.

In his *The History of the Swedish Kingdom from Its Origins till Our Times* (von Dahlin 1747), the Swedish Royal Historian Olof von Dalin (1708–63), as always critical of all sorts of myths, fails to include Runamo. Although the no less famous Lund-based professor Sven Lagerbring (1707–87) on the other hand at first assumed that the Runamo inscription was important, he rapidly changed his mind.

Nils Reinhold Brocman (1731–70), the *Assessor* or scientific expert in the Collegium of Antiquities, actually visited Runamo; in his work “An investigation of the date of our rune stones” (Brocman 1762), published in his 1762 edition of the *Ingvar Saga*, he asked himself, not without reason, how Saxo could have his story tell of King Harald Hildetand after previously having stated that the inscription was unreadable. In a letter to the Danish antiquarian Rasmus Nyerup (1759–1829), Brocman relates that in 1764 he visited Runamo and found nothing there except cracks that could have been caused by rain water. Furthermore, in direct contradiction to Saxo’s narrative, the trail did not go via the marks in the rock and they could not have become worn and unreadable for that reason (B. Hildebrand 1937–38).

Brocman’s statement was the beginning of scepticism

in archaeological literature about the putative runes in Runamo. One such sceptic was professor Nils Henric Sjöborg (1767–1838) in his 1792–93 work *A History and Description of Blekinge* (Sjöborg 1792–93). Among those who over the years visited Runamo was the prominent Danish historian and *Geheimearkivar* (Privy Archivist) Jacob Langebek. The monument designer C. G. G. Hilfeling also visited the site in the early 1790s in an attempt to sketch the supposed inscription on the rocks.

The mystery was not yet solved, however. Christian Thomsen, as mentioned earlier, went to Runamo in 1820. He decided to contemplate the problem in the peace and quiet of his home in Copenhagen, and therefore, rather impiously, had a few pieces broken out of the rocks and brought them home with him. In his *Thomsens Museum*, Jørgen Jensen (1992) noted that in the museum there were several numbered pieces of stone, signed NM.CCXXII. They are no longer there, however, presumably thrown away during the 19th century, after it turned out that they were of no scientific value (personal message to the author from Curator Lars Jørgensen, 30 August 1994).

The Runamo Commission’s field studies

The suggestion that the Runamo controversy should be settled once and for all came from the president of the Danish Academy of Sciences, antiquarian editor Bishop Peder Erasmus Müller (1776–1834), who was working

on a new edition of Saxo. At Müller's suggestion, the Academy decided to let an appropriately constituted commission investigate matters and visit Runamo. They selected three scientists and a draughtsman, the latter being the landscape and theatre painter Christian Ferdinand Christensen (1805–83). In July 1833 the expedition got underway. They were given a warm welcome by Bishop Faxe in Lund, who also wrote a letter of introduction to Vicar Wolff in Hoby.

Who, then, were these gentlemen in top hats and frocks, wandering through the rough terrain of the wilderness leading to Runamo?

Philologist and antiquarian Finn Magnusen was a scion of Iceland's most prominent family of churchmen and literary figures. An editor of older Icelandic literature, particularly the *Elder Edda*, he was made a Danish *Geheimarkivar* (Privy Archivist) in 1829, and was greatly respected as a philologist, but was also considered relatively uncritical and with a weakness for sensational discoveries. He received the title of *Etatsråd* (Privy Councillor).

Christian Molbech (1783–1857) was Chief Librarian and head of the Royal Danish Library, one of Denmark's most important intellectuals, and highly productive in the fields of history and literary history. He maintained a lively contact with Swedish colleagues.

Johan Georg Forchhammer (1794–1865), a professor at the *Polyteknikum*, or Technical Institute of Copenhagen, and later at the University of Copenhagen, was the Secretary of the Danish Academy of Sciences. He was one of the most prominent geologists of his time, with a long series of publications, primarily concerning the geology of Denmark and The Faeroes.

The commission arrived at Runamo on 14 July 1833 and spent two days at work there (fig. 4). Guided by Forchhammer, Christensen sketched the signs the geologist considered made by humans, disregarding cracks in the stone. In November the commission submitted its report to the Academy of Sciences, and Christensen's runic characters were engraved in copper. Finn Magnusen found no meaning in the inscription.

On the afternoon of 22 May 1834, metaphorical lightning struck the room of the *Geheimarkivar* while he was examining the proofs of the copper engraving. He had an impulse to read the "runic text" from right to left, an order which is rare, but which does occur. Then, all was revealed! Finn Magnusen read, and translated to modern Danish (here translated into English):

Hiltekindinn ríki nam . . .	Hiltekind received the kingdom
Garþr inn hjó	Gard carved
Uli eit gaf	Ola oath gave
vigi Óþin rú(na)r	May Odin hallow the runes!
Hringr fáí	May Ring
fall a mold	fall to the earth
Álf(ar) Ástagod	the Elves, gods of love
Óla (fjáí?)	abandon Ola
Óþin ok Frey	Odin and Frey

ok Ásakun
fari (fari)
fjandum varum
unni Haraldi
Ørin sigr!

and the Æsir kin
destroy, destroy
our enemies!
Grant Harold
a great victory

The coming Battle of Bråvalla

The entire text in *fornyrðislag* (the Eddic narrative metre) was thus a prayer for victory for Harald Hildetand in his expedition to the north against the lands of the Sveas, where a tributary king called Ring had revolted. This is nothing other than the famous story from the sagas about the approaching Battle of Bråvalla. Finn had thus also found the name of the runemaster, Gard.

According to the Icelandic *Sögubrot* and *Hervarar Saga*, the aging Harald Hildetand fell at Bråvalla. The battle is described in great detail in *Sögubrot*, which was previously regarded as possibly containing memories of a historical occurrence, the military struggle between the Sveas and the Götes, perhaps during the eighth century. The Uppsala professor Erik Gustaf Geijer (1783–1847) analysed the various statements about the location of the Battle of Bråvalla. Saxo, who had vague concepts of geography, placed the battle between Bråviken in Östergötland and Varend in Småland. Erik Dahlbergh's *Svecia* also provides a careful cartographic sketch and a lively and imaginative presentation of the battle in Varend (fig. 5). Geijer, in turn, in his *Antiquities of the Svea Kingdom* (Geijer 1850) agreed that Bråvalla was to be located by Bråviken. Present-day opinion inclines to trace back the entire story, which incidentally has certain parallels in Indian mythological sagas, to a common pool of Indo-European myths. The battle was nevertheless not without interest for the Swedish national romantic movement in late nineteenth century artistic circles, e.g. in an imposing painting by August Malmström.

As noted above, Finn Magnusen published these results (Magnusen 1834) in *The Danish Weekly* immediately after his sensational discovery. We now return to Royal Antiquarian Liljegren, who was unwilling to include the Runamo inscriptions in his *Runic Inscriptions* (Liljegren 1833). He was sceptical of Magnusen's reading, particularly as he was influenced by Molbech, whose correspondence with Liljegren indicates that he did not accept the Runamo material as runes. In Stockholm Liljegren broached the subject at the meeting of the Academy of Letters on 13 January 1835. Berzelius was chairing on the occasion. Like Liljegren, he had from the first distrusted the matter. He now regarded "the lines regarded as runes as being so scattered and ambiguous that he could just as easily produce an entirely different reading". He regarded the Runamo runes as nothing other than a normal seam in granite bedrock of the so-called *skriftgranit* type.

During a visit to Copenhagen early in August 1836, Berzelius met Thomsen, who was now involved in creat-

Fig. 5 (left). The Battle of Brävalla, whose historical existence has been debated, and which is probably to be sought in the world of the sagas, has long fascinated archaeologists and students of myths.

In his monumental work *Svecia antiqua et hodierna*, which was intended to present Sweden to the world as a nation whose cultural achievements were on a par with its position as a Great Power, the Swedish field marshal and acknowledged master of copperplate drawings, Count Erik Dahlbergh (1625–1703), wished to present not only panoramic views of Swedish cities and palaces, but also illustrations of its antiquarian remains.

An army officer with historical interests, Petter Rudebeck, knew of numerous burial mounds in Värend, for which he provided exact but completely imaginary attributions to various heroes of the Battle of Brävalla, not least the Amazons that, led by a chieftain's daughter called Blenda, fought on the Swea-Göta side against the Danes led by King Harald.

Dahlbergh was told of these matters, after which he assigned cartographer Anders Ekholm to draw up a map of the area in Värend where the battle was said to have taken place. Together with this map, which was finished in 1691, 44 different burial mounds were assigned by name to the fallen, including Harald Hildetand. In this massive battle, dated by Rudebeck at c. AD 395, the Danish forces included numerous peoples such as the Huns, Frisians, Cimbri and so on. The battle scenes with warriors in Renaissance battle-dress were superbly depicted by a Dutch copperplate artist Dahlbergh had brought to Sweden, Willem Swidde.

ing the Danish National Museum. Berzelius received a print of the copperplate from Runamo.

From Copenhagen Berzelius next visited his friend and fellow-chemist, Count H. G. Trolle Wachtmeister at Årup, not far from the border of Blekinge, whence he took the route to Runamo. In his monumental *Biography of Jac. Berzelius* (Söderbaum 1931), H. G. Söderbaum tells us apropos of Berzelius' trip to Copenhagen in summer 1836 about his visit to Runamo on the return journey. According to Berzelius' own description, they passed "through the wildest scenery one can imagine, up mountains and down mountains, entire series of mountains at a time, directly on the rock shelves themselves. Finally, the guide stopped on the road in front of us and asked us to stop. 'Here it is,' he said."

On 14 September Berzelius reported his results to Liljegren. He had the same impression as Brocman had once had, that this was a question of natural cracks, "a quite simple and easily explained natural phenomenon, whereby your belief, my dear Sir, that these figures are not runes, is most decisively confirmed. Furthermore I regard it as possible to demonstrate from the circumstances that even if it had been an artificial inscription, the runes could not be a monument to a major expedition."

Berzelius describes the Runamo rocks

In a speech presented to the Academy of Letters on 15 September 1836, and printed in the Academy's *Annals*

(Berzelius 1838), Berzelius supplied further thoughts on his views on Runamo. Here I will at times be citing his very words:

"What has been presented to me as the Runamo inscriptions consists, if I am permitted to employ a geological expression, of a *seam of traps in granite*. It was clearly the same place as that sketched by Finn Magnusen."

Berzelius assumed that his audience in the Academy of Letters would not be particularly well acquainted with geology, so that he wished to provide a more detailed explanation of what the terms *seam* and *trap* meant. Imagine that this hard bedrock once was fluid. "In these frozen masses there appear, for natural and easily comprehensible reasons, greater and lesser cracks, and through them new parts of the not yet frozen magma are extruded, filling the cracks and solidifying in them. Because the type of rock that fills the cracks has a different color upon solidifying, and often a different texture than the first, cracked type of bedrock has, this circumstance becomes visible afterwards. Such a crack filled with a different type of rock is called a *seam* (Sw. *gång*), or *filon* in French".

Berzelius continues: "During the creation of these seams, the rock masses surrounding them had reached a greater degree of cooling; the molten rock [in the seam] was cooled immediately to a solid state before crystallization could begin, and thereafter broke, just as quickly cooled glass will have cracks. A great many of these cracks in the stairs run almost horizontally straight across the seam between its walls. It thus occurs that six- or four-sided prismatic pieces can break out and thus leave behind step-like depressions, so that the name *trapp* (steps, stairs) was given to this type of rock in Swedish, and subsequently adopted by geologists of other nations. The geological phenomenon to be found at Runamo is of this nature." Berzelius found a number of such broken-off stones. Presumably they were the remains of Thomsen's activities at the site 16 years earlier. It is not clear from his notes and letters whether they discussed the matter when they met in Copenhagen. One may well suspect that Thomsen was not particularly proud of that particular scholarly accomplishment.

Berzelius found here and there signs in the rock "that resemble chiseled runic letters to the extent that no one can be blamed for assuming so, in spite of their form failing to agree with any of the hitherto known runic alphabets." On the other hand, one could with certainty state that the inscriptions that appear in a wide section of the seam from which the earth recently had been removed, probably by the Danish scholars, are nothing other than completely natural cracks in the seam.

"The tendency of the *trap*," continued Berzelius, "to form cracks more or less horizontally straight across the seam, as well as to produce between them these oblique, now straight, now curved cracks, results in a rune-like configuration". When Berzelius compared Finn Mag-

nusen's drawing with the figures on the trap-seam, "whereby it was not always entirely easy to identify correctly now this line, now that, it turned out that between the depressions or chisel strokes on the drawing there were a number of other, similar, but lesser lines, which according to Professor Magnusen's own handwritten notes and drawings were regarded by him as natural cracks, and which it would appear to me can be nothing other than only slightly shallower impressions, produced by the same causes and of a nature similar to that of the deeper ones; thereby disappear all thoughts of a man-made runic inscription."

In sum, and with regard to Finn Magnusen's considerable reputation as a scholar, Berzelius wrote that he did not wish to underestimate the latter's attempts to interpret the Runamo inscription. "I can by no means demonstrate that these figures could not be signs chiseled by a human hand, and containing a meaning – in which case the investigation of that meaning is of the greatest importance. I have only desired to present the reasons that awaken my suspicions that such is not the case." Finally, Berzelius found it too implausible that a monument to Harald Hildetand's campaign against Sigurd Ring should be inscribed far out in a wilderness area where no army could have passed when this easily could be done on the plain not far away, and where there furthermore were to be found rock surfaces appropriate for runic inscriptions.

In the meantime the rumours spread about Runamo and the controversial inscription on the rock face. The matter aroused interest in circles beyond the antiquarian world. Thus, in a posthumous fragmentary poem, *Gerda*, Bishop Esaias Tegnér, the well-known Swedish poet, declaimed:

Vårsol sken på Runamo
där, om du vill sagan tro,
Hildetand i forna tider
högg i berget fädrens strider
vändig runskrift, halv mil lång,
nu förmött av vandrarns gång.

Spring sun shone on Runamo
where – believe the saga if you will –
Hildetand in times of yore
carved into rock our fathers' strife
vast runes, three miles or more,
now worn away by wanderer's feet.

Här och där de djärva dragen
stå oläsliga i dagen
lika dragen till att se
på en död. Förr talte de
jordiskt språk vad nu de mena
veta andarna allena.

Here and there the bold characters
stand unreadable in daylight
like the characteristics seen on
a dead man. Once they spoke an
earthly tongue; what they now say
is known but to the gods.

Finn Magnusen's magnum opus and Worsaae's bomb

Finn Magnusen did not give up. But as Thomsen expressed it to Berzelius: "Magnusen gets lost in too much learning and hypotheses". In 1841 he published an extensive volume, *Runamo and the Runes. A committee reporting to the Royal Danish Academy of Sciences, together with three treatises concerning runic literature, Runamo and various remarkable, in part recently discov-*

ered antiquities (Magnusen 1841).

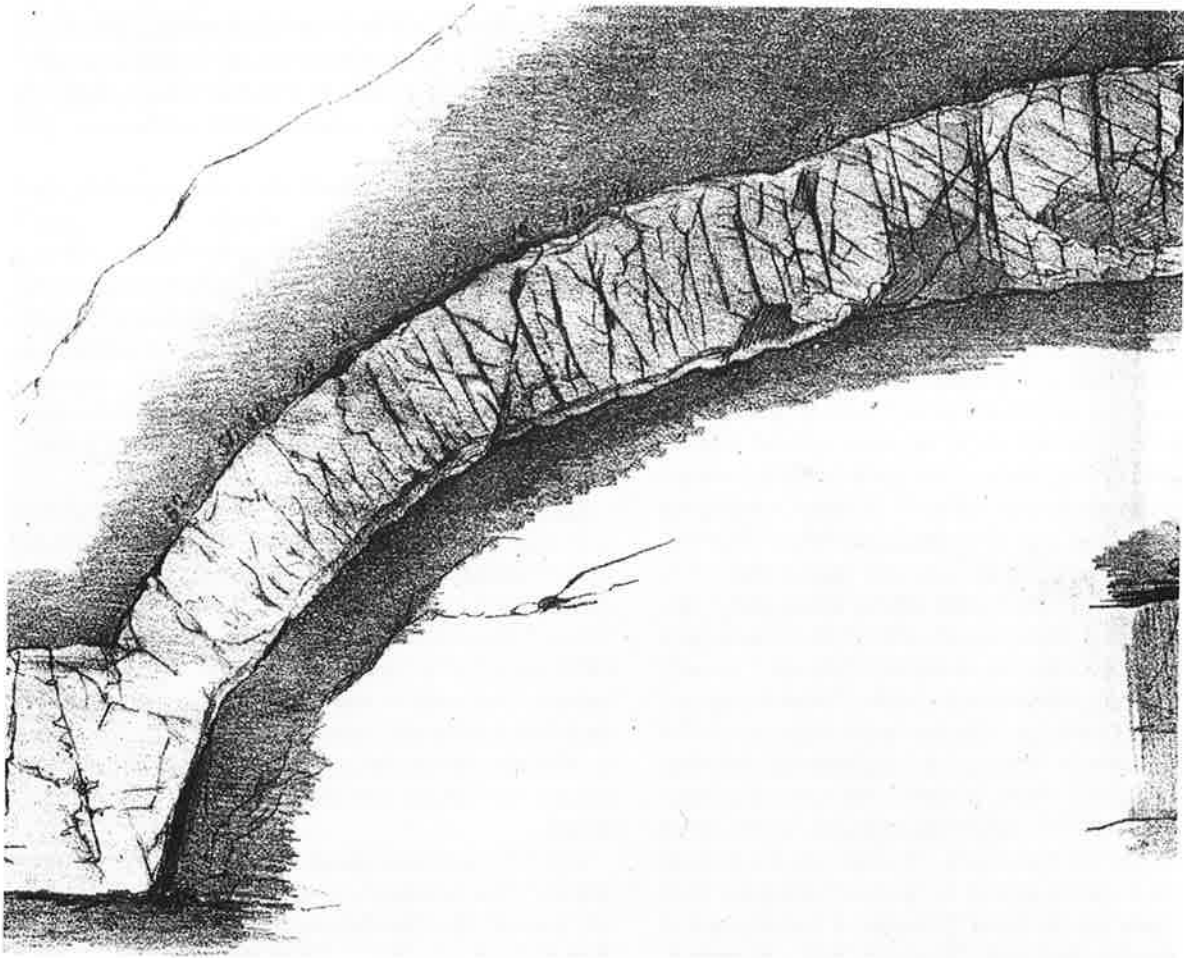
In all it is a formidable tome of 740 pages, crowded with learned digressions and footnotes. Of particular importance is Forchhammer's addendum of 14 February 1839, where he attempts to rebut Berzelius' arguments. After a few polite pirouettes about "the great chemist, Baron Berzelius", Forchhammer rejects his views. If Berzelius had investigated the runic rock a little more closely, it would "have brought the great natural scientist to the same result as ours, viz. that most of the lines on Runamo's trap are inscribed".

While Finn Magnusen's magnum opus was being printed, Professor Sven Nilsson from Lund (1787–1883) had visited Runamo. In his younger days he had been director of the Stockholm Museum of Natural Sciences, as well as chief librarian for the library of the Academy of Sciences. He was a man of many talents, whose learning extended beyond the natural sciences to archaeology, where he was not adverse to imaginative speculation. In connection with Sven Nilsson's and Lennart Åberg's studies of the rock carvings of Bohuslän along the Swedish west coast (Åberg 1838–39), Berzelius, after having seen some sketches of the figures, claimed in a letter to Nilsson that they were nothing but sledges. Nilsson agreed. On the contrary old and modern antiquarians see these carvings as ships.

The signs that Forchhammer claimed were engraved runes were found by Nilsson to be cracks whose depth extended to horizontal lines in the bedrock. Forchhammer's investigation was thus completely inadequate, in spite of all the precautions the latter claimed to have taken. Nilsson was in other words a thorough supporter of Berzelius in this discussion, as may be seen from his report in the *Annals of the Academy of Lettres* (Nilsson 1841). The publication of Magnusen's opus nevertheless aroused great interest, even outside Scandinavia, and it was thoroughly reviewed in learned journals in Holland, Russia and Germany.

Jens Jacob Worsaae (1821–1885) had from his schooldays been greatly interested in archaeological research. When barely 20 he had successfully attacked the Danish professor Niels Mathias Petersen for the latter's attribution of a body preserved in a bog to the Norwegian queen Gunnhild. Worsaae had there demonstrated critical acumen and insight, and continued to impress scholars when at the age of 22 he published an excellent work, *The Primeval Antiquities of Denmark* (Worsaae 1843, English ed. 1849). In the summer of 1842 Worsaae and a friend undertook a field study in Skåne and Blekinge, about which (and its consequences) he reminisced in his incomplete memoirs, "An Antiquarian Scholar's Memoirs, 1821–47" (Worsaae 1934).

He arrived at Runamo and found to his surprise that the pictures in the Runamo volume could not be other than what nature itself had created. Worsaae wished to make a large and more detailed investigation, and that would take time. He would need the help of a draughts-



6. Comparison between Worsaae's (top) and Magnusen's (bottom) versions of the runes.

man, and at that point he did not have the money requisite for a long stay in Blekinge. At home Worsaae studied what Berzelius and Nilsson had to say about the matter, and he became more and more eager to get to the bottom of it all. Through influential supporters he obtained an audience with King Christian VIII, who would surely grant him the money for the trip. Yet Worsaae was worried about the meeting: the king was the patron of the Royal Society of Sciences and could take offence if the young man were to transform the main thesis of the Runamo tome (published by the Academy at great cost) into dust and expose Forchhammer and Magnusen, two of Denmark's most prominent scientists, to general ridicule. The king turned out to be interested and said, "I have indeed had my doubts, but can it really be possible that the entire matter is a mistake?" Worsaae claimed that such was the case, and added that it was much better that the matter be dealt with in Denmark than abroad – i.e. Sweden. "You are absolutely correct about that," said the king. "Go in God's name, and return to me at once with the results. I am indeed eager to find out." In early July 1843, then, Worsaae departed for Runamo, together with an artist called A. Zeuthen and a large chest with plaster of Paris for filling in the cracks in the mountain and obtaining full clarity in their consistency and direction. He worked thoroughly and at length, investigating the geology of the entire area. He displayed his findings in 1844 in a treatise printed by his own publishing firm: *Runamo and the Battle of Bråvalla. A contribution to archaeological criticism.* (Worsaae 1844). Moreover, his work revealed an antiquarian scholarship hardly less than Finn Magnusen's own.

Before the treatise was printed, Worsaae had visited King Christian, who studied his drawings and casts at length, comparing them to Finn Magnusen's work. At last he said, "No one alive can make me believe that there is a single rune there". He laughed until he had to hold his sides, and repeated, "Oh those learned men, and that fat Runamo book. Why, it's an incredible story!" He also offered Worsaae his personal patronage if he were to run into problems with the Academy and the rest of the scholarly community.

This work was to become *Worsaae's bomb*. His was the decisive attack on Forchhammer's description of the lines in the cliff as runes. He clearly demonstrated that the "inscription" was "a freak of nature and to the extent that the Runamo volume was based on it, it was simply a misunderstanding and error" (fig. 6). But Worsaae nevertheless wished to emphasize that with the exception of the Runamo rock face, Finn Magnusen's volume contained a great number of observations and explanations that made a positive contribution to research: "It was furthermore a to an extraordinary extent impossible demand to make of antiquarian scholarship that it, more than all other sciences, should keep itself free of major mistakes."

When Worsaae's treatise reached Stockholm, Hilde-

brand immediately sent a copy to Berzelius, who on 28 February 1845 thanked him with the laconic comment: "It seems as if everyone wants to foist off the blame on poor Forchhammer, whose simplemindedness can hardly be matched."

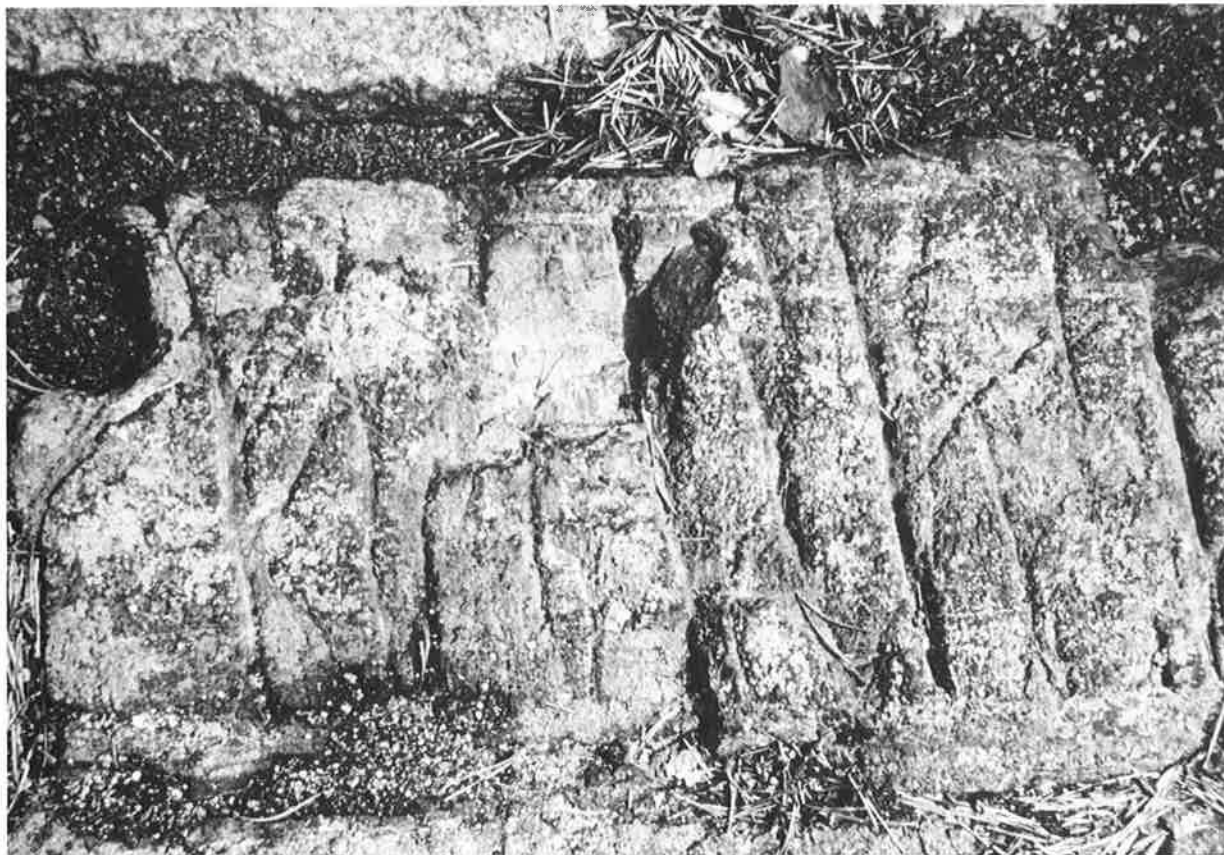
Thomsen in his turn shook his head thoughtfully over Worsaae's unheard-of daring – standing up to Magnusen and Forchhammer, indeed to the entire Danish Academy of Sciences. Even if Worsaae was right, he might easily damage antiquarian scholarship and expose it to ridicule. Others thought that he should have delayed publication until after the distinguished and highly regarded Magnusen had died. Worsaae himself thought that poor scholarship should always be exposed, and the sooner, the better.

Like Berzelius, the Danes felt that the entire fault was to be laid at Forchhammer's door, as his geological expertise had led the enthusiastic Magnusen astray. The latter continued to show Worsaae the same amiability as always. The claim that Finn Magnusen was driven to an early grave by his mistake is a myth. At first Forchhammer was very irritated. But he too ultimately re-established a friendly footing with his critic. According to Worsaae, he was an extremely likeable and cheerful person, but was far too ready to suggest daring hypotheses.

After this an embarrassed silence sank over Runamo and its "illusory runes", to use Linnæus' expression. In his famous *The Wonderous Destinies of the Swedish People* (Grimberg 1915), Carl Grimberg, when writing of runelike cracks in rocks and stones, mentions the Runamo controversy, citing Finn Magnusen as an example of how an otherwise eminent scholar's scientific fanaticism can lead him into completely erroneous byways.

Runamo cannot escape retaining its scientific interest, even if it lies in a different dimension than that intended by the Danish scientific commission of 1833. When in 1993 I was working on these studies in the antiquarian and topographic archives (ATA) of the Swedish Central Board of National Antiquities, and in the library in the Museum of National Antiquities, I ran into an old fellow-student and friend, Sverker Janson, previously the head of the Ancient Monuments Section of the Central Board of National Antiquities. He informed me that when working on the Economic Map of Sweden, he had demanded that Runamo be marked as an ancient monument, due to its significance for the history of science.

The Secretary of the Berzelius Society is Dr Jan Trofast, whose daily work is in the department of pharmaceutical and analytical research and development at Astra Draco AB, a corporation based in Lund. As a highly-educated chemist, he was appointed curator of the Academy of Sciences' Berzelius Museum. I am grateful to him for his careful examination of the chemical text. Dr Trofast has also continued Henrik Söderbaum's publication of Berzelius' correspondence, and in numerous



7. The "runes" photographed by Jan Trofast in 1992.

volumes provided an accurate and illuminating edition of his correspondence with other Swedish chemists, as well as publishing other works about Berzelius. He became interested in Runamo. We planned to make a joint visit to the site, but in the end he had to make the journey accompanied only by his camera (fig. 7). On the way he met people from the area who told him that there still are local antiquarian enthusiasts in the area who are completely convinced that they are true runes and not a natural phenomenon. On a stone near the runes in question, there is carved the following:

Runamo Hällen	The Runamo rock-face
I hävderna nämnd	Named in saga and story
av skalden besjungen	praised by the poet
Saxo Finn Magnusen	Saxo Finn Magnusen
J J Berzelius	J J Berzelius
Esaias Tegnér	Esaias Tegnér

The Bräkne-Hoby district is characterized by forests, its proximity to the Baltic, and its relatively high altitude, with bare rock-faces that can be used as paths and trails.

It was said that numerous visitors had studied Runamo, including several groups from Germany. The site also seems to be known to Danes, as they have appeared there over the years.

The present article is a considerably expanded version of the author's speech to the Berzelius Society on 20 August 1993. The manuscript formed part of a mixed collection of manuscripts, letters and small artefacts presented on 30 April 1994, in honour of his 80th birthday, to Dr Sten G. Lindberg, Keeper Emeritus of rare books and book care of the Royal Library, Stockholm.

English translation by David Minugh.

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