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7.

Weight Systems and Trade Networks in the Old World (2500-1000 BC)

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The presence of raw materials imported from the Indus Valley, Persian Gulf, Mesopotamia, Egypt and the eastern Mediterranean reflect the existence of commercial exchanges throughout the Bronze Age. In each of these regions independent weight systems were developed. Our study demonstrates that commercial relationships developed conversion systems that enabled the different weight systems to be equated with mutual confidence. This convertibility facilitated international trade and exchange.

Introduction

In the last three decades it has become increasingly clear that an abundance of imported artifacts, discovered from Egypt to the Indus Valley and from Central Asia to the Arabian Peninsula, attest to the existence of a lively international trade that was already in place by 2500 BC.

Settlement at Ugarit (Syria), the most important port of the eastern Mediterranean throughout the Late Bronze Age (Courtois 1990), or the shipwreck of Uluburun (Turkey), dated to around 1300 BC (Pulak 1997, 1998), demonstrate the coexistence, within the same city, and on a single ship, the co-occurrence of multiple weight systems. Whether it was within a city or on a ship, merchants were able to convert the standard weight system of the region they were visiting to that of other regions. Needless to say, the existence of conversion systems was particularly important to a ship such as the Uluburun, for it carried a rich load of merchandise to be sold in eastern Mediterranean ports, where a number of different weight systems prevailed.

Foreign trade and long-distance exchange permitted communities to obtain resources which they lacked from distance places, such as lapis lazuli from Afghanistan. Exotic and precious materials also played an important role in conferring status and prestige upon the community and/or the individual capable of commanding such resources.

Additionally, the presence of imports and exports integrated distant regions into commercial and social networks, further conveying prestige and status upon individuals and communities. Patterns of production, consumption and redistribution were transformed by the expanding networks of trade and gift exchange that characterized the Bronze Age Near East.

Weight systems

The principal function of a given weight system was to guarantee that the buyer and the seller exchanged a standard quantity of goods. The principal function of the conversion system, permitting one weight system to be converted into another, was to guarantee the mutual confidence of their equivalence between buyer and seller.

The need for conversion systems was of paramount importance in dealing with transactions involving precious metals, gold and silver, or aromatic essences of great value such as incense. In order to facilitate the conversion of the weight of an object, *i.e.*, an ingot, the object was “packaged,” that is produced to weigh a specific amount. The Uluburun ingots weighed about 1 Syrian talent, allowing for a ready conversion into other weight systems (see Chart 1).

A Sumerian text c. 1800 BC addresses the convertibility of different weight systems: “... they had given to us $5.5\frac{2}{3}$ minas of copper according to the standard of Dilmun. Its weight is in total 611 talents $6\frac{2}{3}$ minas according to the standard of Ur ...” (Roaf 1982: 137-38).

The Uluburun ship was transporting a rich inventory of merchandise, including 354 oxhide copper ingots, of which 317 were four-handled and 31 two-handled, each weighing c. 1 Syrian-Ugaritic talent equal to 28 kg 200 gr, 5 were pillow-shaped of ca. 10.75 kg and 1 was a small four-handled ingot (Pulak 1998: 193-94). The standardization of shape was complemented by that of weight, so that upon arrival in port one needed only to weigh one ingot of a given shape to note the similar weight of all others of that shape.

We know that rare resources such as lapis lazuli were reaching Mesopotamia, Egypt and the Aegean from the closest and indeed only known source, in Afghanistan (Hermann 1968). In Egypt lapis lazuli is present already in predynastic contexts c. 3200 BC (Davis 1983:25), while in Mesopotamia it is a relatively common item in the Uruk period c. 3500 BC (Moorey 1994), while its presence is noted in tomb A of Ayia Triada on Crete c. 2200 BC (Lambrou 1990:192). A Mesopotamian text of Gudea, c. 2130 BC, is explicit with regard to these imports: "Copper and tin, blocks of lapis lazuli, (...) bright carnelian from Meluhha [India]" (Rosen 1988:39). Laboratory analysis of lapis lazuli artifacts recovered from archaeological contexts confirms the fact that the lapis lazuli in the above regions was coming from the Sar-i-Sang mines, located in the Badakhshan region of Afghanistan (Delmas and Casanova 1990:502, 504; Casanova 1992:56).

To date a comprehensive study of the numerous weight systems within the Indus Valley, Egypt, the Near East, and the eastern Mediterranean, together with their conversion rates, has not been undertaken. The significant contributions of Parise (1981, 1986) and Zaccagnini (1986a, 1986b) have offered a foundation for this study.

Previous studies

Four trends exist within studies pertaining to the analysis of weight systems. The first has sought to demonstrate the interrelationship between most of the metrological systems (Lehmann-Haupt 1918) as well as their continuity into the weight systems of the modern era (Berriman 1953; McDonald 1992).

A second trend attempts to relate metrological norms that connect distant regions. An example of this approach connects the Dilmun weight of c. 1371 grs to its shared use in distant regions, *i.e.*, the Indus Valley, Persian Gulf and Mesopotamia. It should come as no great surprise that these three regions, connected by more or less regular commercial exchanges (Ratnagar 1981; Edens 1992), were all aware of and used a common, but not exclusive, weight system (Bibby 1970). A second example is provided by the Hyksos invasion of Egypt in the Second Intermediate Period (Dynasty XV c. 1640-1530 BC). The Hyksos introduced to Egypt from Syria/Palestine the Syrian shekel of c. 9.4 (8.8-10) grs. This became the standard weight of the XVIII Dynasty in Egypt (Weigall 1908:ix).

A third current is extremely conservative. It argues that an insufficient metrological data base prohibits one from formulating comparative weight systems and their equivalences. In spite of a relatively rich textual and archaeological data base, especially in Mesopotamia, this school believes that only with the recovery of more substantive evidence can one resolve the nature of comparative metrological systems (Weisbach 1907; Powell 1979, 1983, 1990).

Finally, a fourth trend, concerned with unraveling the nature of the economic systems that brought the Indus Valley, the Persian Gulf, Mesopotamia, Egypt and the eastern Mediterranean into contact throughout the third and later millennia, considers the fact that independent weight systems were developed in each of the above regions and efforts were made to allow for the conversion of these different standard weights in order to facilitate trade and exchange. The commercial relationships that tied these different regions together demanded the development of conversion systems (Liverani 1972, Parise 1981 and 1986, Roaf 1982; Archi and Klengel-Brandt 1984; Petruso 1992; Zaccagnini 1986a, 1986b and 1991; Courtois 1990; Cour-Marty 1990; Eran 1996). Within the context a model approach is offered by Parise (1981), who attempts to relate the Hittite, Ugarit and Karkemish weight systems.

A new view

Our proposal demonstrates the interrelationship and conversion of the different weight systems. For example, a Syrian-Ugaritic talent has 28.2 kg = 28.200 grs. This can be subdivided by 60 minas of 470 grs, $60 \times 470 \text{ grs} = 28.200 \text{ grs}$. At the same time, each mina can be subdivided to 50 shekels of 9.4 grs, $50 \times 9.4 \text{ grs} = 470 \text{ grs}$. Consequently, 3000 shekels of 9.4 grs formed a talent of 28.2 kg, $3000 \times 9.4 \text{ grs} = 28.200 \text{ grs}$ (see Chart 1).

This Ugaritic shekel (US) of 9.4 grs can be correlated with all the weight systems of the Near East and eastern Mediterranean. It is equal to the Egyptian *kdt* (EK) which also is 9.4 grs. At the same time it equals $\frac{3}{4}$ of the Egyptian gold *dbn* (ED) of 12.83 grs. Furthermore, four Ugaritic shekels ($4 \times 9.4 \text{ grs} = 37.6 \text{ grs}$) is roughly equivalent to three Egyptian gold *dbn* ($3 \times 12.83 \text{ grs} = 38.49 \text{ grs}$). We doubt that the weight measurements in the third or second millennium BC were accurate enough to detect an error of less than 1 gram in 38, or 2.6%.

These equivalences permitted one to make use of weights that were generally multiples of 2 and 5. For example, two weights with the value of 2 Ugaritic shekels, $18.8 \text{ grs} (9.4 \text{ grs} \times 2) + 18.8 \text{ grs} = 37.6 \text{ grs}$. In turn, one could equate the 37.6 Ugarit weight with weights having the value of 1 and 2 Egyptian gold *dbn*, $12.8 \text{ grs} + 25.6 \text{ grs} = 38.4 \text{ grs}$. Thus, $2 + 2$ Ugaritic shekels = $1 + 2$ Egyptian gold *dbn* = c. 38 grs.

Taking other examples, 9.4 grs of the Ugaritic shekel equals $\frac{4}{5}$ of the Hittite shekel (HS) of 11.75 grs. Therefore, $5 \times 9.4 \text{ grs} = 47 \text{ grs}$, at the same time $4 \times 11.75 \text{ grs} = 47 \text{ grs}$, thus allowing for the equivalences of a weight of 5 Ugaritic shekels to be the equivalent of two weights of 2 Hittite shekels, $5 \text{ Ugaritic shekels} = 2 + 2 \text{ Hittite shekels} = 47 \text{ grs}$.

The Ugaritic shekel equals 9.4 grs while the Mesopotamian shekel (MS) equals 8.55 grs. The difference between the two is 0.95 grs. (rounded off to 1 gram). Thus 10 Ugaritic shekels should equal 11 Mesopotamian shekels. A weight of 10 Ugaritic shekels ($10 \times 9.4 \text{ grs} = 94 \text{ grs}$) equals 11 Mesopotamian shekels ($11 \times 8.55 \text{ grs} = 94.05 \text{ grs}$). In commercial terms, a merchant would add 1 Mesopotamian shekel to a weight of 10 Mesopotamian shekels to equal a weight of 10 Ugaritic shekels, $10 \text{ US} = 10 + 1 \text{ MS} = 94 \text{ grams}$ (Chart 1).

Second, on Chart 2 we offer the continuous conversion of a fixed weight of 1370 grams of lapis lazuli and 4700 grams of tin. The hypothetical weights of these objects are chosen from our own weight system. The chart indicates how this weight could be readily converted into the nine different weight systems registered on the chart in a hypothetical route East-West. For example, 1370 grs. would be equal to 100 Dilmun "shekels" ($13.68 \text{ grs} - \text{Dilmun shekel} - \times 100 = 1368 \text{ grs}$), 160 Mesopotamian shekels ($8.55 \text{ grs} \times 160 = 1368 \text{ grs}$), 175 Eblaitic-Karkemish shekels ($7.83 \text{ grs} \times 175 = 1370 \text{ grs}$), etc.

Third, the port of Ugarit in North Syria was the principal commercial node in the eastern Mediterranean throughout the second half of the second millennium BC. At least five different weight systems coexisted in the city: Aegean, Hittite (Anatolia), Ugaritic (coastal Syria), Karkemish (inland Syria) and Mesopotamian. All these weight systems shared the predominance of weights measuring 1, 2, 5 and 10-shekel units. The use of these weights, in any manner of combination, allowed one to determine the weight of any object (Chart 3). The good correlations that we propose for the different weight systems, utilized in the different regions, are presented on Chart 4.

An analysis of the different weight systems that prevailed from the Indus Valley to Mesopotamia and Egypt suggests a very considerable complexity. Yet, we note that behind this complexity there exists a relative simplicity of structure that allows for the conversion of the different weight systems. Our investigation proves not only the fundamental structure of the rules of weight conversion but demonstrates that there was no confusion within the trade networks in dealing with comparable units of weight between far distant regions. As Adam Smith noted there is a propensity for man to “truck and barter,” but that propensity is greatly enhanced when merchants are able to speak a related language. Weight conversion was a paramount component of that language. From the third millennium BC it formed the foundation for the economic interrelationship that connected the regions from the eastern Mediterranean to Egypt, Mesopotamia and the Indus Valley (Lamberg-Karlovsky 1972 and 1985; Zaccagnini 1986a and 1986b; Sherratt and Sherratt 1991; Cline 1994; Mederos 1997 and 1999), and as Colin Renfrew (1992:vii) has noted, was “one of the most significant early developments of the human intellect.”

Writing and weights:

A cognitive transformation and/or a technology of control

Writing, as well as standard weights and measures, first appears in Mesopotamia, Egypt, and the Indus Valley in the context of the first cities. A half century ago V.G. Childe (1950), in his classic study, recognized writing and weights and measures as two of the ten attributes that he defined as hallmarks of the “urban revolution.” Their seminal role in the transformation of human society continues to play on center stage (Senner 1989).

Over a decade ago the psychologist Merlin Donald published his influential *Origin of the Modern Mind* (1991). In this work the author offers an overview of the human behavioral and cognitive evolution. His emphasis upon the cognitive phases of evolution interests us here. Specifically, the transition to the last stage of cognitive development; what he terms the emergence of “theoretic culture.” This stage is characterized by the invention of systems of “external symbolic storage” by which is meant the development of a store of knowledge located outside of the human brain. In this regard the appearance of written texts, as well as the invention of standard weights and measures, is believed to

attest to the emergence of “theoretic culture.” The emergence of “external symbolic storage” systems “changed cognitive architecture completely” (Donald 1991:306).

An entirely new memory structure was needed for reading and writing, including highly specialized skills, such as scanning and analyzing the written image. There was a rapid increase in the number of logograms, alphabetic items, words and graphic images in use; these had to be encoded in biological memory. One requirement for successful use of the ESS (external symbolic storage) is a *map* of its contents. Thus, biological memory must contain information about the structure and access routes of the ESS, as well as its retrieval codes. These skills are necessary, above and beyond the decoding skills needed to understand ESS entries, in order to find the appropriate information when needed. A significant percentage of the knowledge contained in the literate brain falls into this category; this is particularly true of scholars and administrators, whose familiarity with “field” or the “levers of power” usually translates into the possession of a good cognitive map of the ESS entries relevant to some highly specific pursuit...” (Donald 1991:320-21).

Alexander Marshack (1972) was among the first to discuss the importance of cognitive evolution in his treatment of the first decorated and “notational” objects recovered from the Paleolithic period of tens of thousands of years ago. Twenty years ago Colin Renfrew (1982:17) asked whether one could examine the operation of the mind from archaeological evidence. He offered an affirmative answer and one of his examples was in the unraveling of the Indus weight system (0.836 grs) multiplied by integers such as 1, 4 or 8 up to 64 then 320 and 1,600. The development of a unit of measure is taken as an important step in the procedure of mapping the world—a cognitive mapping. More recently Jacques Cauvin (2000) and David Lewis-Williams (2002) attempted to probe the cognitive structures of the mind evident in the first farming communities and of those that produced some of the earliest rock art. Donald (1991) considers the transformations of our cognitive abilities within a long evolutionary perspective, taking us from the Paleolithic to the computer age. The appearance of written texts, as well as weights and measures, attest to the emergence of what he terms “theoretic culture.” Donald (1991:340) states, “Until writing could be combined with other visual symbolic media, the *theoretic attitude*, that is, the deliberate analytic use of symbolic thought, had little chance to develop” (emphasis in original). The most important attribute in the emergence of the theoretic stage is the invention of “external

symbolic storage" systems, *i.e.*, writing and symbols of meaning, as with weights and measures. Thus, a weight bears no relationship to what is weighed and a number has no perceptual relationship to what is represented. Within an evolutionary context the increasing recognition that goods (property) could be, or were allowed to be, systematically exchanged led to an increasing significance of commodity and value. This, in turn, demanded units of measure and a permanence of memory, namely, the development of writing. Donald's second evolutionary cognitive transformation, the emergence of a "theoretic culture," privileges the development of writing as a powerful tool for "external symbolic storage."

Donald argues that writing played a major role in transforming the cognitive processes of the mind by introducing new systems of symbolic storage. If, however, one looks upon the function and nature of the earliest writing, as well as standard weights and measures, one finds them to be new and powerful technologies of social control. Thus, the transforming of cognitive processes in conjunction with a new technology of social control were co-evolutionary processes that transformed both brain and culture.

Writing, whether in ancient Egypt, Mesopotamia, China or the New World, is frequently portrayed as allowing for the collective management and distribution of staple products, controlling the organization of labor and crafts, glorifying the deeds and genealogy of the rulers, and eventually permitting for the codification of law, taxes, interest rates, etc. Within an evolutionary perspective writing is seen as an event-like invention, a powerful tool controlled by the elite in processes leading to the centralization of power. It is self-evident that bureaucratic control does not necessarily serve the interests of the community; it is as likely to serve specific segments of society in their quest for economic privileges. In like manner standardized weights and measurements serve not only to facilitate trade but to control that trade. Thus, toward the end of the third millennium a well-known archaeological artifact is the duck-weight with inscription. The inscription attests to the validity of the weight as authorized by the state. Typically, archaeologists working in the Near East relate writing, cylinder seals, and the standardization of weights and measures as tools of administrative bureaucracy that came into being in the Uruk Period (c. 3500 BC) in the contexts of the first states. A transforming cognitive world within a context of a technology of invented writing should come as no surprise.

With the invention of a writing technology comes an unprecedented rate of cultural change and technological innovation. The co-evolution of writing, monumental architecture, rapid urbanization, standard weights and measurements, the expansion of the crafts, extensive long-distance trade, and an evermore elaborate bureaucracy cannot be a coincidence. All of the above features appear in concert and although occurring in different places at different times, they appear in each instance rather rapidly, whether it be in China, Egypt, Mesopotamia, or Mesoamerica. One can see in this synergistic process the evolution of cultural complexity, a complexity that Robert McC. Adams (2000:101) correctly perceives as “essentially technological,” a movement toward greater centralization and integration. If writing allowed for the beginnings of a system of “external symbolic storage” permitting for a permanence of memory through the written word, it also permitted for a communications revolution through the emergence of an administrative bureaucracy. Cognitive transformation and technologies of social control went hand-in-hand, bringing about a new social and mental map of the world.

Standard Weight Systems	Mass	Talents	Minas	Shekels	Equivalences	Weights
Syrian talent	•	28.200				
mina	kgs.	470×60				
Hittite shekel (HS)	grs. grs.	11.75	×40	×2400	$\frac{5}{4}$ of 9.4 $\frac{3}{2}$ of 7.83 $\frac{12}{7}$ of 6.84 $\frac{9}{5}$ of 6.58	(HS) 2+2=5 (US-EK) (HS) 2=2+1 (EKS) (HS) 5+2=10+2 (IS) (HS) 5=5+2+2 (AS)
Ugaritic shekel (US)	grs.	9.4	×50	×3000	$\frac{7}{10}$ of 13.68 $\frac{3}{4}$ of 12.83 $\frac{4}{5}$ of 11.75 $\frac{11}{10}$ of 8.55 $\frac{6}{5}$ of 7.83 $\frac{11}{8}$ of 6.84 $\frac{10}{7}$ of 6.58	(US) 10=5+2 (DS) (US) 2+2=2+1 (ED) (US) 5=2+2 (HS) (US) 10=10+1 (MS) (US) 5=5+1 (EKS) (US) 5+2=10 (IS) (US) 5+2=10 (AS)
Egyptian kdt (Dynasty XVIII...) (EK)	grs.	9.4		×3000	$\frac{7}{10}$ of 13.68 $\frac{3}{4}$ of 12.83 $\frac{4}{5}$ of 11.75 $\frac{11}{10}$ of 8.55 $\frac{6}{5}$ of 7.83 $\frac{10}{7}$ of 6.58	(EK) 10=5+2 (DS) (EK) 2+2=2+1 (ED) (EK) 5=2+2 (HS) (EK) 10=10+1 (MS) (EK) 5=5+1 (EKS) (EK) 5+2=10 (IS)
Eblaite-Karkemish shekel (EKS)	grs.	7.83	×60	×3600	$\frac{4}{7}$ of 13.68 $\frac{8}{13}$ of 12.83 $\frac{2}{3}$ of 11.75 $\frac{5}{6}$ of 9.4 $\frac{12}{13}$ of 8.55 $\frac{8}{7}$ of 6.84	(EKS) 5+2=2+2 (DS) (EKS) 10+2+1=5+2+1 (ED) (EKS) 2+1=2 (HS) (EKS) 5+1=5 (US-EK) (EKS) 10+2+1=10+2 (MS) (EKS) 5+2=5+2+1 (IS)
Mesopotamian talent	kgs.	30.800				
Mesopotamian mina		513×60				
Mesopotamian shekel (MS)	grs.	8.55	×60	×3600	$\frac{5}{8}(\frac{10}{16})$ of 13.68 $\frac{3}{2}$ of 12.83 $\frac{10}{11}$ of 9.4 $\frac{13}{12}$ of 7.83 $\frac{5}{4}$ of 6.84 $\frac{13}{10}$ of 6.58	(MS) 10+5+1=10 (DS) (MS) 2=2+1 (ED) (MS) 10+1=10 (US-EK) (MS) 10+2=10+2+1 (EKS) (MS) 2+2=5 (IS) (MS) 10=10+2+1 (AS)
gold Egyptian dbn (Dynasty VI-XVII) (ED)	grs.	12.8(3)		×2400	$\frac{15}{16}$ of 13.68 $\frac{4}{3}$ of 9.4 $\frac{2}{3}$ of 8.55 $\frac{13}{8}$ of 7.83 $\frac{2}{1}(\frac{15}{8})$ of 6.84 $\frac{2}{1}$ of 6.58	(ED) 10+5+1=10+5 (DS) (ED) 2+1=2+2 (US-EK) (ED) 2+1=2 (MS) (ED) 5+2+1=10+2+1 (EKS) (ED) 1=2(5+2+1)=(10+5) (IS) (ED) 1=2 (AS)
Dilmun mina		1368		×22.5		
Dilmun shekel (DS)	grs.	13.68		×2250	$\frac{16}{15}$ of 12.83	(DS) 10+5=10+5+1 (ED)
Indus "shekel" (IS)	grs. grs.	6.84		×4500	$\frac{10}{7}$ of 9.4 $\frac{8}{5}(\frac{16}{10})$ of 8.55 $\frac{7}{4}$ of 7.83 $\frac{2}{1}$ of 6.84 $\frac{2}{1}(\frac{25}{12})$ of 6.58	(DS) 5+2=5+5 (US-EK) (DS) 10=10+5+1 (MS) (DS) 2+2=5+2 (EKS) (DS) 1=2 (IS) (DS) 10+2=10+10+5 (AS)
Ashdodite talent		23.700				
Ashdodite mina	kgs.	474×50				
Ashdodite shekel (AsS)	grs. grs.	7.9(7.83)	×60	×3000	$\frac{4}{7}$ of 13.68 $\frac{8}{13}$ of 12.83 $\frac{4}{1}(\frac{12}{3})$ of 11.75 $\frac{5}{6}$ of 9.4 $\frac{12}{13}$ of 8.55 $\frac{6}{5}$ of 6.58	(AsS) 5+2=2+2 (DS) (AsS) 10+2+1=5+2+1 (ED) (AsS) 2+1=10+2 (HS) (AsS) 5+1=5 (US-EK) (AsS) 10+2+1=10+2 (MS) (AsS) 5=5+1 (AS)
Aegean talent		31.600				
Aegean mina	kgs.	480×65.8				
Aegean "shekel" (AS)	grs. grs.	65.8 6.58	×72	×4800	$\frac{1}{2}(\frac{12}{25})$ of 13.68 $\frac{1}{2}$ of 12.83 $\frac{5}{6}$ of 11.75 $\frac{7}{10}$ of 9.4 $\frac{10}{13}$ of 8.55 $\frac{5}{6}$ of 7.9 $\frac{1}{1}(\frac{25}{26})$ of 6.84	(AS) 10+10+5=10+2 (DS) (AS) 2=1 (ED) (AS) 5+2+2=5 (SH) (AS) 10=5+2 (US-EK) (AS) 10+2+1=10 (MS) (AS) 5+1=5 (EKS) (AS) 10+10+5+1=10+10+5 (IS)

Chart 1: Weights systems between the third and first millennia BC.

SOURCE AFGHANISTAN	RAW MATERIAL example 1	SOURCE AFGHANISTAN	RAW MATERIAL example 2
ROUTE EAST-WEST	LAPISLAZULI 'INGOT' 1370 grs.	ROUTE EAST-WEST	TIN INGOT 4700 grs or 4.7 kg.
Dilmun-Indus "shekel" INDUS-GULF	100 "shekels"	Dilmun-Indus "shekel"	344 "shekels" 3.5 minas
Mesopotamian shekel MESOPOTAMIA	160 shekels 100+50+10	Mesopotamian shekel	550 shekels
Eblaite-Karkemish shekel SYRIA	175 shekels 100+50+20+5	Eblaite-Karkemish shekel	600 shekels 10 minas
Ugaritic shekel SYRIA	145 shekels 100+20+20+5	Ugaritic shekel	500 shekels 10 minas
Hittite shekel ANATOLIA	117 shekels 100+10+5+1+1	Hittite shekel	400 shekels 10 minas
Ashdodite shekel PALESTINE	175 shekels 100+50+20+5	Ashdodite shekel	600 shekels 10 minas
gold Egyptian dbn EGYPT	107 dbn 100+5+1+1	gold Egyptian dbn	366 dbn
Egyptian kdt EGYPT	145 kdt 100+20+20+5	Egyptian kdt	500 shekels 5 sep
Aegean "shekel" CRETE-GREECE	208 "shekels" 100+100+5+2+1	Aegean "shekel"	71 "shekels" 4.5 M*

Chart 2: Two examples of the continuous conversion of a fixed weight: 1370 grams of lapis lazuli, weight in grams according to the current standard, with the different prevalent weight systems between the third and the first millennia BC in a east-west route, from the mines in Afghanistan.

ARTIFACTS USED AS WEIGHTS IN THE DIFFERENT WEIGHT SYSTEMS					
Value in shekels	Mesopotamia n	Ugaritic	Karkemish	Hittite	Aegean
1		39	2	8	
2	3	47	3	—	
5	5	29	2	—	
10	7	46	4	—	2
20	15	25	2	—	
50	13	10		3	
100	8	7			
200	7	3			
1000	4	5			

Chart 3: Correlation of archaeological artifacts used as weights with their value in shekels to the different weight systems of the Near East and the Aegean at the port of Ugarit (Syria) during the second half of the second millennium BC, where is observed the coexistence of at least 5 weight systems in the city, and the predominance in all of them of weights of 1, 2, 5, 10 and 20 shekels, which facilitate the transactions (Courtois 1990: 120-122).

Source	Hittite	Ugarit	Kdt Egypt	Ebla	Akkad Babylonia	Dbn Egypt	Dilmun Indus	Ashdod	Aegean
Mederos- Karlovsky, 01	11.75	9.4	9.4	7.83	8.55	12.83	13.68	7.83	65.8
Archi 87	11.75		9.4	7.8-7.83					
Bibby 70							1371.5-1376.8		
Cour-Marty 90			8.8-9.8		7.9-8.8	12-13		7.52	
Courtois 90	112-118	9-9.9		7.83	8-8.5				61.25-64
Eran 96					8.18-8.41	13.65	13.65		
Heltzer 96	11.75		9.1-9.4	7.8-7.9	8.0			7.52	
Hemmy 35					8.22		13.62		
Hendrickx- Baudot 72							13.69		
Liverani 72	11.75	9.4		7.83					
Parise 81	11.75	9.4		7.83					
Parise 86	11.75	9.4		7.83				7.83	65.27
Parise 91	11.75	9.4	9.4	7.83	8.42			7.83	65.27
Petruso 92									61
Powell 79					8.13-8.6		1370		
Powell 90					8.33			7.8-7.9	
Roaf 82			9.7				1350		
Segre 28					8.37	1277-1417			65
Weigall 08			8.8-10			13-14.2			
Zaccagnini 86			9.4	7.9	8.42		1350	7.9	6.5-6.8
Zaccagnini 91	11.75	9.4		7.83	8.5				6.5-6.8

Table 4: Current proposals about the weight systems in grams between the third and the first millennia BC.

BIBLIOGRAPHY

- Archi, A. and Klengel-Brandt, E. (1984), "I pesi provenienti da Zincirli," *Studi Micenei ed Egeo Anatolici* 24:245-61.
- Berriman, Algernon Edward (1953), *Historical Metrology. A New Analysis of the Archaeological and the Historical Evidence Relating to Weights and Measures* (London: J.M. Dent & Sons).
- Bibby, T. G. (1970), "...Efter Dilmun Norm," *P. V. Glob På 60 Årsdagen. Kuml* 1970:345-53.
- Casanova, Michèle (1992), "The Sources of the Lapis-lazuli Found in Iran," in C. Jarrige, J.P. Gerry and R.H. Meadow (eds.), *10th South Asian Archaeology 1989 (Guimet, Paris, 1989)* (Monographs in World Archaeology, 14; Madison: Prehistoric Press):49-56.
- Cauvin, Jacques (2000), *The Birth of the Gods* (Cambridge: Cambridge University Press).
- Childe, V. Gordon (1950), "The Urban Revolution," *Town Planning Review* 21:3-17.
- Cline, E.H. (1994), *Sailing the Wine-Dark Sea. International Trade and the Late Bronze Age Aegean* (British Archaeological Reports, International Series, 591; Oxford: Tempus Reparatum).
- Cour-Marty, M.A. (1990), "Les poids égyptiens, de précieux jalons archéologiques," *Sociétés urbaines en Egypte et au Sudan. Cahier de Recherches de l'Institut de Papyrologie et d'Égyptologie de Lille* 12:17-55.
- Courtois, J. C. (1990), "Poids, prix, taxes et salaires, à Ougarit (Syrie) au IIe millénaire," in R. Gyselen (ed.), *Prix, salaires, poids et mesures. Res Orientales* 2:119-27.
- Davis, W. (1983), "Cemetery T at Nagada," *Mitteilungen des Deutschen Archäologischen Instituts, Abteilung Kairo* 39:17-28.
- Delmas, A.B. and M. Casanova (1990), "The Lapis Lazuli Sources in the Ancient East," in M. Taddei and P. Callieri (eds.), *9th South Asian Archaeology 1987 (Venice, 1987)* (Serie Orientale, Roma, 66 (1); Rome: Istituto Italiano per il Medio ed Estremo Oriente):493-505.
- Donald, Merlin (1991), *Origins of the Modern Mind: Three Stages in the Evolution of Culture and Cognition*. (Cambridge: Harvard University Press).
- Edens, C. (1992), "Dynamics of Trade in the Ancient Mesopotamian 'World System'," *American Anthropologist* 94 (1):118-39.

- Eran, A. (1996), "Weights and Weighing in the City of David: The Early Weights from the Bronze Age to the Persian Period," in D.T. Ariel and A. de Groot (eds.), *Excavations at the City of David 1978-1985. IV*, (Qedem 35; Jerusalem: The Hebrew University of Jerusalem): 204-56.
- Heltzer, Michael (1996), "The 'Unification' of Weight and Measure Systems in Foreign Trade in the Eastern Mediterranean (1500-700 BCE)," *Michmanim* 9: 31-38.
- Hemmy, A.S. (1935), "The Statistical Treatment of Ancient Weights," *Ancient Egypt and the East* 1935 (1): 83-93.
- Hendrickx-Baudot, M.P. (1972), "The Weights of the Harappa-Culture," *Orientalia Lovaniensia Periodica* 3: 5-34.
- Hermann, G. (1968), "'Lapis lazuli'. The Early Phases of Its Trade," *Iraq* 30 (1): 21-57.
- Lamberg-Karlovsky, C.C. (1972), "Trade Mechanisms in Indus-Mesopotamian Interrelations," *JAOS* 92: 222-29.
- (1985), "The Longue Durée of the Ancient Near East," in J.L. Huot, M. Yon and Y. Calvet (eds.), *De l'Indus aux Balkans, Recueil Jean Deshayes*, (Éditions Recherche sur les civilisations; Paris): 55-72.
- Lambrou-Phillipson, C. (1987), *Hellenorientalia: The Near Eastern Presence in the Bronze Age Aegean ca. 3000-1100 B.C. plus Orientalia: a Catalogue of Egyptian, Mesopotamian, Mitannian, Syro-Palestinian, Cypriot and Asia Minor Objects from the Bronze Age Aegean*, (Studies in Mediterranean Archaeology, Pocket Books; Göteborg: Paul Åströms Förlag).
- Lehmann-Haupt, Carl Friedrich (1918), "Gewichte," in G. Wissowa and W. Kroll (eds.), *Paulys Real-Encyclopädie der Classischen Altertumswissenschaft. Supplementband 3* (Stuttgart: J.B. Metzlerscher Verlag): 587-654.
- Lewis-Williams, David (2001), *The Mind in the Cave*. (London: Thames and Hudson).
- Liverani, Mario (1972), "Il Talento di Ashdod," *OrAn* 11 (3): 193-199.
- Marshack, Alexander (1973), *The Roots of Civilization: The Cognitive Beginnings of Man's First Art, Symbol, and Notation*. (New York: McGraw-Hill).
- Mederos Martín, A. (1997), "Cambio de rumbo. Interacción comercial entre el Bronce Final Atlántico ibérico y el micénico en el Mediterráneo Central (1425-1050 A.C.)," *Trabajos de Prehistoria* 54 (2): 113-34.
- (1998), "Ex Occidente Lux. El comercio micénico en el Mediterráneo Central y Occidental (1625-1100 AC)," *Complutum* 10: 229-66.

- and Lamberg-Karlovsky, C.C. (2001): "Converting Currencies in the Old World. Simple Arithmetic Underpinned Trading throughout the Near East during the Bronze Age," *Nature* 411 (6836):437 + 2 tables in <http://www.nature.com>.
- Moorey, P.R.S. (1994), *Ancient Mesopotamian Materials and Industries* (Oxford: Clarendon Press).
- Parise, Nicola F. (1981), "Mina di Ugarit, mina di Karkemish, mina di Khatti," *Dialoghi di Archeologia* N.S. 3:155-59.
- (1986), "Unità ponderali Egee," in M. Marazzi, S. Tusa and L. Vagnetti (eds.), *Traffici Micenei nel Mediterraneo. Problemi storici e documentazione archeologica* (Palermo, 1984) (Taranto: Istituto per la Storia e l'Archeologia della Magna Grecia):303-14.
- (1993), "Unità ponderali e circolazione metallica nell'Oriente mediterraneo," in T. Hackens *et alii* (eds.), *A Survey of Numismatic Research 1985-1990*, I (International Association of Professional Numismatics 12; Brussels):28-34.
- Petruso, Karl M. (1992), *Ayia Irini: The Balance Weights. An Analysis of Weight Measurement in Prehistoric Crete and the Cycladic Islands*, in J.L. Caskey (ed.) (Keos VIII; Mainz: Philipp von Zabern).
- Powell, Marvin A. (1979), "Ancient Mesopotamian Weight Metrology: Methods, Problems and Perspectives," in M.A. Powell and R.H. Sack (eds.), *Studies in Honour of T.B. Jones* (AOAT 203):71-201.
- (1983), "The Standard of Dilmun," in D.T. Potts (ed.), *Dilmun. New Studies in the Archaeology and Early History of Bahrain* (Berlin: Dietrich Reimer Verlag):141-42.
- (1990), "Maße und Gewichte," in D.O. Edzard (ed.), *Reallexikon der Assyriologie und Vorderasiatischen Archäologie*, 7, (Berlin—New York: Walter de Gruyter):457-517.
- Pulak, C. (1997), "The Uluburun Shipwreck," in S. Swiny, R.L. Hohlfelder and H. Wylde Swiny (eds.), *Res Maritimae. Cyprus and the Eastern Mediterranean from Prehistory to Late Antiquity* (Nicosia, 1994), (American School of Oriental Research, Archaeological Report 4; Atlanta: Scholars Press):233-62.
- (1998), "Uluburun shipwreck: an overview," *The International Journal of Nautical Archaeology* 27 (3):188-224.
- Ratnagar, Shereen (1981), *Encounters. The Westerly Trade of the Harappan Civilization* (New Delhi: Oxford University Press).
- Renfrew, Colin (1992), "Foreword," in C.J. Scarre (ed.), *The Origins of Metrology* (Cambridge: McDonald Institute for Archaeological Research, University of Cambridge):vii-viii.

- Roaf, Michael (1982), "Weights on the Dilmun Standard," *Iraq* 44: 137-41.
- Rosen, L. von (1988), *Lapis lazuli in Geological Context and in Ancient Written Sources*, (Studies in Mediterranean Archaeology and Literature, Pocket-book 65; Partille: Paul Åströms Förlag).
- Scarre, Christopher J. (1992), "Accuracy of Extant Sumerian Weights," in C. J. Scarre (ed.), *The Origins of Metrology. Collected Papers of Dr. Daniel McLean McDonald* (Cambridge: McDonald Institute for Archaeological Research, University of Cambridge): 41-47.
- Segrè, Angelo (1928), *Metrologia e circolazione monetaria degli antichi*, (Bologna: Nicola Zanichelli).
- Sherratt, A. and S. Sherratt (1992), "From Luxuries to Commodities: The Nature of Mediterranean Bronze Age Trading Systems," in N.H. Gale (ed.), *Bronze Age Trade in the Mediterranean*, (Studies in Mediterranean Archaeology 90; Jonsered): 351-86.
- Weigall, Arthur E. P. (1908), *Weights and Balances. Catalogue Général des Antiquités Égyptiennes du Musée du Caire, n° 31.271-31.670* (Le Caire: Institut Français d'Archéologie Orientale).
- Weissbach, Franz Heinrich (1907), "Über die babylonischen, assyrischen und altpersischen Gewichte," *Zeitschrift der Deutschen Morgenländischen Gesellschaft* 61 (2): 379-402 and 61 (4): 948-50.
- Zaccagnini, Carlo (1986a), "Aspects of Copper Trade in the Eastern Mediterranean during the Late Bronze Age," in M. Marazzi, S. Tusa and L. Vagnetti (eds.), *Traffici Micenei nel Mediterraneo. Problemi storici e documentazione archeologica (Palermo, 1984)* (Taranto: Istituto per la Storia e l'Archeologia della Magna Grecia): 413-24.
- (1986b), "The Dilmun Standard and Its Relationship with Indus and Near Eastern Weight Systems," *Iraq* 48: 19-23.
- (1991), "'Nuragic' Sardinia: Metrological Notes." *II Congresso Internazionale di Studi Fenici e Punici* (Roma, 1987), I (Roma: Consiglio Nazionale delle Ricerche): 343-47.