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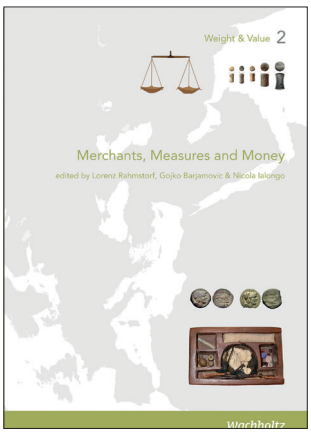

Merchants, Measures and Money
Understanding Technologies of Early Trade in a Comparative Perspective
Lorenz Rahmstorf, Gojko Barjamovic, Nicola Ialongo (eds)

doi: 10.23797/9783529035418

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Merchants, Measures and Money
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Weight & Value: Volume 2
Wachholtz Verlag, Kiel/Hamburg
Published: 2021-3-31

Abstract

This second volume in the series collects papers from two workshops held at the University of Göttingen in 2019 and 2020. The international meetings tackled questions related to merchants and money in a comparative perspective, with examples spanning from the Bronze Age to the early Modern period and embracing Europe, the Mediterranean, Asia and East Africa. The first part of this volume presents historical case studies of how merchants planned and carried out commercial expeditions; how risk, cost, and potential profit was calculated; and how the value of goods was calculated and converted. The papers in the second part address current theories and methods on the development and function of money before and after the invention of coinage. The introduction of balance scales around 3000 BCE enabled the formation of overarching indexes of value and the calculation of the commercial value of goods and services. It also allowed for a selected set of commodities to take on the role of currency. Around 650 BCE, this led to the invention of coinage in the Eastern Mediterranean.

Merchants, Measures and Money

Understanding Technologies of Early Trade in a Comparative Perspective

Proceedings of Two Workshops

Funded by the European Research Council

(ERC)

Edited by Lorenz Rahmstorf, Gojko Barjamovic and Nicola Ialongo

Weight & Value

Edited by Lorenz Rahmstorf
Seminar für Ur- und Frühgeschichte
Georg-August-Universität Göttingen

Volume 2

Publications of the ERC-2014-CoG:

WEIGHTANDVALUE: Weight Metrology and its Economic and Social Impact on Bronze Age Europe, West and South Asia

Göttingen
2021

Merchants, Measures and Money

Understanding Technologies of Early Trade in a Comparative Perspective

Edited by

Lorenz Rahmstorf, Gojko Barjamovic and Nicola Ialongo

with contributions from

Rodney Ast, Gojko Barjamovic, Alain Bresson, Georg Christ, Gareth Dale, Jan Gerrit Dercksen, Mark Gardiner, Anthony Harding, Nicola Ialongo, Carsten Jahnke, Christoph Kilger, Sibel Kusimba, Chapurukha M. Kusimba, Elizabeth Lambourn, Natascha Mehler, Claude Mordant, Rebecca Peake, Lorenz Rahmstorf, Felix Rösch, Malfalda Roscio, Clive Stannard, Piotr Steinkeller, François R. Velde, Julien Zurbach

Proceedings of Two Workshops

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WACHHOLTZ VERLAG KIEL/HAMBURG

This publication was funded by the European Research Council [Grant no. 648055]

The contributions to this volume have been individually reviewed by colleagues from the respective subfields to which they relate. The editors are grateful to the 19 colleagues who acted as peer-reviewers.

Redaktion: Sandra Busch-Hellwig, Laura Hermann, Heinz-Peter Koch

ISBN 978-3-529-03541-8

DOI 10.23797/9783529035418

Cover:
Front cover (top left): Reconstruction of the scale from Bordjoš, Banat, Serbia, c. 1200 BC (modified after P. Medović, Die Waage aus der frühhallstattzeitlichen Siedlung Bordjoš (Borjas) bei Novi Bečej (Banat). In: B. Hänsel (Hrsg.), Handel, Tausch und Verkehr im bronze- und früheisenzeitlichen Südosteuropa. Südosteuropa-Schr. 17 = Prähist. Arch. Südosteuropa 11 (München, Berlin 1995) 209-218, here fig. 5).
Front cover (top right): Spool-shaped balance weights with markings from Tiryns, Argolid, Greece, mid- and late 3rd millennium BC. Courtesy of Lorenz Rahmstorf.
Front cover (upper bottom): Examples of *trientes* of the Second Punic War issue at Minturnae. Courtesy of Clive Stannard.
Front cover (lower bottom): Gold trader's complete weighing tool kit, Bani-Shangul, Ethiopia. Donation by Per Sandvik, Vitenskapsmuseet, University of Trondheim, E 485-38 (photo: B. E. Thingstad).
Back cover (top): Experimental leather zip pouch with fastening of leather loops and bronze baton inspired by the zip pouch found in the Middle Bronze Age Danish tomb of Hvidegard (made by Jess Paske); bone balance beam (made by Vincent Lascour) and three bronze weights (made by Aurélie Legras and Killian Morin) (© Claude Mordant).
Back cover (bottom): The control of lengths of measurements is depicted in a 15th-century version of Jónsbók (Heynesbók) (AM 147 4to). Image provided by The Árni Magnússon Institute of Icelandic Studies, Reykjavík.

Wachholtz Verlag Kiel/Hamburg 2021
Gedruckt auf säurefreiem, chlorfrei gebleichtem Papier

Preface by the editor of the series

This volume presents the contributions of two further workshops which were held within the scope of the research project ERC-2014-CoG 'WEIGHTANDVALUE'. Volume 1 in the series Weight & Value presented the proceedings of Workshops 1 and 2 held in 2016 and 2017 focussing on "Weights and their Identification" and "Weights and Marketplaces". This volume publishes the contributions of Workshops 3 and 4. Workshop 3, "Weights and Merchants. The Technology of Early Trade", took place between 15th-17th May 2019, Workshop 4, "Weights and Money. Understanding Money in a Comparative Perspective from Prehistory to Modern Times", between 27th-29th May 2020. I am grateful that nearly all participants delivered a paper for the proceedings. My special thanks are due particularly to the authors of the last workshop as they had only three months to prepare the written versions of their papers. As with Volume 1, this publication is available as open access. Please note that larger, high-quality versions of the footnotes and figures printed within this volume are available for download: https://doi.org/10.23797/9783529035418

I would like to thank my co-editors Gojko Barjamovic and Nicola Ialongo for their support in editing this publication. The layout of the papers and the book was again arranged by Heinz-Peter Koch. He was also responsible for solving graphical problems. Laura Hermann revised the language, Sandra Busch-Hellwig corrected formal inaccuracies. I would like to express to them and to Olaf Irlenkäuser from Wachholtz Verlag my deepest gratitude for their outstanding work. The invitation and hosting of the workshop's participants, the printing and the open access of this publication have been financed by the ERC Grant.

The two first volumes in this series can be regarded as a *prolegomena* to the material evidence that we have focussed on in the research project: mainly weights, but also scales and weight-adjusted artefacts. In the workshops, the problems of the identification and the contextual use of these objects were discussed for the Bronze Age and later periods. In the volumes which will follow in this series, the actual data, especially the weights from Bronze Age Europe, West and South Asia, which have been investigated by the research team over the years since 2016, will be published in detail.

Göttingen, January 2021

Lorenz Rahmstorf

Contents

Part II: Weights and Money

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What Viking merchants had in mind

Exploring Islamic weight standards and weighing practices within early medieval trading networks

by Christoph Kilger

Calibration, dirham coinage, Islamic miṯqāl, merchants, numeracy, weight units, Viking Age

In the Early Middle Ages, with the rise of the Muslim Caliphate trade and exchange expanded on a global scale. Both archaeological and numismatic sources testify to the development of a supra-regional bullion silver economy in Eurasia, which copied monetary standards and practices current in the commerce of the Islamic world. However, we still know little about the monetary habitus in long distance networks of the Early Viking Age (c. 800-950 AD). In this paper, various aspects of measurement, numeracy and units are presented and discussed. It is argued that Viking Age merchants had a profound knowledge of Islamic coinages and their monetary value. They could probably recognise Cufic script and were able to distinguish between dirhams of different emissions by recognising their design, the presence or absence of Cufic letters or signs. Based on observations from an Ethiopian gold merchants weighing gear it is argued that coins and seeds together were used as a means for calibration. Similar practices could also explain the spread and acceptance of weight standards such as the Islamic miṯqāl.

Was Wikinger-Händler im Sinn hatten.
Die Erforschung islamischer Gewichtsstandards und Wiegepraktiken
innerhalb der frühmittelalterlichen Handelsnetzwerke

Eichung, Dirhems, islamischer miṯqāl, Recheneinheit, Gewichtseinheiten, Wikingerzeit

Mit dem Entstehen des muslimischen Kaliphats im 7. und 8. Jahrhundert entwickelte sich ein weitreichendes Handelsnetz zwischen Asien und Europa. Sowohl archäologische als auch numismatische Quellen bezeugen die Etablierung einer überregionalen Gewichtsgeldzone in Eurasien und die Übernahme geldwirtschaftlicher Strukturen der islamischen Welt. Trotz dieser Anpassungen ist eigentlich wenig über die monetäre Denkweise und gängige Praxis in den Fernhandelskreisen der frühen Wikingerzeit bekannt (800-950 n. Chr.). In diesem Beitrag werden unterschiedliche Aspekte der muslimischen Geldwirtschaft und deren Einfluß auf die Fernhandelszone präsentiert und diskutiert, u. a. wie man in Rechen- und Gewichtseinheiten dachte und sie dann umsetzte. Es wird argumentiert, daß wikingerzeitliche Kaufleute ein grundlegendes Wissen von islamischen Silberdirhems und deren Wert besaßen. Vermutlich konnten sie arabische Schriftzeichen deuten und anhand der Herstellungsweise der Münzen sowie dem Vorhandensein von Beizeichen zwischen verschiedenen Emissionen unterscheiden. Am Beispiel eines kompletten Gewichtssatzes eines äthiopischen Goldhändlers des frühen 20. Jahrhunderts wird veranschaulicht, wie Münzen und Getreidekörner als Gegenstände zur Eichung von Gewichten benutzt wurden. Eine ähnliche Praxis hat vermutlich auch während der Wikingerzeit existiert und kann erklären, wie und warum der islamische miṯqāl als Gewichtsstandard akzeptiert wurde und sich in der eurasischen Handelszone verbreiten konnte.

Introduction

In the Early Middle Ages, with the rise of the Muslim Caliphate, trade and exchange expanded on a global scale. With the Arabic expansion, taking place between the 7th and 9th centuries, long distance networks linked the provinces of the Caliphate with the empires of the "Old world" China, India and Byzantium. Even regions outside the orbit of these empires such as Sub-Saharan Africa, the vast steps of western Asia and the immense forest and river landscapes of Eastern and Central Europe were connected with the Islamic global trade system (Noonan 1980; Lombard 1992). Arabic geographers and diplomats provide us, in some instances with detailed information on long distance trade relations in Eurasia and the agents in the exchange networks such as Viking or Rūs merchants (Montgomery 2000; Kovalev/Kaelin 2007, 9-10).

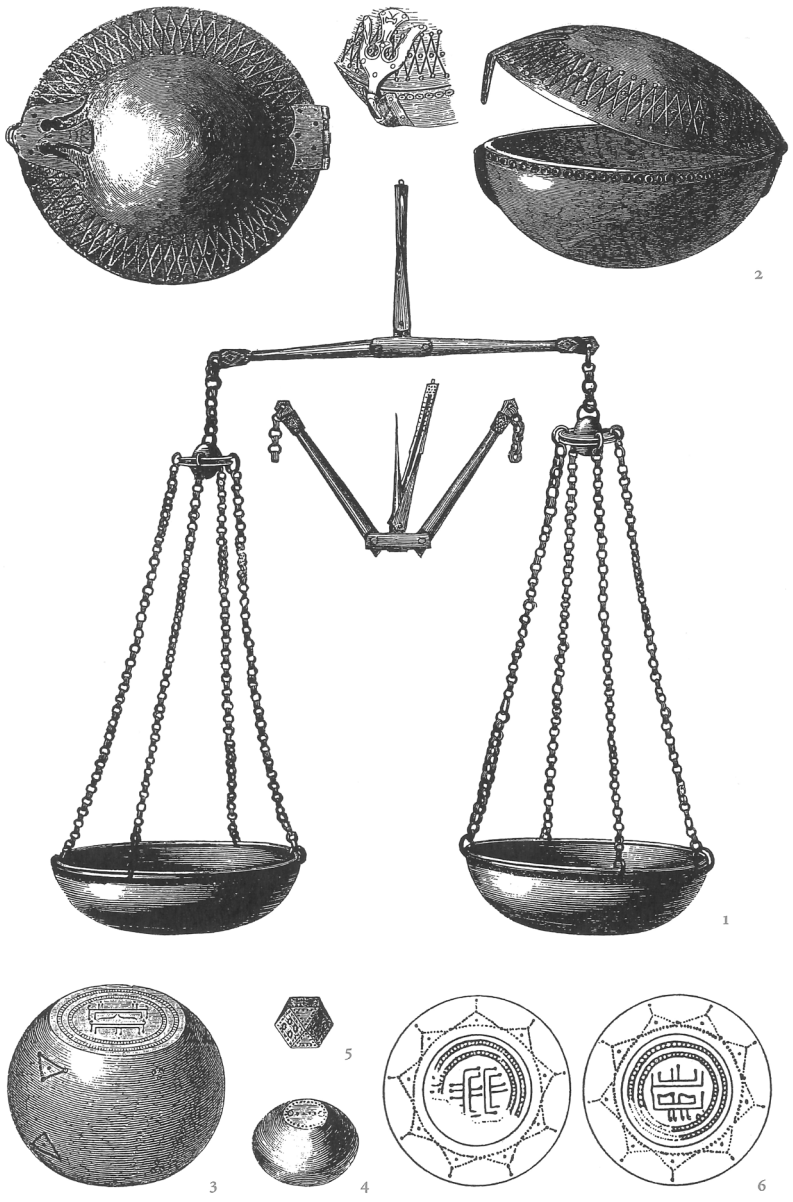


Fig. 1. Weighing equipment with folding balance (1), balance case (2), oblate-spheroid weights with flattened poles (3-4), cubo-octahedral weight (5) and pseudo-Islamic glyphs on spheroid weight (based on Jansson 1988, fig. 4; Kilger 2008b, fig. 8.15).

The material evidence of trade relations and merchant activities with the Islamic world is tangible through different archaeological sources (*e. g.* Jansson 1988; Callmer 2000; Mikkelsen 2008). Islamic influence on merchants tools have been discussed, such as the advanced construction of the balance scales and the standardised design and weight of the so-called cubo-octahedral and oblate-spheroid weights (Steuer 1984; 1987; 1997; Sperber 1996) (Fig. 1).[1] Recent research has focused on the social significance of weights in Scandinavian society; especially aspects of trust, identity and gender in mercantile and commercial settings have been addressed (*e. g.* Gustin 2004; Pedersen 2008; Kershaw 2019). Most conspicuous evidence for contacts with the Islamic world are the hundreds of hoards with Islamic silver dirhams discovered in a vast area stretching from the Caucasus and Central Asia in the east to the British Isles in the west (Brather 1997; Kovalev/Kaelin 2007; Kilger 2008a; Adamczyk 2014). Thus, both archaeological and numismatic sources testify to the development of a supra-regional bullion silver economy in Eurasia, which copied standards and technologies current in the commerce of the Islamic world.

In this paper, I aim to discuss several monetary aspects of weighing precious metal, and how concepts of measurement, numeracy and units were practiced in long distance networks in the Viking Age. The study of the monetary habitus in the bullion weight economy has so far concentrated on the analysis of weights. What I want to address is the mindset of merchants and their way of understanding and handling Islamic coinages. To provide answers I will compare different aspects of coinage in the Islamic Caliphate and discuss possible connections to the silver bullion weight economy. In this context, I will particularly look at how merchants used dirhams as means of payment and as means of standard. Important here is to address the metrological relationship between dirhams and weight units, such as the Islamic mi̲tqāl. To get more clues on merchant practices I will finally present the weighing gear of a modern Ethiopian gold trader (Kilger 2015). This example and other ethnographic sources, not only evidence the impact of the Islamic world trade system that in some areas existed into the early modern period (Johnson 1968), but also provide analogies for approaching conventions among Viking Age merchants.

1 The regulated weights and their use in the Viking bullion economy have been presented and discussed by Jane Kershaw (2019) in the first volume in the Weight and Values series. Her paper represents an excellent introduction to this topic and the most recent update in research. My contribution will try to develop some issues addressed by Kershaw, but focus will be on the significance of Islamic coinage for merchants, and the relationship between weights and coinage in terms of metrology and practice.

Dirhams for merchants

Trade with furs and slaves was one of the incentives for the import of large quantities of dirhams to Eurasia. As witnessed by contemporary Islamic written sources furs gained status as precious commodities under the ʿAbbāsid rulers (Kovalev/Kaelin 2007, 9-12). Prominent in the texts are the Rūs merchant warriors or Rūsiyyah and their hunger for silver. It is not entirely clear, who these merchants were. Their ethnic affiliation has been a matter of a long-lasting contentious debate, whether they were Vikings, Scandinavians of Eastern Swedish origin or Russians (Montgomery 2000, 1-5, 22-25). Current research stresses that not all merchants or people dealing with silver in the Viking period were Scandinavians or Vikings, whatever this word implies. What is important to consider is the agency of different trading communities and ethnic groups in the Eurasian bullion economy (Franklin/Shepard 1996; Kovalev 2005a). Prominent are the nomadic tribes such as the Khazars and Volga Bulgars, who have garnered considerable interest in Viking Age research. Not least because they minted and copied dirhams (Rispling 1990; 2005), but they are also considered as key players, who connected different trading networks active in Eastern Europe (Noonan 2000-2001; Kovalev 2005b).

The Arabic sources provide us with some information, which illuminates certain aspects of this trade, such as travelling routes, commodities exchanged and scattered notes on the value of silver. According to Ibn Khurdādbeh, the author of an administrative geographical account dated between *c.* 850 and 885, Rūs merchants travelled with furs and swords to the southern shores of the Caspian Sea and from there on camels to the capital Baghdād (Kovalev/Kaelin 2007, 9-10). The importance of dirhams is also evident in the eyewitness account of the diplomat Ibn Fadlān, who met Rūs merchants on his visit to the capital of the Volga Bulgars in the early 920ʹs AD. As evidenced by his report the Rūs handled large sums of dirhams. Every time a merchant earns 10.000 dirhams, roughly 30 kg of silver, a neckring was manufactured as a gift to his wife. Other commodities are dark green ceramic beads, highly valued by the Rūs, which were traded for 1 dirham each piece (Montgomery 2000, 6-7). Another source dated to 903 AD attributed to the geographer Ibn Rūstah mentions that the Rūs demanded payment for furs in dirhams. The price for each pelt was reckoned between 2 and 2.5 dirhams, which in weight corresponds roughly to 6 and 8 g of silver (Kovalev/Kaelin 2007, 9-12). However, dirhams were not only currency in trade and exchange, but also a means of paying tribute, for instance levies delivered by the Eastern Slavonic tribes to the Khazar Khaganate (Adamczyk 2014, 69-73).

Yet trade with slaves, controlled to some extent by the Rūs warrior merchants, has been advanced in recent approaches as a major explanation for the development of the dirham zone in Eurasia (Jankowiak 2013, 139-140). One mechanism that propelled the use of dirhams as a viable international currency is that the transaction of human commodities was organised as linked exchanges between middle-men. Such a specialised trade was in need of a stable currency. In this context, Marek Jankowiak has proposed a compelling interpretation as to why the Volga Bulgars started to mint dirhams. Coinage was a means to secure liquidity at the slave market at Bulgar and to increase the demand for coined silver among merchants. Silver dirhams not only advanced as a convenient bulk currency in this particular trading system, but the acquirement of quantities of silver probably also represented wealth and success, and was a means of gaining social status. In due course, the large-scale influx of silver initiated a chain-reaction leading to new economic constellations and webs of social dependencies in the merchants' home countries in Scandinavia (*e. g.* Sindbæk 2011; Kilger in press).

The social and economic mechanisms in the trade with dirhams raise also questions about the connections of merchants to Islam society and its monetary system. What was the Rūs and other merchants' relationship to Islamic coinage, in terms of understanding the monetary conventions made material in these objects? How were weight standards such as the Islamic miṯqāl copied outside the Caliphate in the absence of central authorities who were able to monopolise and enforce monetary standards? Could Viking merchants read dirhams and recognize Cufic signs? Were they able to distinguish between different dirham emissions? These questions relate to two topics, which I will address and discuss in the next sections: First, to monetary aspects of Islamic coinage, such as metrology and weight standards and secondly, to aspects of literacy and the significance of dirhams as textual objects.

Weights and weight units in Viking Age Scandinavia

Studies of weights and their use in Viking Age society have developed into a multidisciplinary research field to explore economic and cultural relations with Islam. Metrological research has provided convincing evidence of weight assemblages used in Scandinavia and the Baltic Sea zone between the 9th and 11th centuries being calibrated with the Islamic miṯqāl as a template. There exist a multitude of different weight types made of lead and copper-alloy. The weights, especially of lead, are characterised by their variety of forms (Pedersen 2008). Copper-alloy weights, on the other hand,

differ from lead weights because of their geometric and symmetrical design. These include the heavier so-called spheroid or oblate weights with flattened poles and the smaller cubo-octahedral dice shaped weights (Fig. 1). The uniform design of these two categories of weights makes them easily recognisable, enhancing notions of standard, trust and reliability, which probably has promoted their status in exchange relations (Kershaw 2019, 128-129). In terms of monetary standard, metrological analyses indicate that both weight types were calibrated to a common unit of *c.* 4 g in accordance with the miṯqāl (Sperber 1996, 110; Steuer 1997, 281-289, fig. 204-205). The lighter cub-octahedral weights weigh between *c.* 0.70 and 4.25 g, possibly representing fractions of the miṯqāl, whereas the heavy spheroid weights about 4 and 200 g represent multiples of the miṯqāl.

Another innovation probably as a consequence of contacts and trade with Eastern Europe and the Caliphate was the introduction of new weight units such as the ertog into the existing Scandinavian øre weight system and its transformation into a duodecimal system of reckoning close to the Islamic system (Kilger 2008b, 304-307). The identification of the ertog unit of *c.* 8 g known from later medieval sources, has been accomplished by the archaeologist Anton Brøgger through his metrological analysis of complete weighing sets from Norway (Brøgger 1921; for a summary of Brøgger's research on weights see Kilger 2008b, 279-280; Pedersen 2008, 140-141). A possible Scandinavian term for the common 4 g unit, or half-ertog was þveiti, meaning "cut pieces, fragments" (Kilger 2008b, 315-317). The study of Viking Age weights allow conclusions to be reached in respect of some aspects of the silver bullion economy and its practice in merchant communities in Scandinavia and beyond. However we don´t know much about the modus operandi, such as numeracy and how new standards such as the Islamic miṯqāl and units like the ertog and þveiti were calculated. It is therefore necessary to pay a short visit to the metrological landscape of Islamic numismatics, which provide some keys for understanding the miṯqāl and its relationship to Islamic coinage, and how weight standards were defined and reproduced in the Caliphate.

▲*Fig. 2. Dirham glass weight from Egypt. Standard of ⅔´s, 2.76 g (Balog 1976, no. 434). Governor Yazīd b. Hātim (762-769 AD). Inscription "In the name of Allāh, Ordered the amīr Yazīd b. Hātim, a weight of dirham of two thirds, full weight". No scale.*

Coins and seed calculation in Islamic contexts

In metrological research, several dirham standards have been identified. In contemporary Islamic sources, they are referred to as fractions of the miṯqāl. On the one hand, the canonical standard of ⅞ described in the Muslim Sari'a law and on the other hand the standard of ⅔´s known from Egyptian glass weights of the 8th century (Bates 1991, 55-56) (Fig. 2). Miṯqāl is synonymous to Latin pondus signifying the ideal weight to measure and evaluate the weight of precious metals such as gold coins (Grierson 1960, 255). Originally, the miṯqāl was used in the Caliphate as a reckoning template to calculate the weight of silver dirhams. This template was according to the 9th century Arabic historian al-Balādhurī based on an earlier Persian standard for Sasanian drachmas. The change of the miṯqāl as a measure to define the weight of the Islamic gold dinar was probably first implemented in the late 8th or early 9th centuries. From then on, the weight of the dirham was defined as the ratio of 10 : 7 of a miṯqāl and tied to the weight of the gold dinar. This means that the weight of 10 dirhams corresponds to the weight of 7 dinars. Such dirhams were addressed by al-Balādhurī as 'dirham weight of seven' (Gignoux/Bates 1995). In the modern metric system, the gold miṯqāl of the early Islamic period corresponds to a value between 4.23 and 4.26 g, confirmed by a number of metrological studies on Islamic gold dinars and extant coin glass weights from Egypt (Bates 1991, 55). Conversely, the standard of ⅞ corresponds roughly to *c.* 2.97 g and the standard of ⅔´s to *c.* 2.83 g. How are such fractional standards to be explained, and how are they implemented as weight units?

In ancient monetary systems, coinage and weight standards were connected and established through a common reckoning scale based on a certain amount of seed or coins (Ridgeway 1892; Grierson 1960; Kilger 2008b, 264-267). The basic gold coin in the Late Roman monetary system, the solidus and the dinar in the Islamic system were calculated through a certain number of carats from the carob tree. In Latin these seeds are referred to as the siliqua, in Arabic described as the qīrāṭ or kharrūba. It is assumed, that the solidus was equal in weight to 24 siliquae and the dinar or miṯqāl to 20 qīrāṭs (Grierson 1960, 255). There is evidence that also the weight and the value of a dirham was reckoned to a certain number of seeds, for example the 'dirham of 13 qīrāṭs' (Balog 1976, 112, 115; Bates 1991, 55). Interestingly, also the value of Egyptian bronze coins was reckoned in number of qīrāṭs. As evidenced by the coin glass weights, there was probably a system operating with values between 9 and 36 qīrāṭs (Balog 1976, 24-27). As local currencies the Islamic bronze coinages fulfilled the needs for small-scale commerce in urban markets (Heidemann 2010a, 649-650). Their weight in contrast to dinar and dirhams was not regulated and the nominal value of one coin or a batch of coins could only be established through weighing. This was especially true of the bronze coinages highlighting that weighing and counting are closely related monetary practices in the Islamic monetary systems.

Another observation that probably carries relevance for the merchant and weighing practices is the correspondence between fractions and a certain numbers of seeds. Theoretically, the dinar

of the 7/10 standard corresponds in weight to the number of 20 qīrāṭs, and conversely the dirham to 14 qīrāṭs (Grierson 1960, 250-253, with further references). In comparison, the standard of ⅔'s was probably based on a reckoning scale with lighter grain seeds as building blocks, referred to in the sources as ḥabbas. 3 ḥabbas were reckoned as equal to 1 qīrāṭ. The miṯqāl in this scale was reckoned to the number of 60 ḥabbas (Hinz 1955, 2; Rebstock 2008, 2261). However, the reckoning scale with a certain amount of seeds per unit was not fixed and there existed a variety of ratios in different regions for the "seed-weight" of both dinars and dirhams (Rebstock 2008, 2261). As emphasized by Ulrich Rebstock (2008, 2255-2256, 2261-2262), metric systems in the Islamic world from the medieval to the early modern period were diverse, and developed into different regional standards. The specific weight of the carob seed was not uniform and varied depending on local and climatic conditions. For instance, the weight of the Graeco-Roman siliqua is estimated to have a specific weight of 0.189 g. In the Islamic weight system, there have been recognised different qīrāṭs, such as the heavier Syro-Arabian qīrāṭs of 0.212 g, and a lighter Egyptian qīrāṭ of 0.195 g (Grierson 1960, 251-254). The theoretical weight of an Iraqi or Baghdādī ḥabba has been calculated at 0.0706 g (Hinz 1955, 2; Rebstock 2008, 2261).

From a numerical point of view the 7/10 standard operates with the numbers 10 and 20. Configured in the number of carob seeds the fraction 7/10 is equal to 14/20 qīrāṭs (Tab. 1). In the merchant's, view the grain reckoning scale compared with qīrāṭ scale had some advantages. Ḥabbas probably identical to the barley grain were more easily available in Eastern- and Northern Europe than carob seeds. In addition, the ⅔ standard of 60 ḥabbas operates with the number 6 as common denominator, which enables the calculation of the miṯqāl in fractions of ½, ⅓ and ⅙ as the lowest unit. Configured in number of grain seeds these fractions correspond to 30, 20 or 10 ḥabbas. Interestingly the Islamic law texts mention also a subunit of the miṯqāl, the so-called dānik, which was reckoned as ⅙ of a miṯqāl and corresponds to between 8 and 10 ḥabbas (Miles 1965, 319; Rebstock 2008, 2261). By assembling the different elements into hypothetical reckoning charts it is possible to visualise the advantages of the grain scale (Tab. 2). Both the dinar and its known fractions and the dirham of ⅔'s or 'grain-dirham' can be aligned in the same scale and are compatible with each other. In addition, all coin nominals are attested in the Egyptian coin glass weight corpus with nearly the same metric values (Balog 1976, 23).

Miṯqāl	number qīrāṭs	weight qīrāṭs	coin-denomination glass weights	meanweight	Balog 1976
1	20	4.23 g	1 dinar	4.20 g	35 sp
7/10	14	2.97 g	dirham kayl	(2.95 g)	no 680
			double dirham	(5.89 g)	no 752

▲ *Tab. 1. Hypothetical reckoning table with the miṯqāl divided into 20 qīrāṭs. Metric value Syro-Arabian qīrāṭ, 0.212 g. Egyptian glass weights: Denominations and metric values (Balog 1976, 23-27).*

However, as already remarked by Philip Grierson (1960, 156)the weight-relationship of 10 to 7, and correspondingly the 14 carat unit, its multiples and fractions "forms not part of any rational metric system". This statement aligns with Michael Bates (1991, 55-56) argument that the 'standard of seven' also known as the 'dirham kayl' or market dirham is rather to be understood as a notional weight unit, detached from the coin object itself. The standard of 10 : 7 defined as a ratio of weight between the dirham and the dinar was, according to Bates, probably introduced during the reign of Caliph al-Ma'mūn 813-833 AD and was a component in his reform of coinage and the minting system[2].

One has to take into account that the specific weights of seeds presented in the metrological literature are theoretical reconstructions, based on the analysis of coins and glass weights. Equally, one has to be cautious in taking the number of

2 Bates puts forward this interpretation in an unpublished critical comment "Grierson 1963 and the metrology of early Islamic coinage". The comment is accessible on ACADEMIA, https://www.academia.edu/10339637/Grierson_1963_and_the_metrology_of_early_Islamic_coinage (accessed 17.08.2020).

Miṯqāl	subunit dānik	number ḥabbas	weight ḥabbas	coin-denomination glass weights	meanweight	Balog 1976
1	6/6	60	4.23 g	1 dinar	4.20 g	35 sp
-	5/6	50	3.53 g	-	-	-
⅔	4/6	40	2.82 g	1 dirham	(2.76-2.84 g)	no 217, 243-245, 357, 434
½	3/6	30	2.12 g	½ dinar	2.09 g	43 sp
⅓	2/6	20	1.41 g	⅓ dinar	1.36 g	42 sp
⅓	2/6	20	1.41 g	½ dirham	(1.35 g)	no 631
⅙	1/6	10	0.70 g	-	-	-

▲ *Tab. 2. Hypothetical reckoning table with the miṯqāl divided into 60 ḥabbas and corresponding fractions based on the subunit dānik. Metric value for grain weight, ḥabba baghdādī, 0.0706 g (Rebstock 2008, 2261). Egyptian glass weights: Denominations and metric values (Balog 1976, 23-27).*

seeds per unit at face value. Since the 9th century, various juridical schools in the Caliphate pursued the development of a legal theory of money, which tried to define the intrinsic value of bullion used in exchanges. Of paramount importance for the lawyers was to address a just bargain. At the core was the principle of equilibrium in the weighing of precious metals (Heidemann 2010a, 650). Seed reckoning as a metric definition was a means in the Islamic law texts to define the monetary value of coinage and necessarily doesn´t reflect practice (Rebstock 2008, 2255). Finally, the suggested reckoning chart for the dirham of ⅔´s should be regarded as a very simplified model, which by no means can describe the complex and changing metrological landscape in the Caliphate.

Weighing and calibration practices among merchants

Ethnological studies of the use of the miṯqāl in the early modern gold trade in West and North Africa prove that seed calculation was not a juridical exercise, but proved a real method for merchants in their business. Both the miṯqāl and larger units such as the ounce were calculated in units corresponding to a certain amount of seeds, such as grains, carob and jequirity beans, or other common fruits (Johnson 1968, 548-552). The anthropologist Marion Johnson emphasises the significance of coins as tools of trade. One famous example is the "miṯqāl Nikky", gold coins which circulated in Trans Saharan trade networks and which were used as calibration weights among Wangara merchants in the early 19th century. Such coins and their ability "to turn the scale" to a certain amount of grains were addressed by the gold traders as coins of full weight (Johnson 1968, 552-558). Johnson summarises her observations about African weighing systems and merchant practices as follows:

"Any system based on seeds and grains, if it is not to break up into an almost infinite number of local systems (as it did in Europe, and was to do in parts of West Africa during the nineteenth century) must be held together either by the enforcement of weight standards by some central authority, or by the circulation of coins minted to a standard weight; a closely organized body of traders could perform the same function." (Johnson 1968, 552)

In the absence of central authorities, seed calculation and the use of highly standardised coins was probably a method among merchants to copy and reproduce weight standards. Gold coins or other coins of good standard were an excellent calibration device, both for selecting seeds of fairly even weight, but also for calibrating and reconstructing basic units in a weight system. In metrological studies of oblate-spheroid weights, which are common in Viking Age contexts, two closely related standards have been recognised: One heavier unit of *c.* 4.23 g, which probably copies the Islamic miṯqāl, and lighter units, such as the Birka unit of 4.0 g or the Hedeby unit of 4.1 g (Sperber 1996, 110). As convincingly argued by Jane Kershaw (2019, 130) these units probably don´t represent different standards, but rather are the result of different methods of calibration.

Following the calibration argument, I would like to suggest that differences from an expected standard might be explained by the use of local grains when producing and calibrating weights. For instance, a unit of *c.* 4.0 g corresponds to the amount of 60 barley or Troy grains with a specific weight of 0.067 g. To conclude, if seeds and coins really were used to calibrate weights of merchants, then the calibration process is conditioned by two circumstances: first, the reckoning scale and the amount of seeds calculated per weight unit, and second, the specific weight of local seeds used in establishing the unit. A question, which needs to be addressed in the following, is if merchants used dirhams as objects for calibrating weights?

The weight of dirhams

There has been long lasting consensus that the dirhams were well standardised and were minted according to ⁷⁄₁₀ standard, close to the value of 2.97 g (Miles 1960, 212-214). However, a recent metrological analysis conducted by Marek Jankowiak (2019, 16-17) on 18,000 dirhams mostly from Swedish hoards reveals a more complex picture and raises new questions about standard. How standardised in weight were the dirhams? Jankowiak's analysis indicates a clearer chronological pattern. Whereas early ʿAbbāsid dirhams seem to observe a lighter standard weight of about 2.82 g, dirhams minted during the 9th century weigh closely in accordance with the canonical weight of 2.97 g. As stressed by Jankowiak this change in weight to the ⁷⁄₁₀ standard is only notional. In terms of standard deviation, the weight of dirhams increases from 0.2 g at the beginning of the 9th century to almost 0.4 g at its end. In other words, the average weight is close to the 2.97 g standard, but there is a clear dispersion of the weight of individual coins. Jankowiak´s observations follow an earlier study by Luke Treadwell conducted on the mint of Samarra, which was active between 838 and 945 AD (Treadwell 2001). There is similar development at Samarra with an increasing but more pronounced standard deviation with 0.1-0.2 g at the start. At the end of the 9th century, the weight pattern fluctuates between 2 and 4 g. Even though the notional standard of 2.97 g was observed, the fluctuating pattern provides an indication of a deregulation of the coinage and the weight system itself (Treadwell 2001, 153). As emphasised by Jankowiak the changes can be explained as a difference between

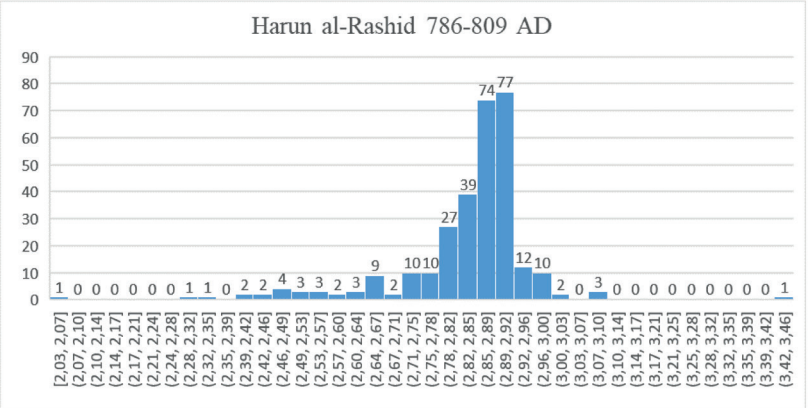
a more rigorous and relaxed standard. However, what constitutes a rigorous standard?

Standardisation is very apparent if 8th ʿAbbāsid coins are included in the comparison. In order to recognise weight pattern with a higher resolution I have analysed dirhams from a well published Gotlandic hoard by applying frequency distribution histograms. Stora Velinge (*tpq* 910/911), is one of the biggest dirham hoards from Sweden containing 2674 specimen (CNS 1977: 1.2.38). Stora Velinge contains quantities of whole and unharmed dirhams, and almost no hacksilver. Only coins without any secondary treatment have been chosen for the analysis. The most common coins in the hoard are issues of Harun al-Rashid 786-809 AD and al-Mutawakkil 847-861 AD. The sample chosen amounts to approximately 300 specimens for each ruler.

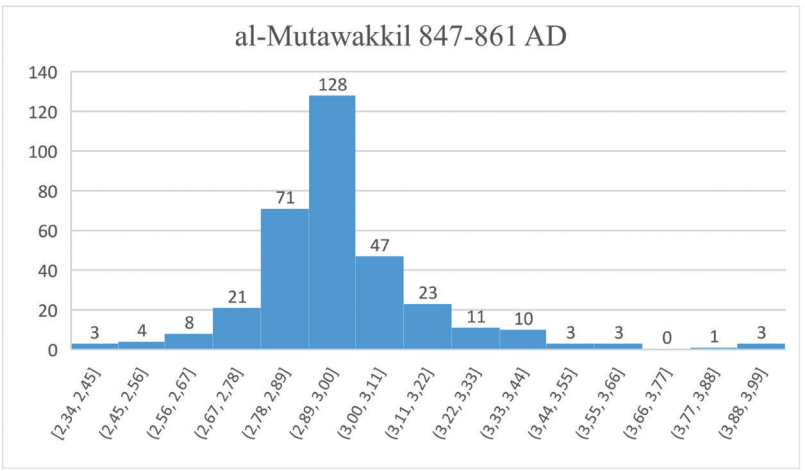
Dirhams minted under al-Rashid have an average weight of 2.83 g. The histogram shows a very concentrated weight pattern, with 220 specimens or 74 % of the sample weighing between 2.78 and 2.92 g. Of these 151 specimens or 51 % weigh between 2.86 and 2.92 g. As shown by the histogram there is clear edge at 2.92 g with only few specimens heavier than this value. Conversely, there is a pronounced "cliff" at 2.78 g with few specimens below (Fig. 3). The weight pattern indicates that dirhams minted under al-Rashid are finely tuned, well in accordance with the standard of ⅔ʼs.

Dirhams minted under al-Mutawakkil display a more dispersed and smooth weight pattern (Fig. 4). The mean weight is 2.97 g, in accordance with the standard of 7/10. There is concentration between 2.78 and 3.0 g, 199 specimens or 59 % of the sample. However, more than 100 specimens or 30 % weigh more than 3.0 g. There are also a considerable amount of specimens weighing below 2.78 g.

The comparison indicates that coinage under al-Mutawakkil was more relaxed and not as rigorous as dirhams minted under al-Rashid. Coins had a firm weight, and their exchange value could be established to some extent more unambiguously, by counting one by one, whereas later 9th century dirhams had to be weighed. The larger deviation in weight of al-Mutawakkil coinage hints that dirhams could only be handled through weighing in batches.



▲*Fig. 3. Weight dirhams, caliph al-Rashid, Stora Velinge I, Gotland (tpq 910/911) (n = 298).*



▲*Fig. 4. Weight dirhams, caliph al-Mutawakkil, Stora Velinge I, Gotland (tpq 910/911) (n = 336).*

Dirhams as messengers of texts

The importance of dirhams as currencies and as objects of value in the Eurasian trade networks leads to the question of their significance as textual documents, as messengers of religious ideas and as tokens of monetary concepts. As argued by Egil Mikkelsen the presence of objects with Cufic script in Scandinavia might indicate the influence of Islam in Viking society. Merchants who handled the dirhams could have acted as missionaries and dirhams could have been used as small "missionary tracts" (Mikkelsen 2008, 545-548). David Wasserstein (1993) on the other hand sees Islamic epigraphic coinages as cultural boundary markers conveying the symbolic universe of Islam. As textual objects he argues that Islamic coins operate on different levels mediating different messages for different audiences. People who handled dirhams on a regular basis could recognize Cufic script and were able to recognize in Wassersteins words the "metalanguage" of Islamic coinage. The presence of script guaranteed its economic value, its legality and authenticity.

People were probably observant of changes in style, scripture and the presence or absence of signs. Ample examples of how merchants checked and processed dinars in their business are provided by later sources such as the Cairoan Geniza dated to the 11th century. In transactions when merchants settled payments with each other they focused on the face value, the appearance and quality of the coins they exchanged (Goitein 1968, 230-233). The ability to read the coins, to recognise changes

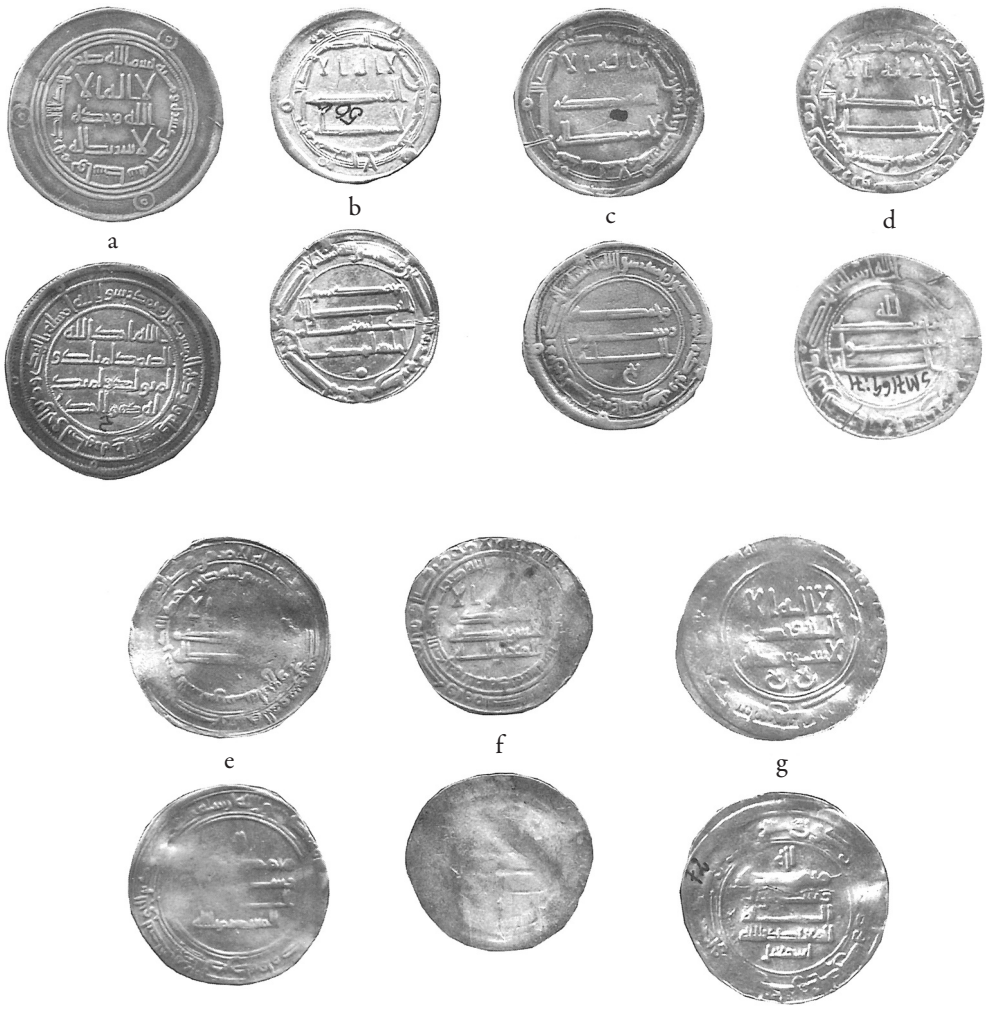


Fig. 5a-g. Scale 1:1 (Leimus 2007, no. x). a. Umayyad dirham with annulet obverse. Anonymous, mint Wāsit, 111 AH, 729/730 AD, 2.82 g (no. 10). b. 'Abbāsid dirham with annulet obverse. Caliph al-Mahdī (775-785 AD), mint Madīnat al-Salām, 163 AH, 779/780 AD, 2.83 g (no. 217). c. 'Abbāsid dirham with annulet obverse. Caliph al-Mansūr (754-775 AD), mint Madīnat al-Salām, with "bakh" sign on reverse, 148 AH, 765/766 AD, 2.83 g (no. 83). d. 'Abbāsid dirham after coin reform under caliph al-Ma'mūn (813-833 AD), mint al-Muhammadiya 207 AH, 822/823 AD, 2.99 g (no. 549). e. 'Abbāsid "blind" dirham. Caliph al-Mu'tasin billah (833-842 AD), mint ash-Shash, 224 AH, 838/839 AD, 2.95 g (no. 576). f. 'Abbāsid "blind" dirham. Caliph al-Mutawakkil (847-861 AD), mint al-Muhammadiya, 2xx AH, ?? AD, 2.89 g (no. 588). g. Sāmānid dirham. Emir Ismail ibn Ahmad (892-907 AD). Caliph al-Mu'tadid billah (892-902 AD), mint ash-Shash, with "bakh" sign on obverse, 281 AH, 894/895 AD, 3.17 g (no. 1108).

in style, and to notice the presence or absence of small signs is highly relevant for the topic of this paper. Could merchants operating outside the Caliphate like the Rūs understand Arabic and read Cufic letters? If not could they make sense of the metalanguage of dirhams? In order to address these questions, I will present and discuss the inscriptions and the fabric of a selection of Umayyad and ʿAbbāsid dirhams from the 8th and 9th century (Fig. 5a-f).

The epigraphic Islamic coinage was introduced under the reign of the Umayyad caliph Abd al-Malik in 696-698 AD, probably as a means to reunite the growing Islamic state, which was weakened by civil strife. A common coinage eased the operation of centralised rule and the implementation of the Arabic language among the bureaucracy (Treadwell 2009). Cufic scripture on coins signals also a clear statement by the rulers to make Arabic the language of the empire (Wasserstein 1993, 310-311). The meaning content of Cufic inscriptions on silver dirhams and gold dinars is dense. Legends can contain up to 150 words. Information on the actual ruler, the place and year of minting is always given. The year of minting is expressed according to the conventions of the Islamic calendar of the hijrah (Heidemann 2010b, 161-162). Hijrah meaning "departure" refers to the exodus of the prophet Mohammed from Mecca to Medina in 622 AD.

The religious inscriptions contain parts of the Quran and varying spellings of the kalimah, the creed of the Islamic faith. The inscription in the centre field of the obverse, characterised by its upwards pointing and elongated "scissors" or split tops of the first line says: "There is no god but God alone. He has no associate". The inner marginal legend mentions the mint and the date: "In the name of God! This dirham was struck at ... and in the year ..." (CNS 1977, XVIII). Neither Umayyad nor the earlier ʿAbbāsid coinages had legends on the outer margin of the obverse. Instead, the outer rim was embellished with ringed or circular annulets (Fig. 5a-c).

The reverse renders the Profession of faith, and significantly on ʿAbbāsid coins references to the prophet. On ʿAbbāsid coins the central inscriptions says: "Muhammad is the messenger of God" or "To God. Muhammed is the messenger of God. God bless him/....and give him peace/...and his family". The marginal legends on the reverse provide quotations of the Quran, such as the surahs

48:29 and 9:33: "Muhammad is the messenger of God. He sent him with the guidance and the religion of the truth to make it prevail over every religion, averse though the idolators may be" (CNS 1977, XIX) (Fig. 5a-c).

During the reign of caliph al-Ma'mūn, 813-833 AD a coinage in new Cufic style was introduced (Fig. 5d). Dirhams in the new style were first struck in the mint of Baghdad in 821 AD. The new coinage and its design was from then on also adapted in other provinces (El-Hibri 1993, 63-68). The annulets common for earlier coinages were replaced by the victory verse, which is a quotation from the surah 30:3-4: "The command belongs to God before and after, and on that day the believers will rejoice with the help of God". The verse probably commemorating the military victory of al-Ma'mūn over his half-brother al-Amīn were kept on Cufic dirhams. The disappearance of the annulets, the amendment of Cufic text in the outer circle goes also hand in hand with a change in the stylistic fabric of the coins. Whereas old style dirhams emphasiszed a rectangular and vertical appearance of Cufic letters, dirhams minted after al-Ma'mūn´s reform display a more curvilinear style (Heidemann 2010b, 163-164).

It is probable that the annulets on Umayyad and early ʿAbbāsid dirhams had a specific meaning in its primary monetary context. What the annulets specifically signaled is not quite clear. As shown by Michael Bates and A. S. DeShazo annulets on Umayyad dirhams displayed the organisation of coinage at the mint of Wasit (DeShazo/Bates 1974). Each governor who was in charge of the mint had a unique pattern of three annulets. These coins were made of pure silver and easy to recognise. What makes the annulet signature relevant in trade is that merchants or other persons handling dirhams on a daily basis who could not read Cufic script were able to recognise Umayyad and early ʿAbbāsid coinages and to distinguish them from later ones. For instance, Sāmānid coins which were exported in great numbers to Russia and Scandinavia in the 10th century (Fig. 5g). Coins with annulets were dirhams of full weight, extremely well tuned in accordance with the miṯqāl standard. Such coins comparable with the quality of gold dinars, were probably trusted because of their stable weight.

There is archaeological evidence, which might underpin the suggestion that people in Scandinavia selected certain dirhams when producing necklaces with coin pendants in 9th and early 10th century Viking burials. According to an extensive study on Viking Age coin pendants presented by Florent Audy there was preference to choose Umayyad and early ʿAbbāsid dirhams as dies to produce silver foils for coin-like pendants (Audy 2018, 200-203, fig. 9.8). Altogether, there have been recorded 25 specimens of foiled dirham imitations, which belong to three sets of necklaces from three different burials in central Sweden and Norway. As stressed by Audy the composition is characterised by its homogeneity. Most of the foiled pendants use Umayyad coins as dies and all of them depict the obverse. Most of the pendants have a bearded border. Interestingly for all specimens for which the orientation could be determined the central inscription of the obverse with "scissors" is aligned horizontally but always oriented upside-down. The fixed orientation pattern might indicate according to Audy that the owners responded to the special geometric design of early Cufic dirhams, but weren´t able to distinguish between upright and inverted Cufic signs.

Dirham al-kayl and dirham fragmentation

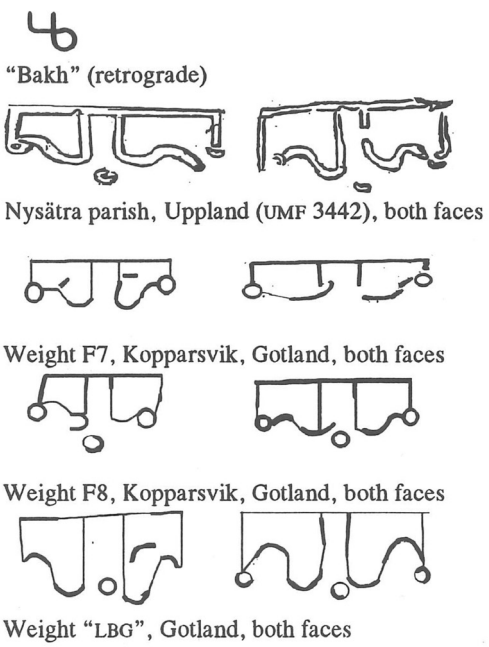
There are several indications that the currency system changed after al-Ma'mūn´s coin reform, which in turn had implications for how coined silver was handled as currency inside and probably even outside the borders of the Caliphate. Until the coin reform of al-Ma'mūn the organisation of the mints in the Caliphate was controlled by the provinces and its governors. After the reform, especially under al-Ma'mūn´s successors the production of the coin dies became more centralised (Heidemann 2017, 97-98). In due course, the fabric of the dirhams deteriorated and the coins became badly struck. The minting of so-called blind dirhams increases from about the 830s and 840s onwards. Inscriptions are often blurred and difficult to read because of the use of worn out dies (Fig. 5e-f). Probably related to this is the change to a more relaxed notional standard of 7/10, the "dirham al-kayl" when the exchange value of silver coinage could be settled through weighing only. This change is corroborated by metrological analysis, which I have referred to earlier.

Another phenomenon, probably related to changes in monetary practice is the appearance of coin fragments in 9th century hoards found within the borders of the Caliphate. The earliest evidence is from coin hoards in the Eastern provinces from the 840s onwards (Ilisch 1990). Fragmentation of dirhams is also known from late 9th century dirham hoards in Spain (Heidemann *et al.* 2018). As argued by Stephan Heidemann fragmented dirhams in this period, substituted bronze coinages in some provinces. Until then bronze coins and cast copper coins comprised the bulk of small change for daily expenses (Heidemann 2002, 362-365; 2009, 502-503, fig. 9-17). The significance of hacksilver in everyday commerce in the Caliphate becomes also evident by the increasing numbers of fragmented dirhams from excavations of urban sites in the Levant (Heidemann 2009, 503-504, fig. 18-20). If these changes in the monetary sphere are indications of an economic crisis can be debated. In any case weighing developed as a necessary practice due to the changing monetary structure in the Caliphate.

Conversely, weights and hacksilver also appear in stratified contexts from urban sites in Scandinavia during the third quarter of the 9th century (Gustin 2004, 312-314; Hårdh 2008, 114; Pedersen 2008, 132-134). In light of the growing evidence of small finds from urban and productive sites in the North Sea and Baltic Sea regions, the significance of hacksilver as a petty currency in everyday exchanges has recently been elaborated on by Jane Kershaw (2019, 135). Silver was weighed in minute proportions and there seems to be a strong correlation among settlement finds between the use of the small cubo-octahedral weights and hacksilver. This might imply that the acceptance of fragmented dirhams in the Caliphate as currency and the use of hacksilver in the Eurasian bullion economy were to a certain extent related.

Weights with Islamic script and signs

There is an indication that craftsmen who manufactured weights in the dirham bullion zone outside the Caliphate possessed knowledge of Islamic dirham coinages, of the fabric, design and possibly also Cufic script. Cufic letters appear on weights of oblate-spheroid type weighing between *c.* 100 and 150 g (Fig. 1,6). Obviously, they copy the epigraphic inscriptions of dirhams, but they are not true Arabic but represent crude imitations of the creed of faith *rasul Allah* "the prophet of Allah". Another detail is the depiction of the sign "bakh" which is Arabic and means "choice" and "good quality" (Sperber 1996, 96-101) (Fig. 6). The "bakh" sign appears on 8th century emissions of ʿAbbāsid caliphs, such as al-Mansur and al-Rashid, and also later on Sāmānid dirhams (Fig. 5c.g). The phenomenon of the pseudo-Islamic glyphs has been interpreted from different angles, such as the owners access to precious metals, communication in trade relations and identity of merchants (*e. g.* Sperber 1996, 96-101; Gustin 1997, 168-173; Fernstål 2007/2008; Pedersen 2008, 169-170; Kilger 2008b, 307-309). In any case, the signs were made after the production of the weights and they indicate that the artisan had Islamic coinages in mind when they signed their product.



▶ *Fig 6. The sign "bakh" depicted retrograde on oblate-spheriod weights from Sweden (Sperber 1996, fig. 8.8).*

There is archaeological evidence that spheroid weights were also manufactured in Scandinavia in Viking towns Hedeby and Birka, and also later in Sigtuna in the early 11th century probably under the supervision of the Swedish king (Söderberg 2006; 2015). On the other hand, the numismatic sources points to an origin in the East and to a mercantile Islamic connection. Oblate-spheroids were clearly inspired by Late Roman and Byzantine prototypes (*e. g.* Kisch 1965, 97 fig. 51; Steuer 1987, 427, 432), but in Islamic times such weights have only been documented outside the Caliphate. Their most eastern distribution is from cemeteries of the Saltovo-Majaki culture, commonly associated with the Khazars (Steuer 1997, 46). They also appear in the Volga-Bulgarian area (Schultzén 2009, 34, fig. 16, with more references). Both the Khazars and the Volga Bulgars started an indigenous coinage imitating official dirhams. The Khazarian imitations date to the 830s, whereas the imitative Volga Bulgarian coinage commences in the early 10th century (Rispling 1990; 2005).

Thus, it is reasonable to assume that oblate-spheroid weights originated in a borderzone beyond the Caliphate. Both the Khazars and Volga Bulgars were accustomed to Islamic scripture and their coinages evidence that they were knowledgeable of the Islamic monetary system, probably also the miṯqāl weight standard and related weighing and reckoning practices. They were possibly mediators of the Islamic currency system to other merchant groups who were active in the Eurasian silver bullion economy.

A merchant´s toolkit from Ethiopia

There exists only a few complete trading-sets from the Viking Age in Scandinavia. The existing sets containing weights and scales are mainly known from burial contexts (*e. g.* Kyhlberg 1980; Pedersen 2000; Holm 2017). The few complete sets have been analysed thoroughly in metrological research and used to reconstruct Iron Age weight standards and units (*e. g.* Brøgger 1921; Steinnes 1927; Kilger 2008b, 283-285, 313-315; Pedersen 2008, 140-144). However, as remarked by several researchers the completeness of weighing equipment could be conditioned by burial traditions, religious customs or social conventions, which necessarily does not reflect the handling of weights and scales in economic practice. There are also source-critical factors to consider such as unprofessional excavations

◀*Fig 7. Gold traders complete weighing tool kit, Bani-Shangul, Ethiopia (donation by P. Sandvik, Vitenskapsmuseum, Trondheim E 485-38).*

or recovery by chance which could have resulted in not all components of a weighing set being recorded (Gustin 2004, 113; Pedersen 2008, 144; Holm 2017, 44). Modern ethnographic sources from Eastern Africa, however, offer insights on the range of different components, which once were part of the complete equipment of a Viking Age merchant. As we will see below, weighing equipment of modern African gold traders includes not only weights and scales but also coins and organic materials such as seeds, namely jequirity beans (lat. *abrus precatorius*), and carob beans. In addition, ethnographic accounts also provide unique insights about practice as to how weights, coins and seeds were used by merchants (Kilger 2015).

In 1977, the Norwegian engineer Per Sandvik presented a wooden box to the Vitenskapsmuseum in Trondheim (Tingstad 2007). The box contained complete weighing equipment from a gold trader from Beni Shangul province in Ethiopia (Fig. 7). Sandvik had acquired the equipment during his stay in Ethiopia between 1930 and 1931. By fortune, Sandvik (1935) also published a travel account of his encounter with the Ethiopian gold traders, which provide additional information on conventions and how merchants used their weighing tools. Sandvik's set of weights contain several brass weights that are strikingly similar in shape to Viking-Age and early Islamic weights (Fig. 8). The foldable scale and the shape of the weights, but also the taxonomy of weight units applied by the merchants that Sandvik renders in his account, suggest

◀*Fig. 8. Brass weights from weighing tool kit, Bani-Shangul, Ethiopia (Vitenskapsmuseum, Trondheim E 485-38).*

connections with the ancient monetary system of the Islamic world.

According to Sandvik (1935, 70-72) every gold trader classifies his brass-weights with a nomenclature. The biggest unit was the okét. All other units were reckoned as divisions of the okét (Tab. 3). ½ of the okét was named alada or aumam. ¼ okét was equivalent to a mutagalla, which refers to the arabic miṯqāl. ⅛ of an okét was a gisma and one-sixteenth corresponds to a grat. A gisma could also be calibrated using 40 small red beans, addressed by the merchants as ḥabbas. These ḥabbas probably refer to the jequirity beans, which were part of the Trondheim weighing equipment.

Okét/ subunits	Okét fractions	number ḥabbas	troy	Okét metric value	weights metric value	weights shape
okét	1	320	480	31.2 g	30.598 g (- 0.602 g)	half-spherical
alada	½	160	240	15.6 g	15.230 g (- 0.37 g)	cubo-octahedral
mutagalla	¼	80	120	7.8 g	7.963 g (+ 0.163 g)	biconical
gisma	⅛	40	60	3.9 g	4.088 g (+ 0.188 g)	cubic
grat	1⁄16	20	30	1.95 g	2.057 g (+ 0.107 g)	half-cubic

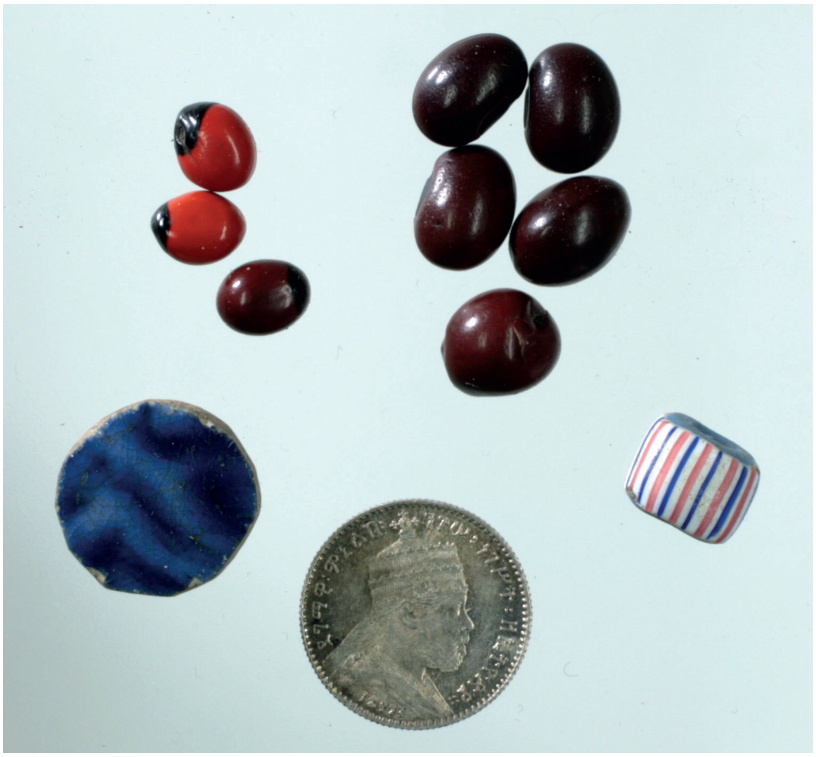
▲▶ *Tab. 3. Reckoning table of the weighing set from Bani Shangul.*

calibration objects	number ḥabbas	objects metric value
gersh coin	14	1.395 g
glass bead	10	0.955 g
carob beans (5)	10	1.033 g

The okét had a metrical value of 31.2 g in some districts in Ethiopia, in others 28.08 g. Unfortunately Sandvik leaves no further explanations for this difference. The unit of 28 g corresponds to the standard weight of a Maria Theresia thaler, a silver bullion coin minted by the Austrian empress Maria since 1741. Thalers circulated in East Africa from the 18th century onwards. Because of their high silver content, they were embraced as means of payment in the population. Sandvik mentions that according to the common opinion, the picture on the coin was not the portrait of the Austrian Empress, but that of the ancient Queen of Saaba. The bust of the empress is usually depicted with a brooch on her shoulder. The brooch is believed to represent the Queen´s navel. Interestingly Sandvik notes that if the brooch is missing the coin will not be accepted.

In the gold buyer´s toolkit from Trondheim, there was no Maria Theresia thaler, but an Ethiopian silver coin, the gersh also called piaster, minted by Ethiopian emperor Menelik II (1889-1913) (Fig. 9). The same ruler also minted a higher nominal, the birr. Both the gersh and the birr follow the weight standard of the thalers and copy its style and symbolism with the bust of the emperor on the obverse and the crowned Ethiopian lion on the reverse. The weight of the gersh also known as piaster is 1.4 g and the birr 28 g. This means that 20 piaster correspond in weight to 1 birr. However, in contrast to the pure silver coin of Maria Theresia thaler, the gersch contained only 0.835 g of fine silver. According to Sandvik, this had lasting consequences for the piasters as a currency in everyday trading. As an official currency the piaster was only accepted in the capital Addis Abeba. On rural markets outside the capital the piasters were valued at lower exchange rates. The Ethiopian bank in Addis Abeba gave 16 piasters for the birr. In the rural areas the birr was a handled at a lower exchange rate between 12 and 14 piasters. Thus as a currency the piaster was not appreciated, but as a calibration device it is a necessary component in the weighing set.

▼ *Fig. 9. Small objects from weighing tool kit, Bani-Shangul, Ethiopia. Jequirity beans, Carat beans, glass bead, piece glazed porcelain, coin Ethiopian piaster, emperor Menelik II (1889-1913) (Etnographic collection Vitenskapsmuseum, Trondheim E 485-38).*



Based on Sandvik's report it is reasonable to assume that there were two different standards in the gold trade in Ethiopia. There is a gold standard with the okét ounce as the basic unit for weighing gold dust. The okét was probably current in gold trade transgressing the national boundaries of Ethiopa. It corresponds with the ounce in use in the gold trade in Western Africa and the Ivory coast (Johnson 1968, 549). The Ethiopian coin represents the official weight standard following the weight standard of the popular Maria-Theresien-Thaler emissions.

Based on Sandviks account and the metrological analysis of the weighing gear from Bani Shangul I suggest the following reckoning table (Tab. 3) as a basic taxonomic model. Metrological values of the weights and the okét standard are rendered both in numbers of ḥabbas and troy grains and according to the modern metric gram system. The table, a telltale of logic arithmetical relations between weight and numbers, reveals how the gold merchant organised his weighing set.[3]

As an analogy, the weighing set from Bani Shangul, provide several hints to understand the Viking Age situation. First of all, the coin is a key object as it provides a template or copy of a common weight standard. Standardised in weight it is a perfect calibration device. The weight of the coin corresponds to the number of 14 ḥabbas. Secondly, seeds are not only necessary in weighing procedures as the smallest building blocks, but employed as numerical devices they can materialise any weight unit through counting. Thus in a weighing situation between two trading partners, the weights employed in the

3 All the objects in the box have been weighed with an electronic scale from the Coin Cabinet at Vitenskapsmuseum in Trondheim. The three jequirity beans had fairly the same weight at *c.* 0.1 g (0.106, 0.103, 0.093), whereas the carob beans show a larger variation in weight (0.252, 0.232, 0.212, 0.170, 0.167). The piaster weighs 1.395 g, the glass bead 0.955 g and the round piece of porcelain 1.276 g.

bargain can be checked through both coin and seed calculation. Third, the basic unit, like the okét ounce is divided into subunits or fractions which are classified by the merchant through a nomenclature. This means that any weighed substance can be assigned a nominal value. For instance, 1 gisma is reckoned as ⅛ of a okét. This corresponds in the modern metric system to the weight of 3.9 g or to the number of 40 ḥabbas.

The reckoning table underlines the argument put forward in this paper that weights in weighing sets were calibrated with common and trustworthy coins in circulation. The beans or seeds are the second calibrating component as they constitute the smallest building blocks in the set. In order to ease weighing procedures the merchant could use also other objects like glass beads. The bead in the set constitutes a larger building block in the weighing set. It corresponds in weight roughly to the amount of 10 ḥabbas. Similarly the five carob beans although more irregular in weight correspond to the weight of 10 ḥabbas. Importantly, the weight of the lowest weight unit the grat must be determined first. From that point on any unit could be built up and checked through double-weighing.

Conclusions

Merchants in the Viking Age were knowledgeable about the concept of Islamic currencies and weight standards, not only in theory, but also methodologically. By methodologically I mean a knowledge on how coins and other objects, for instance seeds, constituted nominal building blocks in weight standards and units. Ethnographic sources from the early modern period in Africa evidence that weight standards were reckoned and calibrated through seeds, grains, fruits and coins of fairly standardised weight. Based on observations from an Ethiopian gold merchants weighing gear and its description it is argued that coins and seeds together were used as a means for calibration. Similar practices could also explain the spread and acceptance of weight standards such as the miṯqāl in the Viking Age networks.

The second argument put forward in this paper is that Viking Age merchants had a profound knowledge of Islamic coinages and their exchange and monetary value. Even though not all merchants could read Cufic script they were probably able to distinguish between dirhams of different emissions by recognizing their design, changes in style and the presence or absence of Cufic letters. Two such signs are presented and discussed in this paper. The quality mark "bakh" visible on oblate spheroid weights and annulets visible on the outer rim of the obverse of Umayyad and early ʿAbbāsid coinages.

Weighing and counting of coinage in an Islamic context are intimately related. In the changing monetary landscape after caliph al-Maʾmūn´s coin reform the weighing of coins became a necessity. This process started after 821 AD when the design of Islamic coinage changed. It accelerated during the second and third quarter of the 9th century when the fabric deteriorated with dirhams becoming increasingly badly struck. In this period also the mean weight of dirhams started to fluctuate and it was not possible to settle the nominal value of the coins through counting. Probably related to this is the fragmentation of coinages, which commences after 840. These monetary changes probably affected practices and induced a different attitude to coined silver in Islamic society. The use of hacksilver in the bullion weight economy of the Viking period, demonstrates that similar processes simultaneously developed outside the Caliphate.

Acknowledgements

My sincere thanks to Lorenz Rahmstorf for the invitation and for the opportunity to attend this well organised workshop. Thanks also to the staff from Vitenskapsmuseum in Trondheim for all their support in documenting the weighing equipment from Bani-Shangul, especially my colleague Jon-Anders Risvaag and Brit-Eli Tingstad. Ivar Leimus from the Coin cabinet in Tallinn has kindly provided me with pictures of dirhams from Estonian hoards. I would also like to express my gratitude to the colleagues who reviewed this text and whose comments improved several of my arguments and interpretations. Finally, thanks to Sam Nixon for inspiring discussions during our research stay in Tübingen 2018 on African gold trade and currencies. Especially for making me aware of Marion Johnson´s work, which has helped me a lot in writing this paper.

Abbreviations

AH	after hijrah (Islamic calendar)
CNS	Corpus Nummorum Saecolurum IX-XI qui in Suecia reperti sunt. Catalogue of coins from the 9th-11th centuries found in Sweden. Kungliga vitterhets-, historie- och antikvitetsakademien (Stockholm 1975).
tpq	*terminus post quem*

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