



Ingmar Stenroth

Weighing Vikings

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Weighing Vikings

Summary

In his memoirs, Rome's first emperor, Augustus, can proudly recount how during his reign at the beginning of our era, he sought contact with the peoples of the north, at the edge of the world.

One hundred and fifty years later, the Greek geographer Ptolemy's world map shows that the Romans began trading with the Germans in the Baltic Sea. He names trading posts that we can still visit today. The Germans had sought-after goods for the necessities of life to offer, but also luxury goods with timeless beauty. The method of counting twelve is gaining an early foothold in the Baltic Sea region, as a result of Roman trade activities. When the Western Roman Empire collapses at the end of the 5th century, their way of calculating is taken over by the Franks and the British, who both create robust coin economies with the Roman calculation as a basis.

The expansion of the Arab world beginning in the 7th century does not go unnoticed in the world of the Vikings. From the eighth century, large finds of silver are made in the Middle East and the Arabs mint coins from the metal they quarry. Via European, Polish and Russian rivers, the coins finally reach the Baltic Sea.

In the early ninth century, the Arab Caliphate introduced a new method of counting. They use numbers and position counting. It would not be until the 13th century that Europe became aware of the Arabic way of calculating and another 500 years before the system became widely accepted in the Western world.

The Arabian silver becomes an exotic parenthesis in the Baltic Sea trade system and the silver flow decreases, at the same time as the Viking Age ends at the end of the first millennium of our era. The

inability of the northerners to recoup their laboriously acquired capital from silver coins is reflected in the silver treasures with Arabic coins, which the Vikings store and which constantly appear in our time during archaeologists' excavations on Gotland and along the shores of the Baltic Sea.

Introduction

At the beginning of our era, the center of the world is in Asia. The Roman Empire is a fringe state of the Asian powers. A number of Germanic tribes are located north and west of the Roman border and are forming into nations. They in turn become satellite states to the Roman Empire.

In the Western Roman Empire, there exists a money economy, which is based on a bimetallic coin system, where the value ratio between gold and silver is 1 : 10. The system would be exposed to great stress over time. From the third century A.D. until the bitter end, the Roman state has a shortage of capital, as a result of which the costs of defending the Empire increase. The coin stamps move out to the battle lines in the northeast, in order to quickly give the soldiers pay for their deadly mission. The militarization of society leads to the leaders of the Empire being recruited from the cadres of the military. The Barracks Emperors take part in the battles on the battlefield and rarely die in their own bed.¹

The lack of precious metals forces the state to reduce the solvency of the circulating coins. Soldiers, merchants, and the general public soon discover that the silver of Roman coins is increasingly being mixed with alloys. The silver value of the coins will be lower than what the embossing gives reason to expect. Hard-to-master inflation follows in the footsteps of manipulation. After a protracted economic chaos in the 300s and 400s, Rome's economic foundations collapse. The Western Roman Empire's last emperor was deposed in 476. The eastern half of the Roman Empire had long held the position of the classical cultural heritage, which is threatened by the expansive Muslims.

The beginning of the decline of the Western Roman Empire can be seen in the years around 400 A.D., when barbarian tribes again increase the pressure on the northeastern border of the realm. With short-term goals, Rome's senators and the Empire's economic upper class believe they will find security in the countryside, where they live in splendid isolation and amass wealth by avoiding pay-

¹ Meijer 2004

ing taxes. Emperor Honorius, who held the post of Western Roman emperor in 395–423, did not have the financial resources to support all the soldiers in the Roman army when the security situation deteriorated, but was forced to demobilize the legions of Britain and Gaul to strengthen the Eastern front. Honorius greets his Western subjects that from now on they will be able to fend for themselves. *Hadrian's Wall*, built in the early 100s, with the aim of protecting Rome's northernmost province from Scots and Picts, soon decays into an ancient monument. On the mainland, the watch on the *Rhine* leaves his post. Barbarian tribes cross the Roman border without hindrance and settle temporarily in the fertile fields of Gaul, on their way to seek new homes in Spain and North Africa.

Even after Rome gave up its claims to Western Europe, traces of the four-hundred-year presence in the region linger, both culturally and economically. The Romans had implemented their economic thinking in the countries they conquered and the Barbarians realized that they had to learn to count as their masters if they wanted to do business. When the Romans leave the stage, their economic structure lingers in the areas where they have emerged.

Monumentum Ancyranum

Just before he dies at the age of 76, the Roman emperor Augustus writes an autobiography, *Res gestae divi Augusti* ("The Life of the Divine Augustus"), which he has engraved on bronze plates and set up in front of his mausoleum on *Campus Martius* in Rome. Copies of the autobiography are placed in strategic locations throughout the Empire. Today, the best preserved copy of Augustus' text remains in Ankara, Turkey, carved on the walls of an *Augusteum*, now called the *Monumentum Ancyranum*, since the Emperor's text was discovered there in the mid-16th century. The inscription has some information, which would be important for the knowledge of the history of the Nordic countries. Augustus writes: "My fleet sailed on the Ocean from the mouth of the Rhine to the land of the rising sun, all the way to the areas of the Cimbri, where no Roman by land or sea reached before



Emperor Augustus on horseback, about the year 10 A.D. 11.

this time. The Cimbri the Semnons, the Charyds and other Germanic peoples in the same area sought by envoy my friendship with the Roman people.”² The expedition is carried out in 5 A.D. with Tiberius as commander of the squadron. At the same time, his assignment will be the first attempt to create alliances with the Northerners, with the ambition of gaining access to the Baltic Sea trading posts.

What Emperor Augustus does not mention in his description of his life is how it goes, when the Roman army meets the tribes who live in the province of Germania, loosely connected to Rome in the northern part of the Empire. In 9 A.D., three legions enter Germania under the command of their commander-in-chief, Quinctilius Varus, to begin work on Romanizing the area, as was the case in Gaul. In the Teutoburg Forest, the Roman army encounters an ambush, organized by the Germanic chief Arminius (called Hermann in later German historiography). As the Romans defile through a narrow pass along the route, the Germans strike with devastating force. The Roman army is felled to almost the last man.³ Given that the entire Roman Armed Forces consisted of 28 legions, the loss of Varus’ 3 legions sends a shock wave across the Empire. Emperor Augustus is said to have exclaimed: *Quinctili Vare – legiones redde!* (“Quinctilius Varus, give me my legions back!”). After the defeat of the Roman army against Arminius and his Germanic coalition, Emperor Augustus realizes that it is futile to try to incorporate *Germania Magna* into his sphere of power in a lasting way. The Romans instead maintain and strengthen the front to the north with a number of border fortifications throughout Europe. They create a *limes*.

Nevertheless, the Romans did not give up their efforts to increase the contacts with northern Europe. Through a revolving movement, they succeed in completing the project that Tiberius began during his maneuvers with the Roman navy and can get behind the enemy lines. The Romans simply get around the difficult barrier that *Germania Magna* poses. With their large ships, the Romans are

² Cooley 2009, p 90 f., p 219 ff.

³ Wells 2004, p 177 ff.

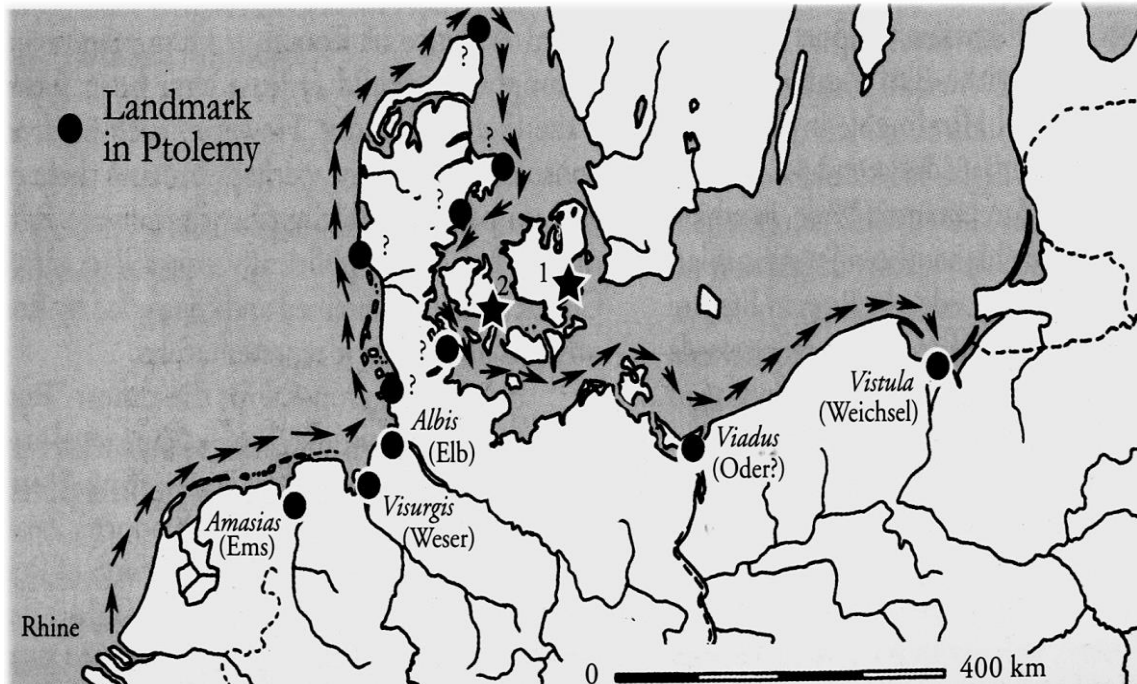
unthreatened at sea and everything indicates, that at the beginning of the first century of our Era they managed to round Jutland's northernmost cape, *Grenen* ("The Branch"), alternatively used the Lim-fjord, to reach the *Baltic Sea*.



Monumentum Ancyranum, Ankara, Turkey.



Res Gestae Divi Augustus engraved on the pedestal of the *Museo Ara Pacis*, located opposite *Emperor Augustus Mausoleum*, Rome (photo: Giovanni Dall'Orto).



The route into the Baltic Sea according to Ptolemy's map from about 160 A.D. It shows a journey from the Rhine to the river Vistula. Two-pointed stars mark rich Iron Age finds in 1. Himlingöje 2. Gudme-Lundborg (Jørgensen 2001, p 14).

When the Greek geographer Ptolemy draws his world map around the year 150 A.D., he based them on so-called *periples*, that is, lists of the ports, which seafarers trades on their way along the coast. We can see that there is detailed information about trading places along the coastline between the river Rhine and the river Vistula on Ptolemy's map, which indicates a trade in the Baltic Sea in the second century A.D., which was influenced by the Romans.

The Barbarians of the Baltic Sea have become accustomed to the international traders' way of counting duodecimally. Such an influence can also be sensed through the finds of a number of chief tombs along Jutland's east coast, which can be dated to the years 1–40 A.D.⁴ In these tombs valuable Roman objects have been found. All indications are that the seafaring Romans created alliances with the Nordic ruling elite through gifts, perhaps in the ambition to turn the chiefs' territory into Roman vassal areas.

The Suiones who are sailors in the Baltic Sea during this time, paddle their canoe-like boats.⁵ It would take several hundred more years before they learn the art of sailing. To the Germans, the sailing ships of the Romans must have looked like huge and astonishing revelations as they anchored at the mouth of the Vistula River.

⁴ Storgaard 2003, p 116 ff.

⁵ Tacitus 2005, p 55f.



Hoby tomb on Lolland, Denmark, 1st century B.C. A Danish chieftain's tomb with Roman status objects.

Photo: The National Museum in Copenhagen/Lennart Larson.

The Amber Road

The dramatically increasing demand for amber, which arose in the Roman Empire during the older Imperial period, not only stimulates seafaring traders, but also increases the need for better land connections with the Amber Sea. Today, the work on this modernized route, can best be studied from the area where the road starts to the south. Excavations on the Vistula River in 1995–1997 lead archaeologists to find the “missing link” of the Amber Route, the road through the marshes between the peninsula that was the center of amber collection, Sambia and the town of Wielbark at the mouth of the Vistula River. The road begins to be built in the middle of the first century A.D., i.e. during the time that Nero was emperor of Rome. It is built of oak planks. The width of the road is gradually increased from 1.5 m to 4 meters, in order to swallow the intense traffic. The transport carts had a wheel width of one hundred and ten (110) centimeters. Up in the north, the road would last for 300 years, while further south towards Rome it is only intact for a little more than a hundred years, due to the political unrest.⁶

What is it that makes the journey to the port on the Vistula River so important to the Romans? The estuaries of the Baltic Sea have been trading places for a long time. Finds of tools for preparing leather hides suggest that the Northerners exported hides to the Romans, who had a great need for the product, not least for their army. Above all, the Romans’ interest in the mouth of the Vistula River consists in the fact that they can buy what is usually called “Nordic gold”, amber. Amber had an economic potential that was greater than what other marketed goods could offer. Just during the century after the birth of Christ, the desire for amber increased to a fever in Rome.

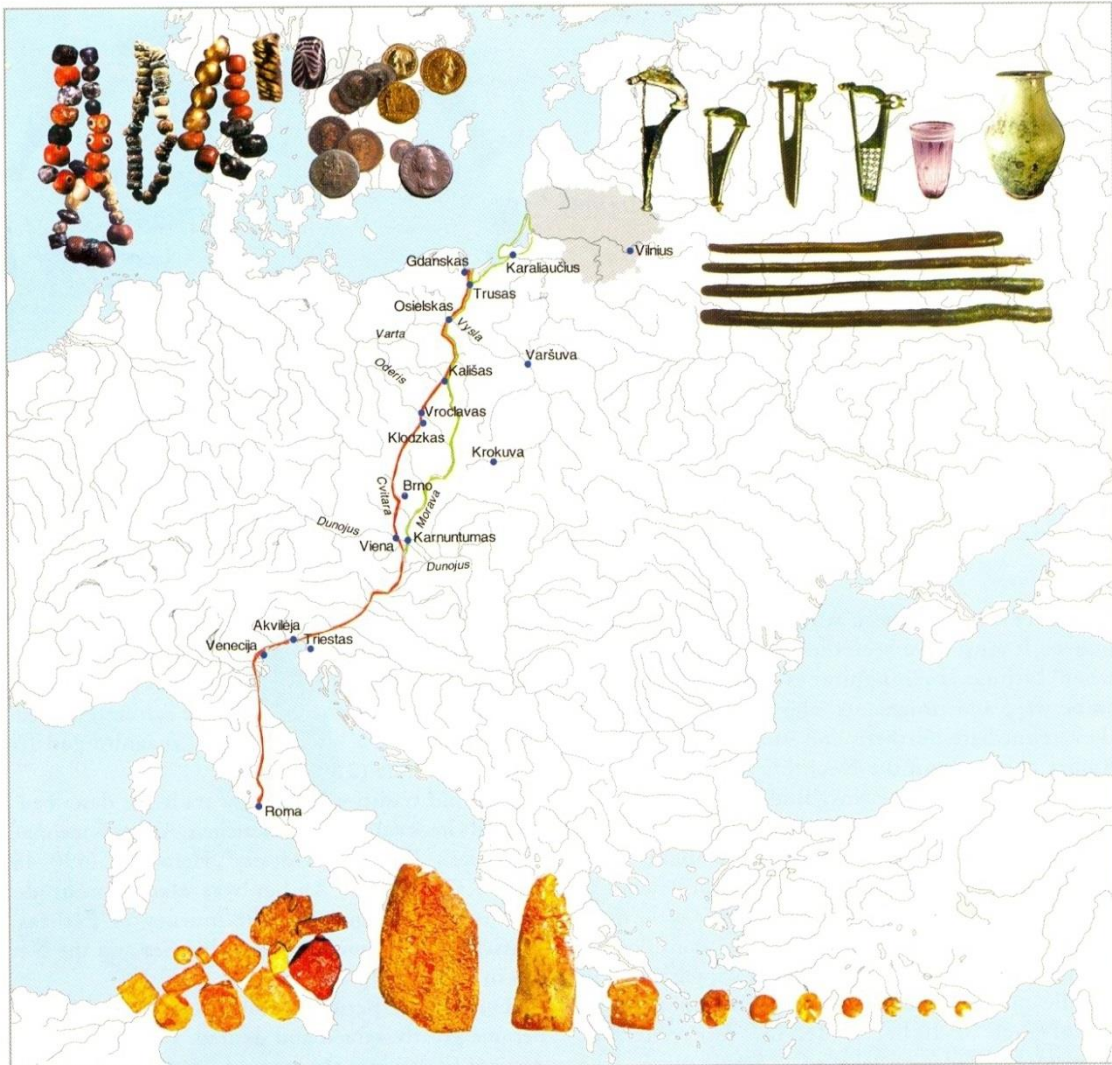
What happens at Gdansk Bay at the mouth of the Vistula River during the first centuries after the birth of Christ is something almost improbable. Far beyond the Roman border stations, the merchants of the ancient world meet with their colleagues from Barbaricum. The Romans come from the

⁶ Urbańczyck 1998, p 397 ff.; Nowakowski 1996, p 117; se även Köhegy 1982, p 129 ff.

Rhine estuary in the west and from the Carnuntum border station on the Danube in Austria in the south. Northerners leave their settlements on the west coast of Scandinavia and on Gotland and seek refuge in the Vistula River. The unique melting pot of impulses that arises at the estuary, leads to a completely new cultural form developing there, at the time of the beginning of our era.

At the same time, the Romans' entry into the Baltic Sea area means that they are given the opportunity to introduce their way of doing business. Their economic system is based on duodecimal, twelve-figure. Many mathematicians believe that counting twelve is the best way to calculate. However, the Romans' knowledge of mathematics is not sufficient for a trouble-free use of a duodecimal system. They cannot use the number 0 (zero) in counting, and therefore do not understand the number 10 that arises when multiplying by 5 by 2. We notice that traders avoid using the numbers 5 and 10 in their calculations. We can, after all, be aware that the count of twelve was the predominant method of calculation in the Baltic Sea area for a long time, in Sweden until 1855, when the decimal system became statutory as the norm for mathematical calculations in the country.

Amber is fossil resin from trees, which grew on our earth 30–60 million years ago. The climate was so hot in the Nordic countries at that time that the amber trees could grow there together with cypresses and palm trees. The resin emitted by the amber tree is washed up on the shores from the bottom of the sea. The resin is usually yellow, but can also be dark brown, green or white. Amber floats ashore on Jutland's west coast, but above all along the coasts of the Baltics. It could be collected by hand on the beach, raked up with rakes or caught with nets. Riders ride along the shallow shores to sweep in the amber with nets. The fossil resin on the Danish West coast and in the Baltic Sea was the gem of the Nordic countries. In addition to being admired for its beauty, amber was considered a good fortune: it was worn as a talisman and could be used to cure diseases. We find a fascinating phenomenon in some amber. Small insects that get stuck in the resin become part of the fossil. We can see ants, which 50 million years ago fought with each other and met a common death. A spider is about to catch a mosquito that is stuck in the resin, but ends up in the claws of death itself.



The Amber Road. Unprocessed amber and processed amber in the form of necklaces and pearls, exchanged for costume fibulae, glass beakers, ceramics and weapons. (Jovaiša 2001, p 150)

Determining the authenticity of the amber is possible because it is so easy compared to stones. The density of water is 1, 0, while that of amber is about 1, 05. Whoever puts a piece of amber in a glass of fresh water with a few teaspoons of salt, finds that an amber floats, while ordinary stones, which are heavier, sink. Another method to test the authenticity of the amber is to knit the stone with an annealed needle. A genuine piece of amber burns and then gives off a strong smell of resin. The Swedish word for amber, “bärnsten”, is derived from the German word, which means “burnt stone”.

Amber was collected and used as a means of exchange as early as the Bronze Age. The amber trade may have contributed to the Bronze Age Western Swedish high culture. We find amber from the Baltics in the tombs of the Pharaohs in Egypt and in the tombs of the rulers of China. During the Bronze Age, trade in this valuable “stone” was to be directed towards Greece, which before the high culture around the year 400 B.C. has a great interest in amber. There it is sought after for its beauty, but also for its magical properties. If you rub amber against wool, static electricity is generated, which means that the fabric attracts lighter particles. The Greeks therefore call amber *electron*, the same word we use two thousand years later as a term for electric currents. In *The Odyssey*, Homer tells in the eighth century B.C. how Odysseus’ wife Penelope receives an amber necklace as a gift from a suitor, when everyone thinks that Odysseus is lost forever. The German archaeologist Heinrich Schliemann found quantities of amber in the two cities that he excavated in the late 19th century, Mycenae and Troy.

The influx of amber to Rome is related to the expansion of the Empire to the north. One of the Roman Emperors has an almost fanatical interest in amber, namely Nero. Emperor as a teenager in 54 A.D., his life would end with suicide in 68 A.D. Nero was unusual as an Emperor on account of his interest in culture and beautiful things. He donates lots of amber jewelry to his wife Poppaea, whose blonde hair matched the colors of the amber. Nero himself plays the zither and performs on stage. *Qualis artifex pereo!* were his famous last words: “What artist dies with me!”



Relief panel showing Nero as Emperor, crowned by his mother Agrippina (Aphrodisias Museum, Turkey).

To the left is Nero's helmet, which he took off to be crowned. Agrippina had poisoned her husband emperor Claudius in order to make her son emperor. She, in turn, was murdered by Nero.

The desire for amber makes the people around the Baltic Sea, after centuries of anonymity, visible to us in the ancient sources. Five authors within two generations contribute to the geographical and ethnographic discovery of the Baltic Sea region, two from the Greek cultural circle and three from the Roman. In chronological order, they are *Strabo*, *Pomponius Mela*, *Pliny the Elder*, *Tacitus* and *Ptolemy*. Most interesting are the detailed information that flows from Pliny the Elder and Tacitus. Both live in Rome during Nero's reign, when the interest in amber is at its greatest.

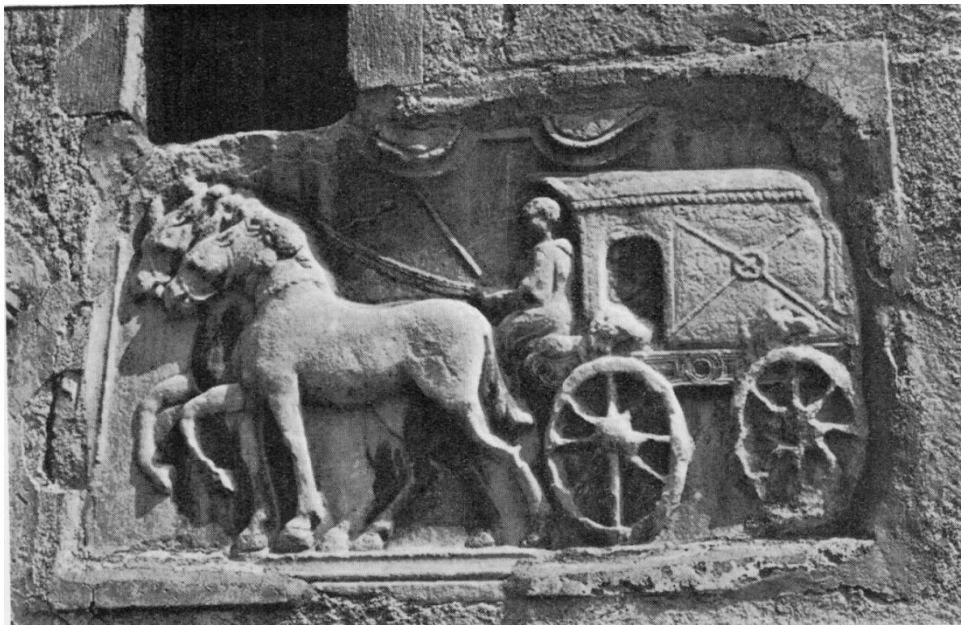
Pliny the Elder was born in 23 A.D. and dies of the poisonous fumes during the catastrophic eruption of Mount Vesuvius in 79 A.D., trying to save a friend. Of Pliny's rich production, only parts of his *Naturalis Historia* are extant today, a conversational lexicon of sorts, which summarizes the knowledge of his time. Pliny collects the information during the time of Emperor Nero, but does not publish his work until in the 70's, when Vespasian is Emperor. The Romans' interest in amber means that Pliny stays on the subject for a long time, he presents the theories about how amber was created and tells about its function as a jewel and as a health bringer.⁷ At the same time, he is critical of the fact that amber has become an expensive luxury item. An amber statuette could condition a price that is higher than the price of healthy slaves, he writes.

By telling of an expedition made by the Romans, Pliny illustrates the need to search for the origin of the magical amber: "The coast of Germany from which the amber is retrieved is about six hundred thousand double steps from Carnuntum in Pannonia. This has recently been thoroughly explored, and a Roman knight is still alive who was sent by Julian, who organized Emperor Nero's gladiatorial games, to obtain amber. This knight visited both the markets and the coasts, and then fetched such a quantity that the nets that would enclose the animals and protect the imperial lodge were fastened together with amber, and – so that every day would offer new splendor – the weapons, the corpses and all the state for a single day was of amber. The heaviest lump he had with him weighed thirteen bowl pounds."⁸

⁷ Plinius 1962, p 186 ff.; Plinius 1997, p 318 ff.

⁸ Plinius 1962, p 196 ff.; Plinius 1997, p 324 f.; Hjärke 1938; Spekke 1957, p 47 ff.; Kolendo 1981.

In a study of the discovery of the Scandinavian Nordic countries, Lauritz Weibull poses the Question of where all that amber, which Pliny mentions in his *Naturalis Historia*, came from. Gdansk that Pliny is referring to. The amber supply is plentiful there. A trade route has been established from Carnuntum According to Weibull, the research has “stuck” to Pliny’s story and believes that it is the coast at Samland and the bird route is 600 Roman miles, which is in line with the distance from Carnuntum to the Gulf of Gdansk. Weibull now points out that Pliny in his story is based on the knowledge that amber occurs in the East Frisian islands and that the Germans there call amber *glaesaria*. “This is crucial. It makes it impossible to use the representation that has been made. Any determination that the Romans reached Samland is out of the question for Nero’s time.”⁹



Roman merchant on The Amber Road in Carinthia, Austria.

Is Lauritz Weibull right in his argument? No. What he apparently overlooks is that Pliny himself calls the Baltic amber *succinum*, a term that was common among the locals. It is only in this part of Europe that amber is found in large quantities. Even today, more than 400 tons of amber are extrac-

⁹ Weibull 1934, p 96 ff.

ted per year through industrial operations in the Russian enclave of Kaliningrad on the shores of the Baltic Sea.¹⁰



Amber rings stored in the Aquileia National Archaeological Museum, Italy.

An examination of the amber, which is shown in various forms today in Italian museums, suggests that it has almost exclusively elements of succinite and is from the Baltics. All finds of amber, which fell from the carriages along the routes from the north down to Italy through the Resia and Brenner Passes, consist of succinite coming from the Baltics.¹¹ In Lithuania, moreover, 9 bronze fibulae have been found (type Almgren 238m, dated to 40–80 A.D., and type Almgren 238r, dated to 50–100 A.D.).¹² Outside limes, we find similar fibulae only in three other places, on the Zambian Peninsula west of Kaliningrad Oblast in Russia, in Wrocław, Poland and in Puchevé, Slovakia.¹³ It must have been Nero's "amber knights" who left the fibulae, as gifts or as payment, to great men or merchants at the Baltic.

With his two works *Historiae* and *Ab excessu divi Augusti* ("After the Death of the Divine Augustus", commonly called *Annales*, "Yearbooks"), Tacitus is probably the foremost historian of the Roman Empire. For us northerners, his essay published in 98 A.D. on the history and geographical

¹⁰ Plinius 1962, p 194 f.; Plinius 1997, p 324

¹¹ Angelini 2005, p 441 f.

¹² Almgren 1923, p 108 f.; Michelbertas 1995, p 19; Sidrys 2001, p 159

¹³ Garbsch 1965, p 63 f., p 70 f.; Nowakowski 1996, p 77 ff.

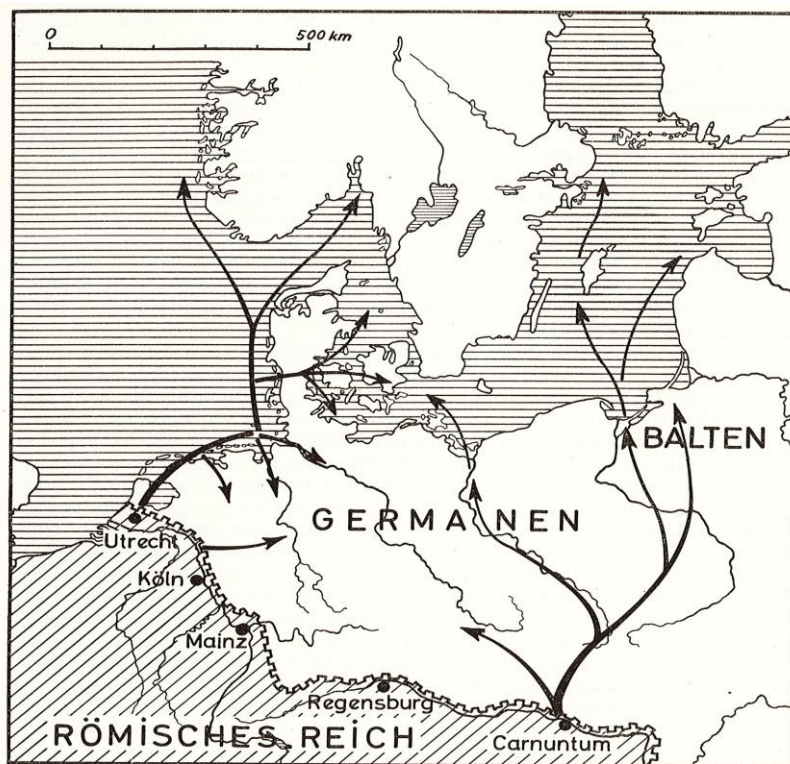
location of Germany, *De origine e situ Germanorum* (“The origin of the Germans and their settlements”), popularly called Germania, attracts even greater interest. Pliny died in 79 A.D. and almost 20 years later, in his book on the Germans, Tacitus can present detailed descriptions of Suiones and Gothones, but also discuss the role of amber in the societies of the Baltic Sea. He writes about Aestii, which are the people who collect the amber.

From Germania, Chapter 45:” Beyond the Suiones, we find another sea sluggish and almost stagnant. This sea is believed to be the boundary that girdles the earth because the last radiance of the setting sun lingers on here till dawn, with a brilliance that dims the stars. Popular belief adds that you can hear the sound he makes as he rises from the waves and can see the shape of his horses and the rays on his head. So far and no farther (in this, report speaks truly, does the world extend. Turning, therefore, to the right hand shore of the Suebian sea, we find it washing the country of the Aestii /- -/. They seldom use weapons of iron, but clubs very often. They cultivate grain and other crops with a perseverance unusual among the indolent Germans. They also ransack the sea. They are the only people who collect amber *glaesum* is their own word for it – in the shallows or even on the beach. Like true barbarians, they have never asked or discovered what it is or how it is produced. For a long time, indeed, it lay unheeded like any other refuse of the sea, until Roman luxury made its reputation. They have no use for it themselves. They gather it crude, pass it on to unworked lumps, and are astounded at the price it fetches.”¹⁴

Tacitus continues to develop his theories on how amber is formed. Although Tacitus in this scientific description follows Pliny the Elder’s text, it is clear that he has exploited additional sources in the unique ethnological extension he makes of his historical theme, by describing the amber people. Maybe he got an eyewitness account of the “amber knight” that Pliny mentioned, or came across merchants who followed the trade routes from the Gulf of Gdansk to Rome. Tacitus’ statement that Aestii is surprised by the price of his goods lacks credibility and may be regarded as a topos, a standardized

¹⁴ Tacitus 2005, p 56 f.; Gimbutas 1963

way of describing the barbarism of the Barbarian peoples, not least in their relation to wealth. The amber trade was nothing new for the people of the Baltic Sea. It had been going on for a thousand years before Tacitus and the Romans' interest in the "gemstone" intensified. Tacitus notes that Aestii uses the term *glesum* for amber, that is, the Germanic word for resin, the same word that Pliny claims that the Germans used for amber in the Frisian islands in the years around the birth of Christ. The name of the amber, which Aestii uses, is probably a translation loan from the Germans.



Trade routes between the Roman Empire and Germany

(Jankuhn 1963, p 19).

Rota Fortunae



Emperor Marcus Aurelius, fragment of bronze statue created after A.D. 170.

In the year 166 A.D. a catastrophe occurs in the Roman Empire. A number of Roman legions return to *limes*, after conquering the mighty Parthian Empire in the East. In their trail follows an enemy who had not been defeated. It is the plague, which within a few years kills perhaps 20 million Romans and dramatically weakens the defense of the Roman Empire. Riots had occurred at the Roman northern border throughout the 160s, culminating in the winter of 169/70, when the Markomannians, a Germanic tribe, crossed the Danube and broke through *limes*. The barbarians continue and raid Italy. The Marcomannians are fiercely combated by Emperor Marcus Aurelius. A lasting peace between the Romans and the Markomannians was not concluded until after the Emperor's death in 180.¹⁵

The Markomannian Wars were fought in the territories where The Amber Road meanders towards the Roman city of Aquileia. This setback against the opportunities to conduct profitable trade with the raw material suppliers of amber in the North comes, when the Markomannians besiege Aquileia. Thus, the artisans who work with the precious amber are deprived of the opportunity to practice their profession. The amber deliveries cannot reach their final destination in Rome and the economy of this line of business. The trade in amber, however, gradually find other roads and instead takes a western route to the Danish lands and then along the rivers down into Germania Magna and to the Carolingian Empire. To the east, a trade route will also be created, leading down to the Black Sea, with its ports and trade routes in contact with the Oriental world. Important stops for trade in Western Europe are the Frisian emporium *Fectō* (near present-day Utrecht in the Netherlands) and Colonia Agrippina, present-day Cologne, which becomes the capital of the Roman province of Germania Inferior. Cologne is emerging as the principal venue for processing amber.

¹⁵ Böhme 1977, p 153 ff.; Godlowski 1984, p 327 ff.; Stuppner 1994

Already during the years around the beginning of our era, archaeologists can show that tribes from the Nordic countries seek their way down to the intensive activities at the mouth of the Vistula River. Near Szczecin on the Polish Baltic coast lies Lübzow, where a number of richly adorned “royal tombs” have been found that bear witness to the culture of the ruling social class, inspired by a Roman way of life. One of the most magnificent tombs contains a series of objects from the Roman sphere: two beautiful silver goblets with double handles, a white metallic mirror, a large bronze basin, a wine jug, two ladles and a bronze jug, two glass bowls, scissors and tweezers of bronze. Locally made objects are also among the grave goods: drinking horns, fibulae, silver needles and bronze belt buckles.¹⁶ Through new migrations during the first century of our era, city-like communities grew up along The Amber Road south of Vistula. They act as intermediaries in the thriving trade. The geographer Ptolemy names one of these emporia on his world map *Geografike hyfegesis* (Guide to Geography), Calisia (Kalisz), which is now considered to be Poland’s oldest city.

A new wave of migration from the Nordic lands to the southern Baltic Sea followed in the early 100s. The newcomers occupy the hills of Elblag, east of the mouth of the Vistula River, a moraine ridge that reaches a height of 180 meters above the sea level. Here existed excellent conditions for cattle breeding and agriculture. From the Elblag area, it is not far to the lagoon at the Sambian peninsula, which was the collection area for amber. The peninsula is situated 70 km from Elblag. Traders could also reach the Elblag hills road via a terrace system. The inhabitants of the Elblag hills are the ones who get to take care of the unprocessed amber and distribute it south via The Amber Road. The wealth created through the export of amber is reflected in the graves of Elblag women during the years 100-160 A.D. The jewelry sets of the buried women usually consist of three bronze brooch a pair of bracelets, an S-shaped fibula (a kind of dress buckle) and a belt buckle. Towards the end of the period, necklaces made of glass beads and amber beads also appear. While a complete range of jewe-

¹⁶ Wheeler 1956, p 45 ff.; Eggers 1953, p 58 ff.; Gebühr 1974, p 82 ff.; Wigg 2008, p 253 ff.

lery can only be found in the richest graves in the burial grounds of the surrounding groups, abundance is common in all undamaged graves in the Elblag culture.

When the economic benefits of The Amber Road are lost for the trading posts on the road to Carnuntum and Aquileia, it will be the residents of the Elblag culture, who take the initiative to trade in amber. Skilled artisans refine the unprocessed amber on site in Elblag, and produce jewelry that is sought after by the aristocracy throughout Europe. In addition to the increasing trade with the peoples of Southeastern Europe, the Elblag culture finds sales for its products through the western trade route by sea, via the Danish islands down to the mouth of the River Rhine.

During the period 160-220 A.D. there is a drastic increase of the Elblag culture's grave goods. Bronze fibulae and S-shaped hooks in gold or gilded silver are often found in the graves, as well as pendants and silver bracelets, several on each arm. In graves for young women there are elegant amber necklaces, deposited together with a large selection of glass beads. The prosperity that the grave goods reflect also in the graves of the general population makes the Elblag culture unique in the Baltic Sea area. In the 4th century, the amber trade shifted to the West and thus also the prosperity, which is witnessed in the following century through the Polish burial grounds in Malbork and Pruszcz.

The trade in jewelry products always takes place in environments where rich seekers of fortune reside. The profitable trade in luxury goods, which originated in the Baltic Sea region during West Rome's imperial rule must have taken place with the help of the economic systems mastered by the international merchants, when they appeared to do business on the Vistula River in Calisa in central Poland, or further south in Carnuntum in Austria or in Aquileia in Italy. The business model had been designed in the Roman Empire. The Roman merchants apparently seem to have had to share their knowledge of the duodecimal system, in order to profit from their barbaric counterparts.

Lokkom Her!

It is striking how little information the ancient sources convey about the Roman army from the time of the division of the Roman Empire in 395 to the year of the dissolution of West Rome, 476. In 407 the self-appointed Emperor Constantine III moved the Roman army from the province of Britannia to the European mainland, after the legitimate Emperor Honorius had taken his hand from them. The Roman army would never again return to Britain. In 411, it was Spain's turn to see the Roman troops abandon the country. In Gaul, the Roman army disappeared in 418 and handed over the defense of the province to the Visigoths, who were establishing themselves in the area.

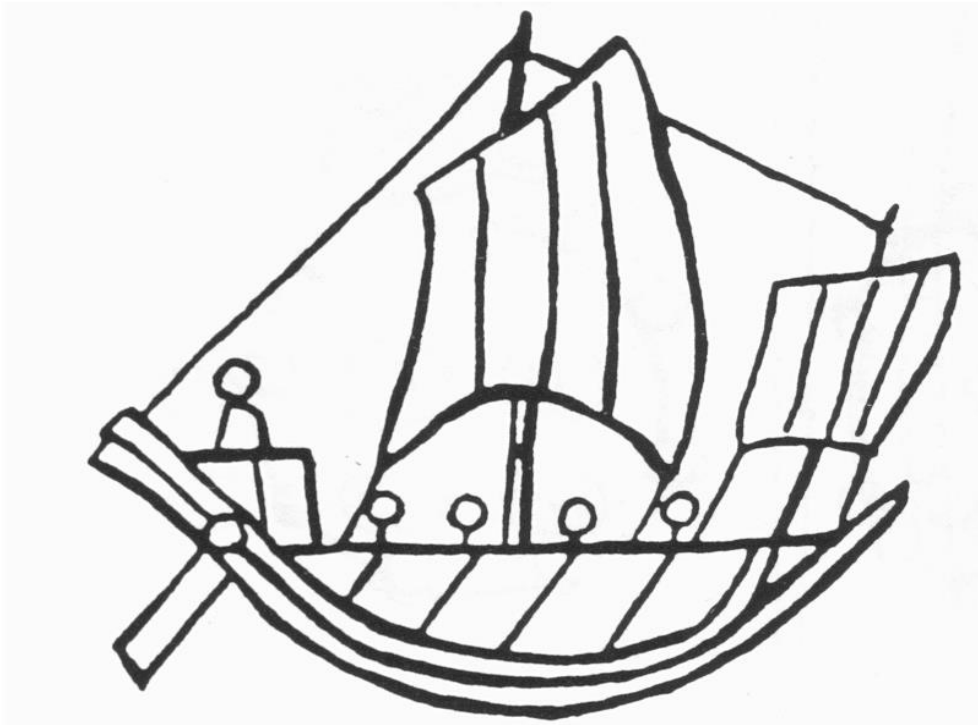
Both archaeologists and historians usually call the following period the Migration Period or the Barbarian Invasions. The movements of the various Germanic tribes are illustrated by spaghetti-like threads, which ramble on the European map. But reality is usually different from the myths. The political vacuum that arises when the Western Roman armed forces collapse is quickly filled by a neighboring resident population, or by military elite units, which have banded together with the intention of exploiting the situation, conquering territories and enriching themselves. For seafaring traders, the situation will be catastrophic. Without the support of the Roman troop presence, European coasts are destabilized and long-distance trade ceases. The Roman merchants also abandon the Baltic Sea area.

At some point in the 5th century a distressed man sat on the banks of River Weser, on the western north coast of Germany. Our unknown friend is engaged in trade and has had the Romans as partners. He's waiting for a ship. But no more ships are arriving from the south. In his desperation, this anonymous man from Weser resorts to runic magic. He takes bones from an ox, which he sacrificed,

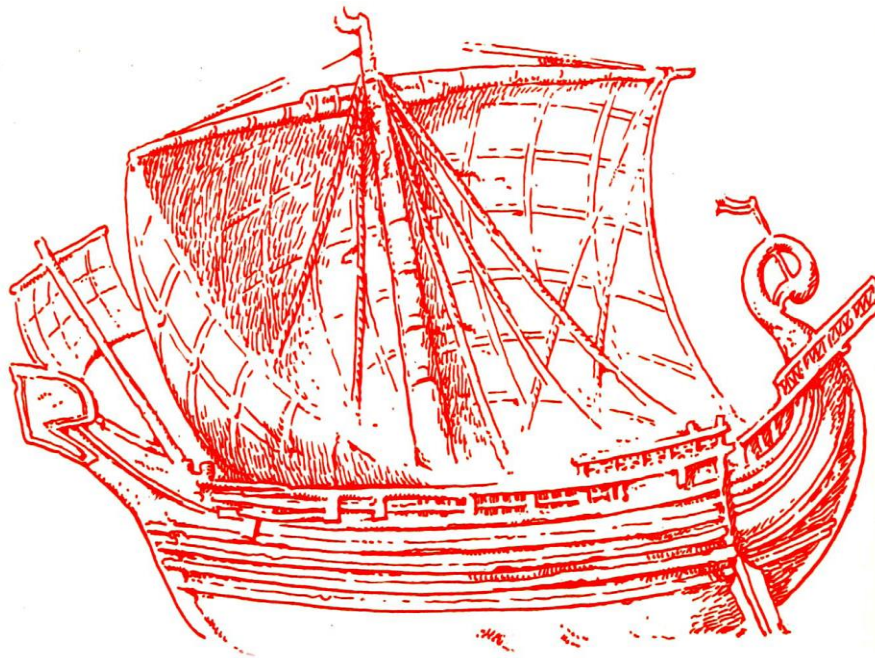
and carves a picture of what he would like to see appear on the horizon: a Roman merchant ship. Then he adds some troll runes: “Lokom her” (“I lure you here!”). He sacrifices the bones into River Weser’s water.¹⁷

When archaeologists fourteen hundred years later examine the river bank at River Weser, the magic runes resurface. Had his witchcraft had any power? We will never know, but it is doubtful. Our distressed friend’s carvings on the bone fragments still convey an insight as good as any. They provide the only image we have of a Roman merchant ship, depicted by a German. We see a large ship manned by five vigilant sailors, who are probably maneuvering for entry or exit at the mouth of the Weser River. These carvings symbolize the end of an era in trade relations between Rome and the Germans, a trade route between the Rhine and the Vistula River on the Baltic Sea that had been cultivated for some 400 or 500 years.

¹⁷ Ellmers 1994, p 124 ff. ; Ellmers 1972



Roman merchant ship at River Weser. Carved on a bone from an ox (14.5 cm).



Roman merchant ship depicted on a sarcophagus in Sidon, Lebanon.

Rome, the Frank Empire and the Nordic Countries

The Frank Empire gradually increases its presence in Northern Europe and displaces the Saxons, Avars and slaves who inhabit the region. Gradually, the Merovingians and the Charlemagne of the Franks built a state that would be completed in the German-Roman Empire in 800. A few years later, a breakthrough for the possibility of establishing trade relations with the Baltic Sea region would take place, as Charlemagne made peace with the previously hostile Danes and helps to develop the emporia of Haithabu, which is strategically located between the North Sea and the Baltic Sea.

Already in his *Res Gesta Divi Augusti*, Emperor Augustus praises himself for having had contact with the merchants along the Frisian coast and Jutland.¹⁸ Archaeological evidence in the Baltic Sea area make it probable that the Romans operated in the Danish archipelago to form alliances with Danish small kings.¹⁹ Amber was a coveted luxury item for Roman merchants. It was already available early on the west coast of Jutland. When the Romans establish a trade connection from Carnuntum at Limes in northern Italy to the mouth of the Vistula River in the southern Baltic Sea, the amber in the Baltic countries becomes more readily available for trade than before. The exchange of goods between the Baltic Sea area and the Roman Empire via The Amber Road is intense during the first centuries AD. Among the Romans, the scientist Pliny investigates the nature of amber in his *Historia naturalis* and the historian Tacitus is interested in Germania and the nations living around the Baltic Sea. Trade between the Amber Coast and the Roman provinces in the west also takes place by sea and land – the city of Colonia Agrippina, now Cologne, is emerging as a breeding ground for jewels from the Baltic Sea. The fall of Western Rome means disruptions in relations between the merchants of the south and the north, but contacts are quickly re-established, through the Frisian seafarers who seek their way north in the wake of the expanding Frankish state. Glass and ceramics

¹⁸ Cooley 2009

¹⁹ Storgaard 2003, p 110 ff.

are among the archaeological finds that show a cultural influence from the Merovingian period in the Baltic Sea basin.

With trade follows culture and already in the 700s we can find a depiction of the famous blacksmith in the Wieland Saga on a Gotland figurine. The saga has its probable origin in Westphalia.²⁰ Archaeologist Birger Nerman can prove findings from Gotland, which makes it probable that a Christian mission took place there already around the year 800.²¹ Already around the year 710 there is written evidence for a mission trip to the Danes, by the Frisians' missionary and Utrecht's first bishop Willibrord.²² It would be followed by a powerful effort by Ansgar, who in the ninth century twice applied to Birka, based on the bishopric of Hamburg-Bremen. From Ansgar's successor Rimbert's biography "*Vita Anskariü*", it appears, among other things, that contacts with the Frankish empire Dorestad were well established.²³

When Charlemagne's sphere of power at the end of the eighth century reaches all the way to the Baltic Sea, his kingdom belongs to the leading economies of the Western world, in competition only with Byzantium and the Caliphate in the east. The reason for the success lies in the Franks' ability to combine political power and economic insight. In the middle of the eighth century, the Frankish king Pippin the Short began to prepare a new economic system, which could harmonize the players in the market in the West. Pippin and his successor Charlemagne mainly focus on distinguishing their finances from those of the English.

²⁰ Jankuhn 1963, p 265

²¹ Nerman 1941, p 30 ff.

²² Willibrord 1998

²³ Rimbert 1986

A Change of Method

In their attempts to recreate the lost world of the medieval systems, the archaeologists who are interested in numismatics and related subjects, start from coins, weights or jewelry, which they find in the earth. The study of the wear and corrosion of the objects found becomes an important part of the work trying to recreate the original shape of weights and coins. Advanced scientific methods are tested on the more than thousand-year-old objects.²⁴ The results are reported in decimal values with an accuracy that must have been completely foreign to those living with the findings at the same time.

In the Baltic Sea region, there are no kings who can guarantee the value of weights, nor any developed coin economy. The silver that flows into the huge Baltic Sea basin, during the 800s and 900s, comes mainly from Arab mines. Trade takes place primarily at trading posts along the shores of the Baltic Sea region. The researchers who study the activities during this trade believe that the presence of the Arab coins, and the weights and scales used during the trade, lead to that an Arab economic model has had an influence on thinking in the Baltic Sea region.

An aspiration among businessmen in a Europe without a money economy is to be able to count on numbers that are divisible. Arab coins are often seen by researchers as bearers of exemplary weights in the medieval Baltic Sea region. Above all, it applies to two coins with the weights 4, 23 g or 4, 25 g. Both units are indivisible in a meaningful way for medieval westerners, when business is to be settled. In his doctoral dissertation on the Viking Age weight system in the Baltic Sea region, Erik Sperber believes that there is a normative weight of 12, 7 g which has been achieved by merging three identical Arabic coins, mithqal, with a weight of 4, 233 g.²⁵ According to Sperber, in this way an Arabic / Swedish weight system:

²⁴ Sperber 1996, p 18 ff.; Schultzen 2009

²⁵ Sperber 1996, p 54 ff.

$$4,233 \text{ g} \times 3 = 12,7 \text{ g} / 16 = 0,8 \text{ g} \times 5 = 4,0 \text{ g}.$$

The weight 4,0 is common in Birka, according to Sperber. He calls the weight a Birka mitqal.

One may be surprised that Sperber's mathematical calculations have not been criticized by the research community. It must be considered completely improbable that an everyday person in Birka, or in other emporias, would understand such a complicated and inconvenient way of doing business in line with the model that Sperber presents. It has its roots in the Arabic decimal system, which no one in the West knew.

It is possible to calibrate a Russian pound, 409,5 g, using the English "jeweler's weight" Troy grain, 0,065 g. 6300 Troy grain gives the weight of the Russian pound. The unit of weight used by the Russian merchants in the emporias is a zolotnik, 4,266 g, which is 1/96 part of the weight of the Russian pound. There is a weight in Birka that is 4,0 g. Should this weight be a "jeweler's weight", it is calibrated with 62 pieces of Troy grain. If the weight is intended to be an avoirdupois weight, it can be calibrated with the aid of 83 pieces of the grain weight used in Sweden 0,048 g.

Birgitta Hårdh draws attention in a study from 2016, that the Ukrainian-born researcher Ome-lijan Pritsak sees the origin of the Scandinavian *mark* in a mark, which was minted by the English king Alfred (871-899), and which weighs 25,5936 g. would correspond to a Swedish *öre* or 3 *örtugar* à 8,5312 g.²⁶ The question of how a medieval coin maker could achieve such precision in his work, as the weigh of the coin presented by Pritsak has, is left unanswered by Pritsak. "An Anglo-Saxon as well as an Oriental origin might be claimed for the emergence of the Scandinavian weight system," Birgitta Hårdh concludes, but she also emphasizes the German-Roman Empire's coin system as a possible influencing factor.²⁷ In her dissertation on the cubo-octahedral weights, Ingrid Gustin discusses role models for the weight systems in the Baltic Sea region. Nor does she solve the question of

²⁶ Hårdh 2016, p 50

²⁷ Hårdh 2016, p 50f.

The origin of the Scandinavian weight system.²⁸ As a better alternative to the method of researching the results of the calibrations, coins and weights, is to focus on the material for the calibration, the grains. Since ancient times, people have chosen two cereals in weighing and in the creation of weights, the weight of which is in the ratio 3 : 4.

Charlemagne has the ambition to create a coin economy in his kingdom. It has often been discussed to what extent he succeeds in implementing his plans. Some believe that the economy will continue to have its basic structure in a barter trade. Gradually, the trade in coins would increase in volume, especially since silver deposits were made in the 960s in *Rammelsberg* in the German mountain range Hartz. The state guarantees the authenticity of the coins and a consensus can emerge on the weight and value of the German-Roman Empire.

The Economic Structure

The basic method for calibrating weight units and coins in the West is to attain increased precision by using light units, which necessitate large volumes. One strives for even numbers.

In order to approach the way of thinking that the Frankish kings had when they began to devise a new payment system, we must be aware of the great difficulties that exist in determining the value of goods, weights and coins. The Babylonians, Egyptians, Arabs, Greeks and Romans all use grain as a starting point for size and weight. So do the Celts and Germans. As a calibration weight, grains were picked from the middle of the ax. Different crops in different countries resulted in different weight standards, which could create confusion among merchants in international trade.

As a legacy from the Greeks, the Romans received another calibration measure consisting of a pea-grown seed, the carat of carob, weighing 0,19 g. We find how the weight is established in the Roma

²⁸ Gustin 2004, p 238

system through the coin *siliqua*, with its relations to adjacent coins.

An overview of current coins during the later period of West Rome is shown here:

	denarius	vikt	denarius
chalcus	1/48	0, 071 g	3, 41 g
siliqua	1/18	0, 19 g	3, 42 g
obolus	1/6	0, 57 g	3, 42 g
scrupulus	1/3	1, 14 g	3, 42 g
denarius	1	3, 42 g	3, 42 g
unica	8	27, 28 g	
libra	96	327, 36 g	

The two crops used in weight calculation in Western Europe are barley and wheat. The ratio between the two types of grain is, as expected, 4 : 3. In France, there is a grain with a weight of 0, 053 g, the famous Paris grain. The heavier weight module is taken from the lightest coin, found in the Roman system, a chalcus, weighing 0. 071 g, 1/8 part obol. The weight is constructed based on the need for a lighter coin and is not calibrated in the usual way with the help of plants. The chalcus weight will be the starting point for the construction of the "jeweler weights", which are used together with fine scales in trade in precious metals in the Frank Empire.

In Britain there is a slightly lighter wheat grain than the French one, with a weight which is 0, 048 g. The heavier grain must, according to the principle with a weight ratio of 3 : 4, be 0, 065 g. from the market in the French city of Troyes. It came to be called *Troy grain*. The ratio between the English Troy grain and the French Paris grain is determined to be 50 : 61.²⁹

²⁹ Hultsch 1866, p 128; Ridgeway 1889, p 95; Grierson 1965, p 529 ff.; Kilger 2008, p 270.

Central Europe cultivates the very widespread Dutch grain, *ass*, 0, 048042 g. As a variant, there is a Cologne grain, with a ratio of 19 : 17 to the Dutch *ass*. The Cologne grain thus weighs 0, 053694 g, a value comparable to the weight of a Paris grain. As we shall find, it is reasonable to assume that both the Dutch *ass* and the Cologne grain existed in the Nordic countries during the Middle Ages. If we want to test what weight may have been used in calibrating weights and coins in the medieval world, there are 3 weights of grains to keep in mind: **0, 048** g (English wheat, Dutch *ass*), **0, 053** g (Paris grain, Cologne grain) and **0, 065** g (Troy grain). In addition, the weight of a Roman *chalcus* coin, **0, 071** g (1/8 part of a Roman *obol* coin) is central to the medieval French jewelry trade and to its coinage.

Ways of Counting in Europe

The 8s and 16s Bill

During the Middle Ages, the *avoirdupois* system was developed in England, where 16 ounces corresponded to 1 pound. The *avoirdupois*-pound is calibrated with 7000 grain (0, 06479 g), and has a weight of 453, 59 g.

The ability of the 8s and 16s bill calculations to be able to divide the number 8 by 2 twice and 16 by 2 three times, is flexible and easy to understand. The name of the system, *avoirdupois*, is French and refers to the weight of goods (*avoir de pois*, "goods by weight"). The system originates from the wool trade. The *avoirdupois* system is joined in England by the apothecary system for weighing medicinal chemicals and the Troy system, which is used in weighing jewelry and metals.

12s Bill

In the Roman Empire, the method of counting twelve units, the 12s bill, is dominant. Counting with twelve means opportunities to divide by 1, 2, 3, 4, 6 and 12. The duodecimal system is considered by many to be the best calculation method. There are mathematicians who

regret that man was not born with twelve fingers, which would have increased the understanding of mathematics in older times. When England and France-Germany build up their coinage systems, the duodecimal system plays a crucial role. The Roman Empire's ability to use its system is more limited than today's. The Arabic numerals are of course unknown, the Romans do not understand the sign zero and do not know position calculation. The human inability to count to ten means that she actually starts counting again when she reaches nine. A multiplication table in the Roman Empire looks different compared to the school children of our time who learn to wear in:

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>	<u>6</u>	<u>7</u>	<u>8</u>	<u>9</u>	<u>A</u>	<u>B</u>	<u>10</u>
2	4	6	8	A	10	12	14	16	18	1A	20
3	6	9	10	13	16	19	20	23	26	29	30
4	8	10	14	18	20	24	28	30	34	38	40
5	A	13	18	21	26	2B	34	39	42	47	50
6	10	16	20	26	30	36	40	46	50	56	60
7	12	19	24	2B	36	41	48	53	5A	65	70
8	14	20	28	34	40	48	54	60	68	74	80
9	16	23	30	39	46	53	60	69	76	83	90
A	18	26	34	42	50	5A	68	76	84	92	A0
B	1A	29	38	47	56	65	74	83	92	A1	B0
10	20	30	40	50	60	70	80	90	A0	B0	10

Duodecimal multiplication table.

Multiplication by 5 is called A and is replaced by the following position, 6. The procedure is repeated when we get to the numbers 10 and 11 and so on.

The Roman way of counting should have been easy for the Germans to accept. "Hundrath" originally means the number 120 in Old Germanic languages, sometimes called "big hundred" or "long hundred", and is based on the vigesimal way of counting in scores. Six scores are thus 120 pieces. The number 180 stands for 200 and the number 200 for 240.³⁰ In the English-speaking world, "score" is the same as 20 units. "6 score" is a "long hundred".³¹ The Germans could quickly understand that the

³⁰ Gordon 1957, p 292 ff.

³¹ Stevenson 1889, p 313 ff.

Roman numeral "X" does not mean 10 but 12. "C" analogously does not mean 100 but 120. Since the Romans made their entrance into the Baltic Sea region during the first century of our era, the twelve counts has been the predominant approach when it comes to doing business. Thousand years later, we can notice that the twelve counts is central in Sweden.

It is not until the 18th century that tens of bills becomes observable in Sweden. However, the ancient dozen counts live on among the common people and the bourgeoisie and among the businessmen. As recently as 1923, the Swedish Academy's Dictionary states about this lost world: "Dozens are counted and sold above all a lot that has use in the home, so e.g. plates, glasses, cups, knives, forks spoons, further cloths, towels, handkerchiefs, napkins, sheets and pillowcases, as well as numerous in larger numbers of used clothing slips, ss. shirts, undershirts, underpants, socks, collars and gloves, shoelaces, buttons and the like. Likewise, certain spices are counted in a dozen ss. oranges and lemons. Other items sold by the dozen include pencils, bottles of beer, etc., chairs."³²

10s Bill

Decimal counting can be said to be the only linguistic communication that has gained total international acceptance. The system is a creation of a mathematical genius, who lived in the 6th century in India. Numbers and the zero number are used to construct the decimal system and provide the knowledge of position calculation. India was an important trading partner of the new Arab state, the Caliphate, and the Arabs adopted the Indian way of counting A.D. 820 supported by the Persian mathematician al-Khwarizmis (lat. Algorismus).³³ After the rapid expansion of the Arab world, Europe has contact with the Caliphate by land via Spain and through trade connections from the south on the rivers up through Russia to the Baltic Sea area.

³² SAOB 1923, D 2397

³³ Butterworth 2000, p 98 ff.

The Arab coins have been imitated and used as a silver value and they have sometimes been weighed on scales with Arabic inscriptions and with weights with Arabic characters in the merchants' Europe. It is a superficial form of cultural appropriation, which may not have led to any understanding of the Arabs' coinage system or their way of counting.



Leonardo Fibonacci, Pisa, Italy (1170- ca 1250).

In 1202, the Italian mathematician Leonardo Fibonacci presents his *Liber Abaci* (The Book of Arithmetic), “the nine Indian digits” and “the sign o (zero)” for the Europeans ignorant of Arabic arithmetic. It would be some time before the French Revolution in the 1790s before the decimal system became widely recognized in Europe. In Sweden, the decimal system will be state-sanctioned in 1855.

20s Bill

20s counting, vigesimal counting, goes back to very old layers in the cultures of the world and is based on the counting of the fingers and toes of the hands. In the South American Mayan culture, which can be traced to the 2000s B.C., the vigesimal system is well documented.

In Europe we know that Celts and Basques used the census of the 20s bill and it is probable that these peoples influenced the French and Danes, who in modern times have remnants of the vigesimal system in their arithmetic systems. Trade contacts between the Franks and the Danes were intense during the early Middle Ages and one might think that their vigesimal account was built according to the same principles, but this is not the case. The French, for example, state the number 90, with additive counting, as *quatre-vingt-dix* (4 times 20 + 10), while the same number among the Danes is expressed, by means of subtractive counting, as *halvfems* (ninety = 100-10, ie 20 times 5, minus half of the last 20s of 80 + 20).

During the Middle Ages, the high base of the 20s system of counting could serve as a starting point for the construction of the coinage system of the newly formed European monarchies, in combination with the duodecimal calculation method. In Sweden, we can in our time find remnants of the 20s bill among older generations, who buy crayfish and eggs in scores. The mathematician's angular calculation with 360 degrees and our division of one hour time into 60 minutes and 60 seconds is based on the Babylonian way of calculating from base 60, but has certainly survived with the help of the knowledge of arithmetic with 12 and 20.

Cubo-Octahedral Weights

Among the weights used in the Baltic Sea area is a type that has interested researchers, not least for its distinctive shape. They are called cubo-octahedral weights. In her doctoral dissertation, Ingrid Gustin examines the weights of four trading places and finds that the cubo-octahedral weights make

up about 25% of all weights used.³⁴ As early as 1973, the German researcher Heiko Steuer analyzes the weights used in the early medieval trading posts in the Baltic Sea region.

Steuer has no knowledge of the methods of calculating during the Middle Ages and does not know the vigesimal or duodecimal calculus. He has therefore not been confronted with the French “jeweler weight”, which has a final weight of 4, 26 g, or the Russian weight unit zolotnik, with the final weight 4, 266 g. Nor has he inserted Charlemagne's currency reform as a part of the community created by the Viking-era weight systems in the Baltic Sea region.

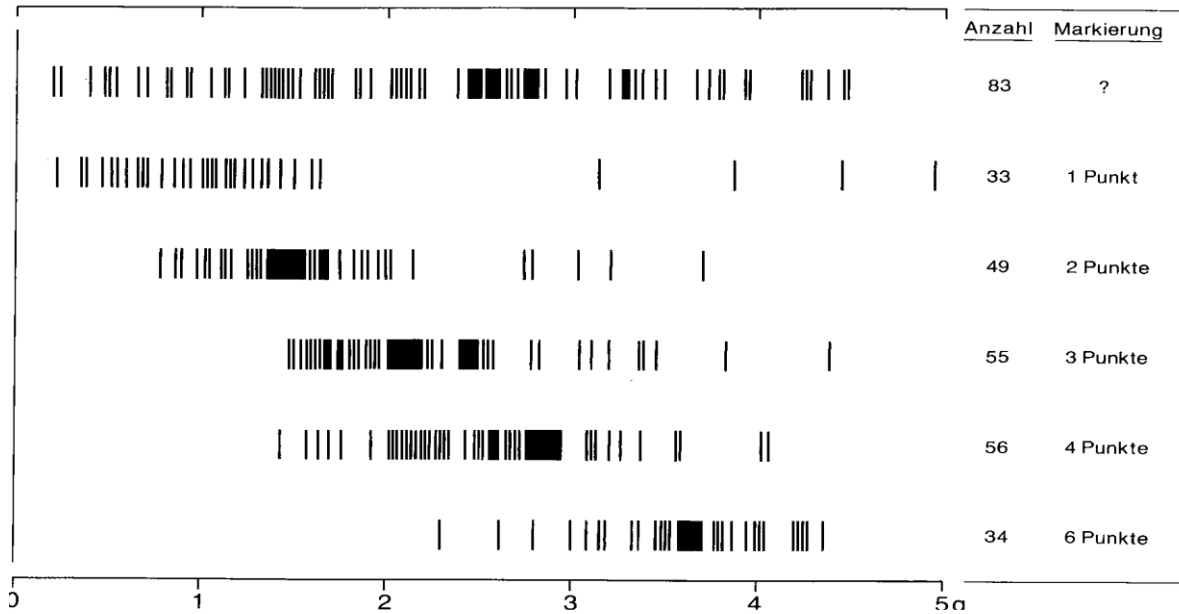


Diagram displaying cubo-octahedral weights in Haithabu, Birka, Paviken, Bandlundeviken and Rurik-Gorodische, distributed by weights and dot markings (Steuer 1997, p 281 ff.).

A table can be set up, where the vigesimal whole and half values for the weight 0, 071 become visible by the concentration of weights around these values:

³⁴ Gustin 2004, p 89 ff.

1 unclear weight ratios

1 **2 points** (20 times 0.071 g) 1.42 g

2 **3 points** (30 times 0.071 g) 2.13 g

3 **4 points** (40 times 0.071 g) 2.84 g

4 **6 points** (50 times 0.071 g) 3.55 g

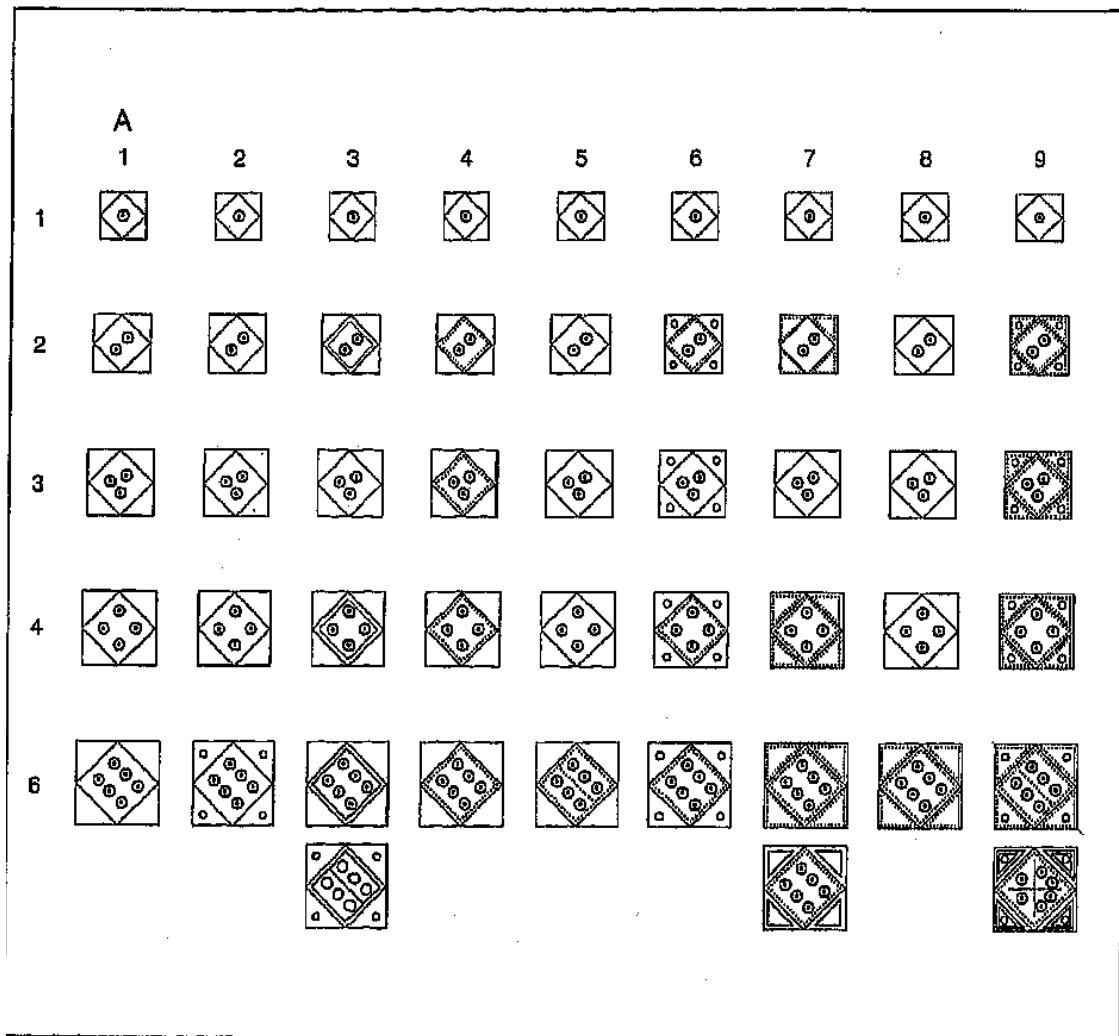
The absence of 5 points: see the duodecimal multiplication table p 41

6 **6 points** (60 times 0.071 g) 4.26 g

Steuer's diagram shows that the cubo-octahedral weights are calibrated according to a vigesimal system with a weight of 0.071 g as a base. The lightest weight in the system is built up using 5 times the basis weight and has a weight of 0.355 g.³⁵ The weight is not clearly visible among the weights that Steuer presents in his survey.

Cubo-octahedral weights are provided with points, in the same way as modern game dice, from 1 to 6. However, there is a difference compared to the points of the game dice: 5 points are not plotted on the cubo-octahedral weights. The explanation is given to those who are familiar with the Roman duodecimal way of calculating. In this system you do not multiply by five, because the result is 45 becomes 10 and the Romans cannot count with 0 (zero). The Roman Empire had occupied Gaul and Britain for 400 years and at the same time implemented its way of counting in Western Europe. The presence of the cubo-octahedral weights in the Baltic Sea region is decisive evidence that trade there during the Viking Age has its starting point in the Roman way of applying the duodecimal system.

³⁵ Gustin 2004, p 99



Dot markings on cubo- octahedral weights type A in Scandinavian, Baltic and Slavic emporias. Dice with the dot mark 5 are missing (Steuer 2004, p 72).

The Roman Empire had occupied Gaul and Britain for 400 years and at the same time implemented its way of counting in Western Europe. The presence of the cubo-octahedral weights in the Baltic Sea region is decisive evidence that trade there during the Viking Age has its starting point in the Roman way of applying the duodecimal system.

Oblate-Spheroid Weights

In his study from 1973, Heiko Steuer also examines another type of weight, "Kugelzonen-gewichte", oblate-spheroid weights, which make up a significant part of the weights used in the trading empires. They are used for heavier goods than the cubo-octahedral weights, which were suitable for precious metals. Steuer finds no weight system that can satisfactorily explain the weight of the spheroid weights.³⁶ He presents his results in a diagram. Nor in a survey from 1997 has a solution to the problem been possible, Steuer says.³⁷

A study of the weight systems in Sweden for heavier goods can provide answers. In Sweden, two weight systems crystallized during the Middle Ages, one in *Svealand*, where 1 mark corresponded to 192 penningar, one in *Götaland*, where 1 mark corresponded to 384 penningar. In Götaland, the number of coins is thus twice as much per land, compared with the situation in Svealand. When the different parts of the country merge, the way of counting in Svealand becomes the predominant one. No explanation for the system's design has ever been provided.

An overall value unit is *mark* that is considered to be of Scandinavian origin. It has been spread across Europe. The mark is a theoretical unit, a so-called calculation coin³⁸ that is considered to weigh about 210 g. For someone living in the Viking age, it would, however, be impossible to comprehend a weight such as 210 g, as position calculation was unknown. The problem arose already when he reached the number 100, which was impossible to handle. To get divisible units when weighing numbers close to 100, the Viking age man would stop at 98 or 96, and then start counting again.

The number 98 is divisible by 1, 2, 7, 14, 49 and 98. The number 96 is divisible by 1, 2, 3, 4, 6, 8, 12, 16, 24, 32, 48, 96. The number 96 will have to replace the number 100 in business agreements, both in Rome and Russia and in the Baltic Sea region.

³⁶ Steuer 1973, p 18 ff.

³⁷ Steuer 1973, p 18 ff

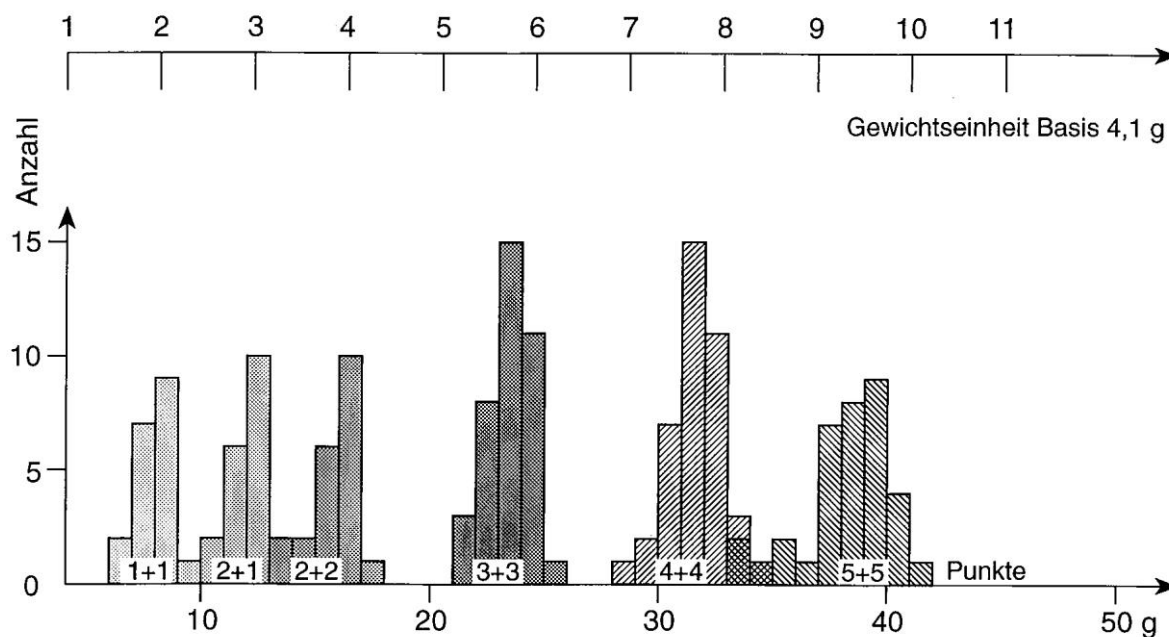
³⁸ Heckscher 1942, p 3

According to the Svealand count, this corresponds to 1 mark

192 coins	192 times 1 g	4000 grains at 0.048 g
8 öre	24 times 8 g 8 times	500 grains at 0.048 g
24 örtugar	24 x 1 g x 8 g	24 x 20.8 korn x 8 at 0.048 g

The calibration weight used, thus has the same weight as the wheat grain found in Britain and with the grain found in the Netherlands, which is called "ass". When the Swedish coin system was reformed in the 17th century, Sweden in 1667 officially joined the Dutch *ass* as a calibration weight, and set a bowl pound weight to 8848 Dutch grains of 0,048042 g, i.e. 425,076 g. The Dutch grain should have been common in Sweden already in the early Middle Ages.

The deviations of the diagram in the ideal model presented by me are no greater than that the basic principle of how to calculate is clarified. It is the 8s or 12s bill calculation that is applied to the construction of the spheroid weights, used in the Viking-era Baltic Sea, a precursor to the *avoir-du-pois* system that would gain a foothold in medieval Europe. The calibration weight in the Baltic Sea area is a grain distributed in Europe that weighs 0,048 g. An even number of this type of grain, 4000 pcs, the starting weight is 192 g, for the method accepted in Sweden during the Middle Ages with 192 (theoretical) *penningar*, which can be divided into 8 *öre* (money) and 24 (theoretical) *örtugar*. As shown in the diagram, the system makes it possible to avoid numbers that contain the number zero (0).



The weight distribution of spheroidal weights in the trading emporium Haithabu during the Viking Age

(Steuer 1997, p 285 ff.).

8 örtugar (8 g), i.e. $1/3$ öre, interval 1 (1 + 1).

12 örtugar (12 g), i.e. $1/2$ öre, interval 2:1 (2+1)-

16 örtugar (16 g), i.e. $2/3$ öre, interval 2:2 (2+2).

24 örtugar (24 g), i.e. 1 öre, interval 3 (3 +3)-

32 örtugar (32 g), i.e. 1 och $1/3$ öre, interval 4 (4+4)-

40 örtugar (39-40 g). i.e. 1 och $2/3$ öre, interval 5 (5+5)

Western Europe Starts Over



The Frankish realm's export of goods during the expansion to the North during the 700s-800s

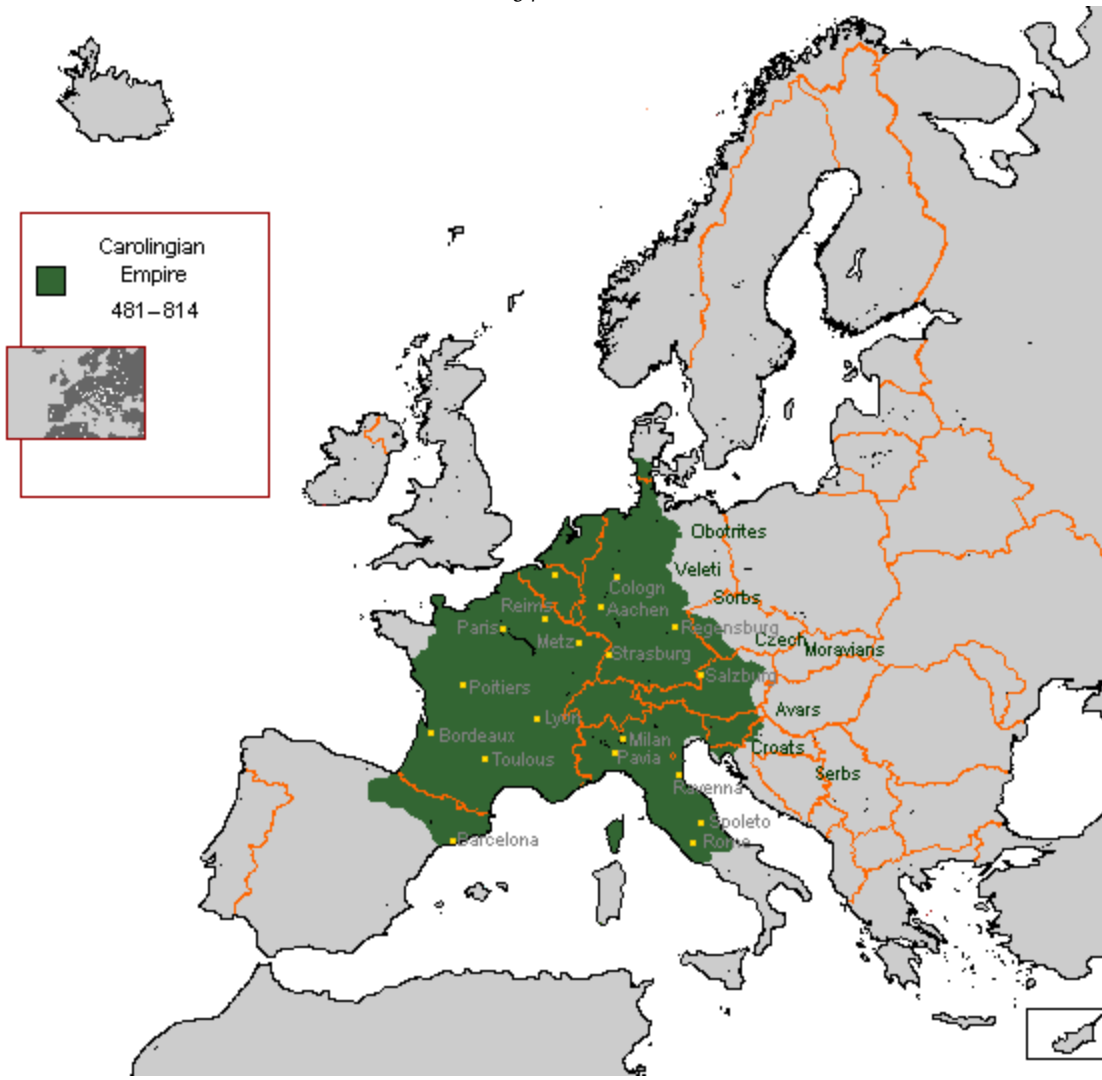
(Jankuhn 1963, p 79).



Franco-Frisian trade routes in the North Sea and the Baltic Sea during the 600s and 700s (Jankuhn 1963, p 29).

As Charlemagne expands his sphere of power to the north, the Baltic Sea region becomes increasingly interesting as a trading zone for European merchants. The Danes want to take part in the business opportunities that are opened up and drastically move a German trading town on the bay of Slie in Schleswig to the Baltic Sea and order the merchants to move with it. Charlemagne responds to the provocation militarily, but after the Danish king is assassinated, a settlement is reached, which makes the new empire Haithabu created by the Danes the Baltic Sea region's most important link for trade with Southern Europe and the rest of the known world. The second wave of silver from the mines of the Middle East began to arrive in Europe in the late eighth century. The merchants take the least risky road via the Black Sea and the rivers Don and Rhine to the early industrial city of Mainz, which with its blacksmiths manages a centuries-old craft tradition with metals as raw material.³⁹ From Mainz, the Arabian silver is distributed to the coinage workshops of the southern Frankish kingdom. In addition to the Mainz logistics center, the depleted silver mine in Melle near Poitiers in the south of France will be a central location for Charlemagne's coin production, which will be launched with the aim of creating a uniform economic standard in the country. In Anglo-Saxon England at the end of the eighth century, King Offa of Mercia built a coin system, which has the Roman duodecimal way of counting as its starting point and the English's Troy grain as the calibration unit. One pound is divided into 20 shillings, while one shilling could be divided into 12 pence. One pound is thus equivalent to 240 pennies. There is no doubt that the system was robust. It would not be replaced by decimal counting until 1971. What King Offa does not know is that Charlemagne, with a new currency system, plans to take a drastic step to profile his kingdom's economy against British trade, which is largely handled by Frisian merchants. The shortage of silver had long been felt in Europe, but now the Arab silver is flowing in as a redemptive wave in the European economy. Charlemagne can afford to make a coin that is both larger than European standards and also heavier. He creates an impressive dinar in silver that weighs 1.7 g.

³⁹ Blanchard 2001, p 502 ff.



The Frankish realm in the early ninth century.

Charlemagne's Currency Reform

In the final stages of the German-Roman Empire's expansion to the north, Charlemagne carried out a currency reform. Charlemagne's organizational ability forms the basis for Western world's future position as a leading economic center. Important driving forces for Charlemagne are to be able to free the European mainland's economic system from Britain's and to try to harmonize its currency with the norms for doing business in the Baltic Sea region, where a weight economy is still prevalent.



Charlemagne

The front of a silver denar struck in Mainz in 812-814 (*Cabinet des Medailles, Paris*).

The most striking thing about Charlemagne's coinage is that he raises the weight of the system's base coin, the denarius, which originally weighed 1,3 g. This early coin was based on the grain that would be taken over by Britain, Troy grain, where 20 Troy grain à 0,065 g gives a pence weighing 1,3 g.

By raising the weight of the denarius to 1,7 g, Charlemagne clearly distinguishes his denarius from an English pence. The Nestor of medieval numismatic archeology, the late Philip Grierson, launches a theory that the change is a result of a grain other than Troy grain was used as the calibration weight, namely Paris grain. Thirty-two (32) pieces of grain at 0,053 g. Gives the weight 1,696 g, i.e. an almost identical weight to the denarius, weighing 1,704 g.⁴⁰ Grierson's conclusions have several weaknesses. Paris grain is not a "jeweler's weight", but is used when calibrating heavier weights and when weighing heavier goods. Using the multiplier 32 in a system based on an alternation between duodecimal and vigesimal arithmetic, as Grierson does, is also not reasonable.

That Charlemagne chooses the French "jeweler's weights" as the calibration instrument, when he creates his new denarius, might seem obvious, but this has not been the case. The study presented here is the first to suggest that it is 0,071 g, which Charlemagne uses as a calibration weight, when he implements his coin reform at the end of the eighth century. Multiplied 24 times gives the denarius a weight of 1,704 g. If we multiply the denarius 240 times, we get the German-Roman Empire pound, weighing 408,96 g. In the central part of the Baltic Sea area, the weight 4,266g must have been a starting point for much trade. The Russian pound weighs 409,5 g, which can be calibrated by 6300 Troy grain at 0,065 g. To gain manageable weights, Russian traders divide the pound by 96. The choice of dividend reflects the inability to handle the number zero (0), which Russian merchants share with other merchants in the Baltic Sea region during this time. The Russian unit of weight is called *zolotnik*. A division of 409,5 g with 96 gives a value of 4,2656 g.

⁴⁰ Grierson 1956, p 529 f.

The weights, which were used with a zolotnik as the heaviest unit, are designed as cubo-octahedral weights. From the investigations of the cubo-octahedral weights presented in 1980, Swedish archaeologist Ola Kyhlberg found at excavations in Birka, it appears that these usually weigh 4, 266 g. There is thus no doubt that the weights found, represent the weight one Russian zolotnik, although Kyhlberg himself, and other researchers, do not realize that this is the case.⁴¹

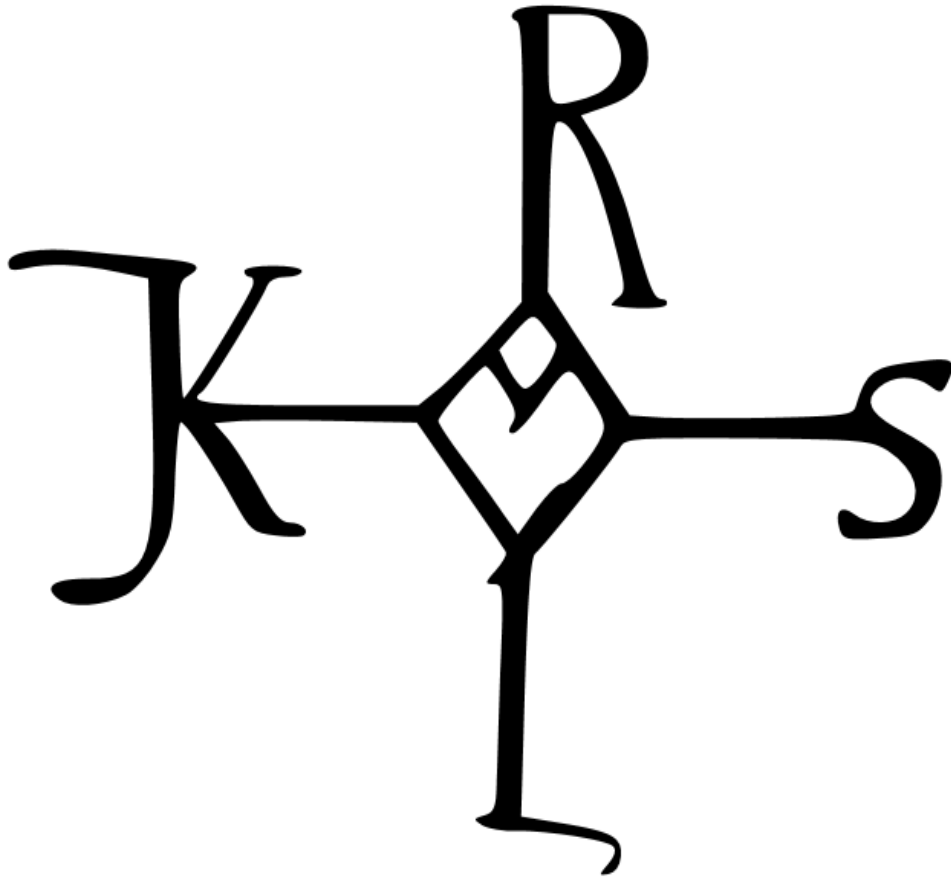
Archaeologists have found cubo-octahedral weights in Haithabu. This indicates that the heavier calibration weight in France, based on the weight of the lightest Roman coin, chalcus, 0, 071 g, was a standard in a vigesimal counting system in Haithabu, where the third stage, 60 times 0, 071 g, becomes a weight of 4, 26 g.⁴²

The French create a currency system that would facilitate trade, profile the German-Roman economy against the British, and harmonize their weight system with the norms that were common in the Baltic Sea area, in order to participate in the trade that took place there. Karlspundet, 1 gold libra, corresponds to 20 silversous. 1 sou corresponds to 12 denarii. 240 silver denarii thus corresponds to 1 gold libra.

We also find this change between the dozen and the twenty when the British take over the Frankish model. Here it will be thus 1 pound equals 20 shillings, while 1 shilling becomes 12 pence. According to the same principles as are calculated in France, 240 pence will then be equal to 1 pound. A denari with a weight of 1, 704 g gives Karlspundet a weight of 408, 96 g. The British, on the other hand, create a penny of 1, 55 g and as a result get a "Troy pound" with a weight of 372 g.

⁴¹ Kyhlberg 1980, p 270; Steuer 1973; Sperber 1966, p 54f., p 110; Steuer 1997, p 283. Gustin 2004, p 113, does not take a position to the issue.

⁴² Steuer 1973, p 9ff.



Karolus. Monogram.



Coin workshops in the Frankish Empire during the latter part of the ninth century, located south of the Rhine

(Spufford 1988, p 45).

The Silver Treasures

During the first half of the 20th century, Swedish historiography lived in a sense of excessive national pride when it came to relations with Russia. The information in the *Nestor chronicle*, written in Russia in the 12th century is taken at face value, when it tells of a Swedish state formation in Kiev in the ninth century. According to the scholars, the Nordic region becomes involved in Eastern European trade, which leads to contacts with the expanding Muslim empire in the Middle East from the 7th century.

In 1939, Swedish historian Sture Bolin published an article, “Muhammed, Karl den store och Rurik”, in the historical journal *Scandia*, where he sees a parallel between the Northerners’ eastern contacts and their trading partner in the west, Charlemagne’s Frankish Empire. The Baltic Sea region will be a terminal for the large volumes of Arabian silver that flow there, as an effect of the Northerners’ trade with the Arabs. Bolin claims that the silver continues its journey into Western Europe, where there is a crying silver shortage.

The sources thus make it clear, that after a while the Frankish transit trade between the fur and slave-producing area in northern and eastern Europe, was overrun by a direct Nordic-Arab trade along eastern lines.”⁴³ National pride is evident when Bolin continues: “As masters of the great Svitjod, the Northerners dominated an area which, with regard to their production, was of the utmost importance. It produced more slaves and furs than any other country in Europe.”⁴⁴

The Swedish archeology that emerged during the 20th century was impressed by the Swedish historians’ view of Sweden’s efforts in Russia. In an early archaeological dissertation on Sweden’s relations

⁴³ Bolin 1939, p 179; Gustin 2004, p 70 f.; jfr Bolin 1953; Gruszczyński 2019; Gruszczyński 2020.

⁴⁴ Bolin 1939, p 215

with Russia and the Arab world, *La Suède et l'Orient*, (1914), Swedish archaeologist Ture J:son Arne investigates the Swedish presence in the Russian lands. After Bolin's article in *Scandia*, archaeologist Birger Nerman is inspired by Bolin's views regarding Sweden's connections with the eastern cultural spheres, and he reinforces Bolin's somewhat chauvinistic interpretation of historical events. A popularly written book entitled *Sweden's First Period of Greatness*, published during the Second World War, deals with the Viking conquests in Russia under chapter headings such as "The Swedes Establish a Baltic Empire" and "The Era of Great Success".

A recent successor to the nationalist-minded archaeologists is Holger Arbman, who in 1937 defended a dissertation entitled *Schweden und das karolingische Reich. Studien zu den Handelsverbindungen des 9. Jahrhunderts* (Sweden and the Carolingian Realm. Studies in Trade Relations during the 9th Century.). Arbman directed his interest to the east later in the 1950s and 1960s, documented through book titles such as *Svear i österviking* (Swedes: Vikings to the East) and *Vikingarna: härmadståg, handelsvägar, kultur* (The Vikings: War Expeditions, Trade Routes, Culture).

The large number of finds of Arabic coins found buried in the countries around the Baltic Sea during the period 800-1000 set the imagination of chauvinist Swedish scholars during the first half of the 20th century afire. They believe that only a fraction of the coins in circulation are buried. About 100,000 coins have been recovered, making up perhaps a tenth of the coins that have been in circulation. If so, putatively one million Arab *dirhams* would have been in circulation among Baltic traders during these few centuries, not to mention the amount that also flowed down further into Western Europe, contributing to the emergence of the French coinage.

Intensified research regarding the Nordic countries' medieval relations with Russia after the Second World War has immensely changed the view of the role of the Arab *dirham* in terms of legal tender for Viking-era trade in the Baltic Sea. The silver coins that arrived in the Baltic Sea area seem

often to have been deposited in the ground without reaching the market and the merchants. In the western part of the trading area, coin silver appears in fragmented form. The flow of silver into the Baltic Sea basin cannot have been as torrential as previously imagined. Along the rivers of Central Europe the Arab silver has been extensively perused to use as a means of payment for the slave trade on the market in Prague⁴⁵, and as a raw material for coin production in over a hundred workshops in the Frankish Realm.

The Silver Treasures in a Macroeconomic Perspective

Bolin's thesis from 1939 poses the question why Viking Era silver treasures are collected at all. For a long time, the silver treasures on Gotland were considered merely as an expression of the prosperity created on the island, a result of the lively trade in the Baltic Sea region. Gotland forms a hub for goods exchange. The hiding places of the silver treasures so-called could be viewed as contemporary "bank vaults". They house a saved capital, which can serve as a "nest egg" for old age or a legacy to pass on to future generations. When the silver treasures are reduced, this would be a sign that misfortune has befallen Gotland society.

As early as in the end of the 1920s, Sture Bolin entered the discussion about the silver treasures on Gotland. The matter was taking a new turn. According to Bolin, the treasures are not primarily an expression of trade and prosperity, but of the wars that have plagued the island. In times of unrest the rich conceal their assets. Perhaps something unexpected happens to the man who assembled the treasure afterwards. He may have to flee from the area where he belongs, or in the worst case he is killed, without having passed on the secret location of his treasure in time. The silver remains in the ground and is only discovered by chance in our days. "The more treasures, the greater the ravages

⁴⁵ Blanchard 2001, p 502 ff.

and the greater the need” – this is Bolin’s summary of his position, a view of events that would become the predominant one in scholarly circles for decades to come.⁴⁶

The idea that the finds in the earth have a connection with lively trade and economic development was abandoned in the early 1970s by archaeologist Mats P:son Malmer. He believes that the silver treasures instead can be seen as an expression of a primitive economic culture. When there exists a lively economic activity in an area, merchants sell their assets. They trade and invest. In such circumstances, no treasures will lie idle in the ground as dead capital. On the contrary, in a situation where there is low economic activity, a financial surplus can arise, since it is then not feasible to gain returns on capital in a meaningful way. The hiding places for the silver treasures may therefore be a sign of a steadily more stagnant economy on Gotland, a condition that does not necessarily have to do with acts of war.

Mats P:son Malmer’s reorientation of the debate was supported by Brita Malmer in the early 1980s. She compared Gotland to the countries that evidently displayed a lively trade during the era in question and where coins circulated: Germany and England. While Gotland has an abundance of silver treasures, only a few have been found in England and Germany. In Western Europe, capital was put to work, while it often was buried in the Baltic Sea region. Brita Malmer’s conclusion is that Gotland had a low economic activity with little circulation of coins during the Viking Age. The silver seems to have been saved a reserve, a local farm’s fortune and used “only occasionally, perhaps mainly as raw material for jewelry, perhaps as a travel funds for trips abroad”.⁴⁷

⁴⁶ Bolin 1926, p 209

⁴⁷ Malmer 1983, p 113.f.

The Silver Treasures as Booty

The question of whether the silver treasures on Gotland are proof of economic activity or stagnation was reconsidered when the English historian Peter Sawyer published his book *Kings and Vikings in 1982. Scandinavia and Europe A.D. 700-1100*. The Vikings could hardly, in Sawyer's view, have had anything to offer the Russians when it came to trade. The Swedish treasure troves are instead remnants of the ravages of the Viking raids, in other words, consist mainly of booty. The Vikings have looted these treasures abroad, brought them home and buried them in the ground. The treasures remained in the earth, as many Vikings set off on new robbery raids, often not returning from their perilous journeys. When the silver treasures increase in number during the latter part of the ninth century, it is due to the fact that the Russians have strengthened their ability to defend themselves. Fewer Vikings come home unscathed, to take advantage of their savings. The situation is similar when it comes to the somewhat later treasure deposits of Western coins in the Baltic Sea area, Sawyer states. These coins may also be considered as booty. They emanate from the taxation imposed on the Anglo-Saxon kings by the Vikings to refrain from attacking them, the so-called Danegeld.⁴⁸

But Sawyer's boy book fantasy of Vikings ravaging in the East is dispelled by the American historian and numismatist Thomas S. Noonan. While England and France are prosperous countries, with monasteries and cities easily accessible for looting, located on the North Sea coast or on the rivers that flow into the English Channel, the situation is completely different in Russia.

The trail into Lake Ladoga and to the only trading place there, Old Ladoga, goes via the Gulf of Finland, on rivers, which are surrounded by sparsely populated forest areas and swamps. There may not have been anything to plunder on a larger scale in these areas. An examination of the tombs that archaeologists find in northern Russia shows that they contain little of value to an outsider. It must

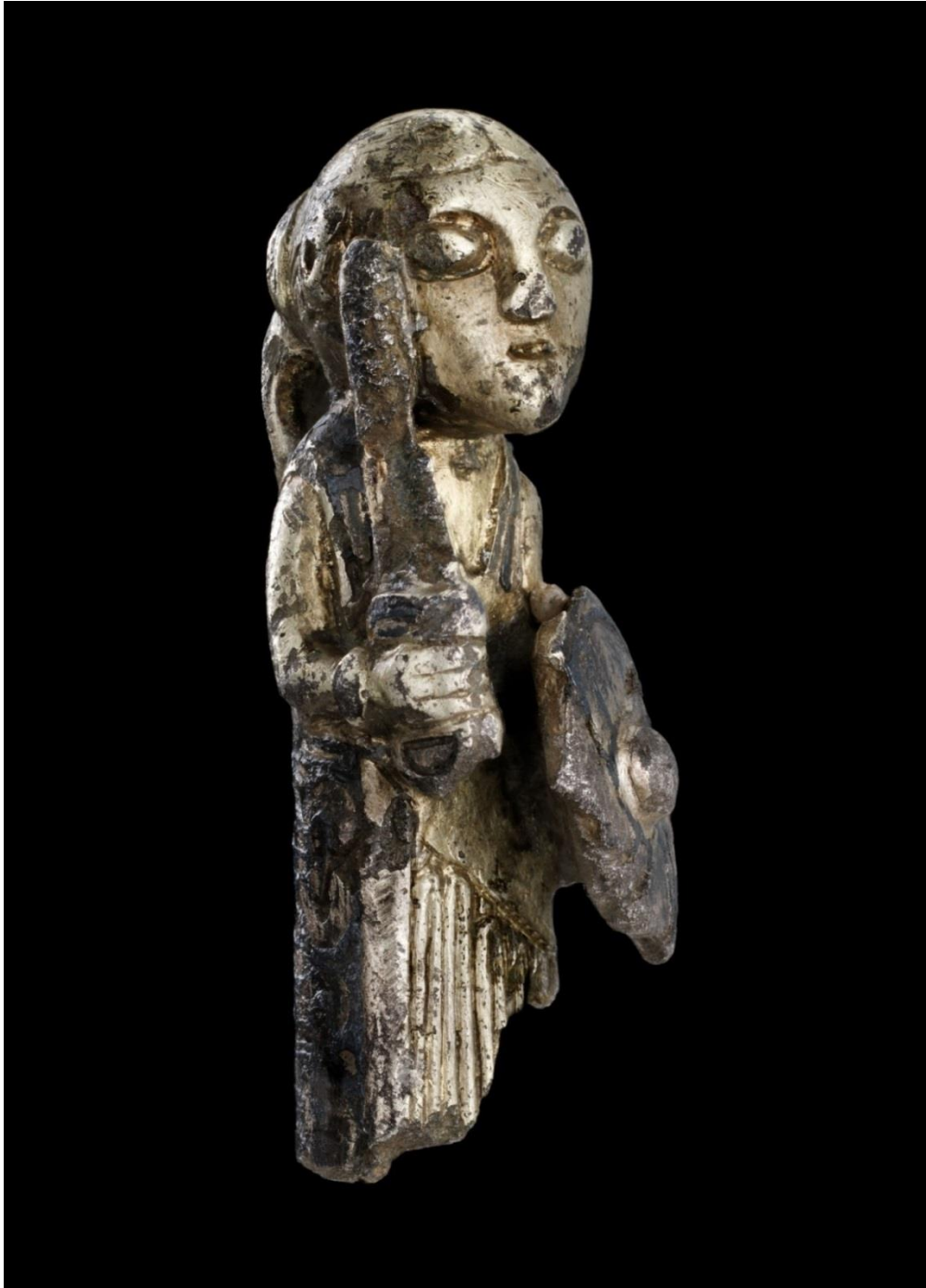
⁴⁸ Sawyer 1982, p 124 ff.

be merchants, and not robbers, who have entered these sparsely populated areas, according to Noonan. The finds of *dirhams* occur almost simultaneously in Old Ladoga and in the Baltic Sea in the late eighth century. During the decades up to the year 840, the finds of silver treasures increased in both areas. About 30% of the coins that come to Russia are transported to the Baltic Sea every decade. The continuous flow of coins indicates that it is a result of trading activities.⁴⁹

In the mid-1980s, almost at the same time as Noonan presents his findings to a Scandinavian audience, the Swedish archaeologist Ingmar Jansson published a description of the Viking Era Gotland and its relationship to the outside world. Like Noonan, Jansson believes that the Vikings' travels to the east must have had mainly to do with trade. A study of settlements along the rivers, which lead to the Black Sea and the Caspian Sea, shows that the tombs house both women and men. These may be residents of Finnish, Slavic or Scandinavian origin. Maybe they are traders, maybe farmers. The Northerners seem have been few in this social environment, and gradually assimilated into Slavic culture.

Nor do the silver treasures that contain Western coins have a convincing connection with the Vikings' surprise attacks on Western shores. When the researchers reconcile the times for the payments of the Danegeld with the years when the deposits of the west-oriented silver treasures on Gotland take place, they see no chronological connection between the events. It is moreover doubtful whether any of the Danegeld was transferred to the Nordic countries or whether it instead stayed in its international environment.

⁴⁹ Noonan 1986, p 321 ff.



Figurine in gilded silver, 3, 4 cm, find from the year 2012 in Hårby parish, Fyn, Denmark. Viking Age.

With a wide-open gaze, this Valkyria selects fallen warriors, worthy of dwelling in Valhall.

Photo: Arnold Mikkelsen, National Museum of Denmark, Copenhagen.

The Silver Treasures in a Microeconomic Perspective

Archaeologist Åke Hyenstrand views, in an article from 1985, the silver deposits in the Baltic Sea area in a narrower perspective than has been the rule. His point is that the Viking Age society consists not only of great men and chiefs, but also of local craftsmen and merchants. Through them it becomes possible to create the capital that would lead to larger central towns being built up, and it is in these locations we find the silver treasures. Hyenstrand wants to *de-dramatize* the treasure finds – usually they are small in view of the large amount of silver that has been minted and that has been in circulation, or that has been melted down and become jewelry and silver bars.⁵⁰

Hyenstrand's interpretation of the function of the Viking Era silver treasures was inspired by a discovery made by marine archaeologists on Gotland in 1962. It consists of an extensive cultural layer at a bay 25 km south of Visby, which has sludged and become a lake, but is still called Paviken. The Swedish Museum of Maritime History examined the area in the years 1967-1973 and found a Viking Era world there. The people who lived at Paviken built boats and engaged in fishing and trade. On an area of 1000 m² archaeologists found more than 10,000 objects, including scales, weights and 120 silver coins, which have been cut to make smaller units of weight. A summary of the finds is given by the archaeologist Peter Lundström in the work *De kommo vida...* (1981).⁵¹ The numismatically focused historians do not always seem to have sufficiently absorbed the knowledge that the sensational findings from Paviken convey. They undoubtedly testify that there was a lively trade in coin-like silver fragments as a means of payment on Gotland during the Viking Age.

The discovery of Paviken would inspire researchers to search for more ports along the Gotland coasts. Archaeologist Dan Carlsson maintains that a large part of the prehistoric cultural heritage is

⁵⁰ Hyenstrand 1985, p 64

⁵¹ Lundström 1981, p 41 ff.

hidden underground, and constitutes what he calls “the invisible cultural landscape”. He searches for trading places on Gotland and finds no less than 60 bays, which may have served as ports during the period 600-1100 A.D. The focus of his research is on the harbor in Fröjel, which is located 40 km south of Visby, and was abandoned as early as the 13th century.⁵² It has since been left in peace for human activities. Time has stood still in Fröjel.

The town becomes the ideal mirror of a Viking age world, as it took shape at a Baltic Sea port. Here the archaeologists find the same vitality as at Paviken, when it comes to crafts and trade. In 2006, two archaeologists reported a sensational find in Fröjel: they found a workshop with a furnace for silver refining and molds for casting silver jewelry. The discovery provides support for the researchers, who believe that the silver treasures on Gotland were partly deposits for raw materials in the production of jewelry.

The structure and organization of trade has been more complicated in the Baltic Sea region than researchers previously thought. The starting point for the description of the trade has assumed that there have been only a few large ports in the region. Dan Carlsson, on the other hand, proves it probable that at least one port would have been established in each coastal parish during the Viking Age. The traditional image of the Baltic Sea as a trading zone, must be reinterpreted in the light of this hypothesis, Carlsson argues, and the same pattern, formed by the many ports that may have existed on Gotland, should also be sought elsewhere.

⁵² Carlsson 1998; Carlsson 2004, p 17 ff.

The Treasures as a Household Fund

Majvor Östergren was the archaeologist who would primarily be inspired by the results of the excavations at Paviken. She started a project on Gotland in 1976, using the new technology offered by the metal detector. The world of thought that surrounds the project was presented in an essay in 1986, and the scientific results in 1989 in her dissertation *Between stone foundation and stone house*. The title of the dissertation indicates what she considers to be the main location of the silver treasures on Gotland. Contrary to the prevailing view that the Viking Age Gotlander would have sneaked out into the woods and hidden his silver, she demonstrates that the silver treasures instead often were hidden indoors. Where treasures have been found, after careful searching, one can often also find old settlements, abandoned by later generations of farmers and craftsmen. Through Majvor Östergren's interpretation, the silver treasures take on a new dimension: they become a tool for mapping the Gotland agricultural landscape the centuries around the year 1000.⁵³

Of great interest is the random coins that Majvor Östergren often found in the excavated settlements. These do not belong to the extensive silver treasures that were assembled in that period. The conclusion she draws from these findings is that coins must have been widely used as a means of payment, more or less as legal tender, on Gotland during the Viking Age; this view is further supported by the large number of weights discovered at the settlements her team investigated.

The silver found both in the Baltic Sea area as a whole and on Gotland is only a limited part of all the silver that was in circulation and that could be used for trade, invested or deposited as treasures, according to Majvor Östergren. She therefore supports Hyenstrand's view that silver treasures, both economically and socially, should be de-dramatized. The majority of the treasures are, in essence, relatively small. Silver has been common on the Gotland farms during the Viking Age and belonged

⁵³ Östergren 1986; Östergren 1989

to individuals' fortunes. They have constituted a surplus created by trade and crafts. In Majvor Östergren's view, Gotland's position as a center for trade in the Baltic Sea during the Middle Ages was already established during the Viking Age. This is when the development begins, which leads to a trade treaty with the German-Roman Emperor Lothar in 1130 and establishing local coinage on the island no later than 1140.

The Silver Treasures as Stock Items

Arab merchants live in an environment where trade has been conducted for many thousands of years. For the Northerners, the meeting with these experienced traders must have been inspiring, but also raised doubts and created difficulties.⁵⁴ The Arabs were used to cunning to succeed in their trade. When the Arab diplomat Ibn Fadlan travels on a mission north of the Caspian Sea, he meets a group of traders whom he signifies as "intoxicated". He listens to a merchant's prayer to his god, and hears him pleading not to have to bargain on the price of his goods.⁵⁵ Of one thing could the Northerners be sure: until the end of the 930s, the silver in the *dirhams* that end up in the Baltics, makes up over 90% of the coin's weight, i.e. as close to pure silver as one could demand. The traders would have few opportunities to ascertain the coins' value in the field.

To purify silver, a smelting furnace must be built. Bowls are required in the oven, which are required with absorbent material. In addition to silver, lead must be added and sufficiently strong heat generated, so that silver and lead are fused together to form a compound, at the same time as all other alloying elements leave the melt. In a second round, oxygen is added to the furnace, to precipitate the lead metal. It leaves the silver in the form of liquid PbO. Silver melts at 960 degrees, gold first

⁵⁴ Gustin 2004, p 174

⁵⁵ Wallander 1978, p 31 ff.

at 1063 degrees and copper at 1083 degrees. In the case of alloys, the temperature required is somewhat more moderate. After all, very high temperatures must be achieved and the process requires trained specialists. With the help of the scales, the purified silver can be weighed and the degree of silver content in the original material determined. It is estimated that the smelting furnaces could refine silver up to 99%.⁵⁶

The Arab coins have been used as a means of payment, perhaps even in the function of coins, in the Baltic Sea region. But if merchants from the German-Roman Empire showed up, or traders who had Central Europeans as customers, they would surely demand to have the silver delivered in molten form, as bars, since foreign coins were not allowed within the borders of the former Frankish lands. Another way to transform the look of coins is to turn them into jewelry. Made by a skilled blacksmith, they increase the value of the metal. We know that jewelry plays a major role in Viking Age society. The beauty of the rings and necklaces that we find in the treasures is eternal. The Vikings' jewelry is imitated by the silversmiths of our time.

Gotland had no cities during the Viking Age. The population lived in villages and was engaged in trade and crafts. As mentioned earlier, a research team in the early 2000s found a silversmith on Gotland, at the port of Fröjel. What did the everyday life of the Viking Era blacksmith look like? How has he financed his business? We have no reason to believe that the silversmiths themselves had any significant capital. Anyone who wanted to refine their Arab coins, and thereby increase its value, had to leave them to the blacksmith. Apart from the fee that the blacksmith received – probably in silver – the question arises: how would the person who submitted his silver know that he received a correct amount of refined goods back? The problem was not so great when the coins contained almost pure silver. However, if silver coins with a low silver value were unknowingly handed over, the blacksmith could easily be embarrassed if he was expected to give up a full-fledged item. The delivered silver me-

⁵⁶ Odelberg 1966; Arrhenius 1973, s 151; Söderberg 2004, s 115 ff.

tal would weigh less than the submitted metal. There is reason to believe that coins, which could be suspected of having a low silver content, were melted down in the customer's presence and sight.

An analysis of the treasure finds that have been made on Gotland shows that they are hidden indoors to a far greater degree than previously thought. When the treasures appear a thousand years after they have been hidden, the houses they have been stored in have decayed and disappeared, as often also the casings in which the treasures are kept. Perhaps some of the silversmiths' treasures provide insight into a silversmith's workshop, into his stockpile of raw materials for the production of jewelry, which could be used as status symbols and as means of payment.

Can the treasures also be examples of products that the blacksmith has made, but which the customer did not have the opportunity to acknowledge? Then as now, those who traded in precious metals had a risky profession. But also people who owned silver acquired envious people. Was it the blacksmith who died and took the secret of his store with him to the grave, or was it the client who disappeared?

The Silver Treasures as Sacrificial Gifts

A different interpretation of the mystery of the silver treasures is that the treasures are remnants of a sacrificial act. When treasures are found in streams, lakes or bogs, the thought arises that those who abandon their fortunes in these inaccessible areas, never expect to see them again in their earthly life. In *Ynglingatal*, in Snorri Sturlasson's *Heimskringla*, Odin's statement is related that the dead should be able to enjoy the treasures he brings with him when he is burned at the stake, as soon as he comes to Valhalla. But also the treasures, which the dead laid in the ground during his lifetime, would benefit him from in his life hereafter.⁵⁷

⁵⁷ Thunmark-Nylén 2006, p 461 ff.; Westholm 1994, p 53 ff.

In *Egil Skallagrimsson's Saga*, written in the 13th century, it is told how Egil hides two treasure chests at the end of his life to make his heirs unlucky. When Egil's survivors try to track down where he has hidden his treasures, they focus on a bog where fires have been seen shining at night. It was in the swamps that the heathen world came into contact with its gods. Perhaps it is with the help of the gods that Egil wants to preserve his fortune.⁵⁸

Does *Ynglingatal* and *Egil Skallagrimsson's Saga* reflect the beliefs that existed during the Viking Age, or are these writings rather an expression of how the Christian world in the 13th century imagines the world of thought of the pagan period? Source critics reject the value of the saga era, seeing them as noting else than as an expression of their own time.⁵⁹

In the religious world of the Viking Age, there was the notion that the soul separated from the body after death and moved to the realm of the dead. But the connection between the soul of the dead and his bodily remains in the earth persists. The dead possess a dual identity. He still is in contact with his survivors and receives their cult at the grave. Should piety towards the dead cease, he risks that he would no longer enjoy the tranquility of the tomb. He may leave the world of the dead and return to the realm of the living, to haunt the living. The fear of ghosts, the corpse ghosts, was widespread in the Viking Age. The night belonged to the ghosts. They could attack their victims, who die a sudden and unforeseen death. Epidemics and other plagues nourished the belief in ghosts. The population was declining simultaneously as the number of ghosts were increasing. People were powerless in the face of the invisible forces that caused mass death in the countryside.⁶⁰

⁵⁸ Saga 1998, p 257

⁵⁹ Krag 1991

⁶⁰ Ström 1985, p 219f.



Reconstruction of a sacrificial bog from our first millennium. *Sagnlandet Lejre*, Zealand, Denmark.

Project manager Hans-Ole Hansen.

Belief in the ghosts leaves an explanation for the fact that silver treasures remain in the earth or in the house of the dead, although they may have been known by those who survive him. You wouldn't want to, or not dare to, disturb the peace of the grave. A relevant objection to the idea that "Oden's law" would have been a common occurrence on Gotland during the Viking Age, however, is that the dead would in that case have brought with them plenty of grave goods. However, studies of preserved tombs show that this is not the case. Perhaps the sacrifices to the gods were more short-sighted. They wanted to appease their gods, to succeed during their time on earth.

Silver as a Selective Form of Savings

In the middle of the 16th century, the English economist Sir Thomas Gresham launched a theory, which proved so viable that it came to be named after him: "Gresham's law". When a monetary system is established, an agreement is reached on the value of the coins. Once the norm has been set, the state can begin to degrade the metal value of the coin without anyone being aware of the situation to begin with. After a while, it becomes apparent that the older coins have a better metal value than the younger ones. The effect is that ordinary people save the older coins and use the younger ones for daily use. The worse coins thus push the better ones out of the market. It is this observation that constitutes Gresham's law: in a coin system where two coins of equal value exhibit a different quality, a bad coin always drives away the better. A good coin, on the other hand, will never drive away a bad coin.⁶¹

It is known that the quality of silver was gradually declining in the Arab coins. A study conducted by me, provides the scientific evidence for this observation. In the years before 940 A.D., the coins had

⁶¹ Mundell 1998, p 19 ff.; Herschend 1989, p 373 ff.

a high silver content, after which the value decreased. The silver treasures that were deposited may have been selected with knowledge of which coins were most valuable, i.e. the deposits may have been prime examples of Gresham's law. The absence of inferior coins in the deposits after 940 may simply be due to the fact that these coins were not saved, but were allowed to circulate or were melted down. The deposit may have been a process, which extends over a long period of time. It needs not be the result of the sudden submission of vast fortunes that archaeologists often expect.

One phenomenon that supports such an idea is the sorting of Arabian coins from the arena. A table illustrates the development. There is reason to believe that loose coins were used as a means of payment, even by the simple man. We find that coins with over 90% silver content disappear from the market in the middle of the 10th century. They cease to circulate and should be found in the treasures that are increasingly deposited in the following decades.

Danish archaeologist Roar Skovmand examined coin finds from Denmark and Schleswig and was able to demonstrate that the high-quality Arab silver coins in the treasure hides were replaced by European coins with a high silver content during the latter part of the 10th century. A diagram can be drawn using Skovmand's tables. The appearance of the Gotland depots in a somewhat recent time is similar to the Danish and Schleswig depots.

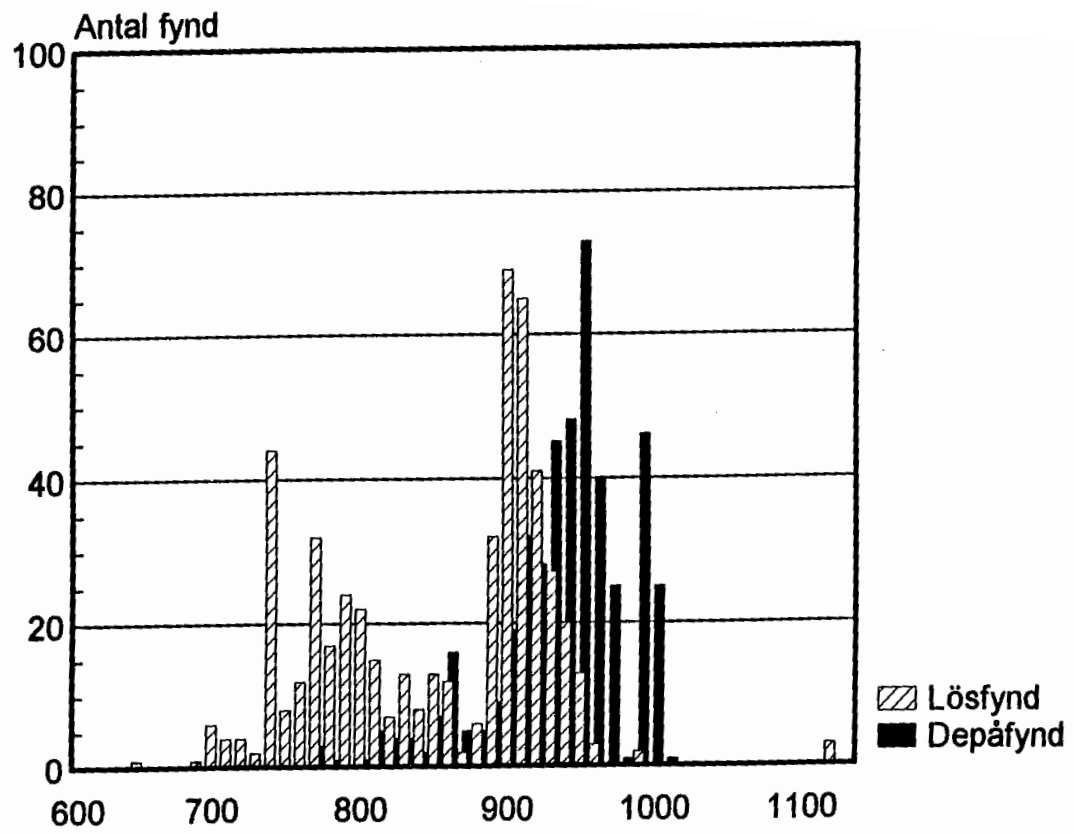
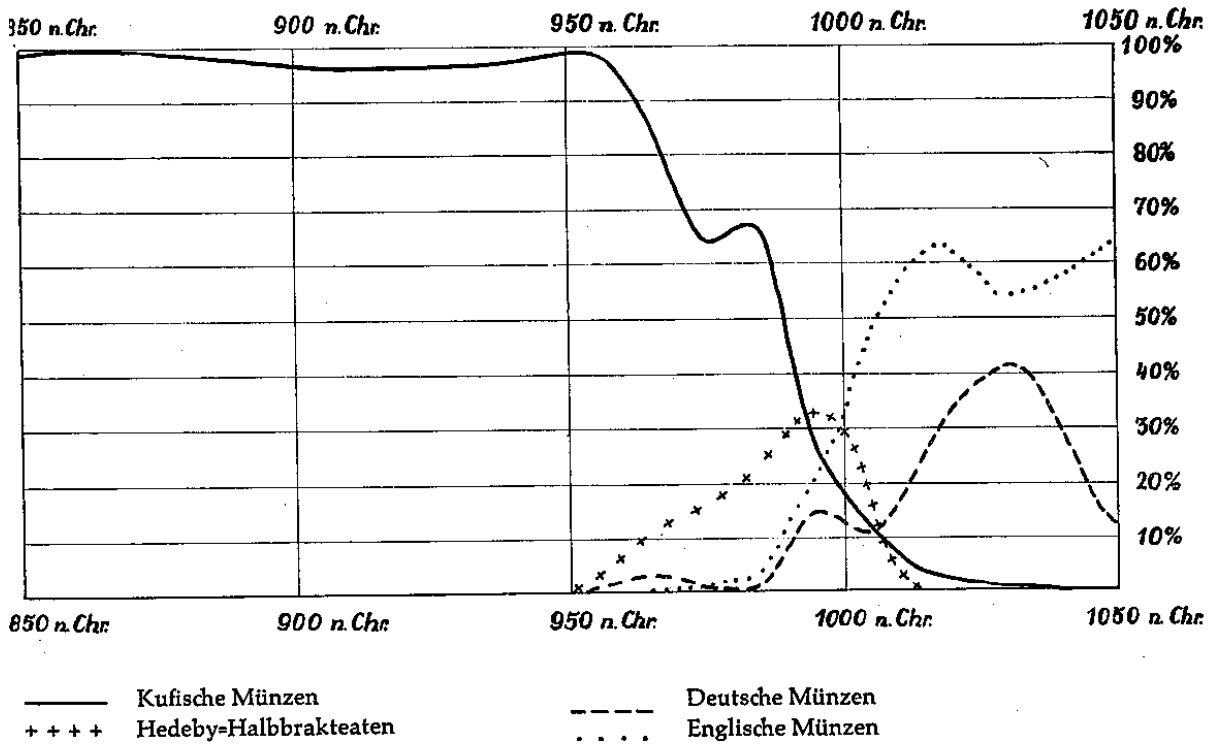


Fig. 3. Lösfynd och depåfynd med islamiska mynt i Sverige.

Loose finds and depot finds with Islamic coins in Sweden.

Kilger 1995, p 32



Changes in the composition of the coin in depot finds in Denmark and Schleswig during the Viking Age.

(Skovmand 1942, p 13 ff.)

Conclusion

At first glance of this paper, the reader will raise objections: Vikings did not weigh – they did not do business: they robbed! It is true that Vikings all too often appear as perpetrators of violence and extortion on the European scene in the centuries around 1000 A.D., but their role as actors in international trade is certainly far greater than that of looters.

During the time of Emperor Augustus, the Romans were keenly aware of the economic resources that the Baltic Sea region had to offer. There existed a vast reservoir of materials to build ships in the deforested Mediterranean area, and furs to be traded, as protection when the cold sets in. The amber washed up along the shores of the Baltic Sea was admired by the Romans and valued higher than precious gems. Slaves were in demand in the southern countries and readily available in the areas that not yet had been affected by Christian jurisdiction.

The Frankish Empire takes over as the Northerners' main trading partner after the collapse of Western Rome. The Franks and the Northerners trade in glass, swords and silver coins. The Baltic Sea countries can offer amber, slaves, horses, falcons, furs and walrus teeth. A hard-to-document but coveted item among Christians is wax candles. They will be a replacement for the oriental oil lamps, which were lost during the Arab onslaught. The candle is used to illuminate the many sacred dark rooms which house Christian seekers. The candles also have a spiritual dimension, which is central to a Christian. In the Gospel of John Jesus says: "I am the light of the world, he who follows me, he will not walk in darkness, but will receive the light of life."

As political stability increases in the Muslim world, trade relations are also established between the Orient and the Baltic Sea region. Arab silver coins are a sought-after exchange item for the Northerners. What do you do with silver in a barter economy? Some researchers see the prevailing econo

mic circumstances as an expression of a weight economy. But the weights and scales that they so carefully examine are just tools in a commodity exchange economy, which requires a diversity of goods to work. He who has only one commodity to offer, in this case precious silver, will soon fall short in the struggle for existence. Large portions of the coins flowing into the Baltic basin are deposited almost immediately.

The way of conducting business among the tribes and nations of the Baltic Sea area follows ancient rules of the game. The octal and duodecimal system, as well as vigesimal counting is applied. The Arabs' way of counting numbers and positions was a foreign and incomprehensible concept in the West, still using finger counting in the trade and conduct of daily life.

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By the bright green shaw
the oxen striding,
The heavy plough draw,
the soil dividing.
The plough stops.
Sorest of shudders
through the forest rushes.

The bird-quire hushes
sudden its strains.
Holy silence
over all reigns.
Then rings in the mould.
The ancient gold.

Adam Oehlenschläger, *The Gold horns* (1803).

Translation: George Borrow (1913).