

## *Balance history*

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# **A BRIEF HISTORY OF THE BALANCE IN SOCIETY**

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## **Abstract**

One of the earliest measuring instruments used by human beings was the balance; evidence of this dates back more than 5.000 years. Initially, the weights of goods were measures rather of value than of mass. Besides yardsticks and graduated cups, scales are today the most widespread instruments, found in almost all laboratories, factories and households. Indeed, the balance accompanies us from birth to death.

The balance very early achieved a metaphorical meaning and was used for the comparison of ethical values. It first appeared as an instrument in the death tribunal in Egyptian religion and later in Christianity. In the hands of the Grecian Gods, weighing was a deciding factor as concerns victory or death. In Judaism and for the Romans, scales become the symbol of justice. Several trade and handicraft guilds currently use the balance as an attribute, demonstrating in this way their sincerity and accuracy. The balance is of dubious significance in astrology, as one of the signs of the zodiac.

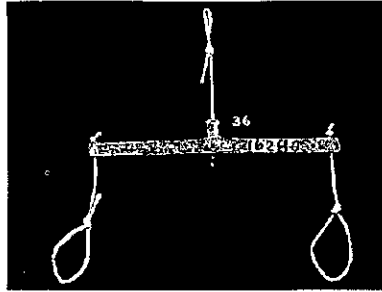
**Keywords:** balance, history of techniques, scales, social history, weighing

## **Introduction**

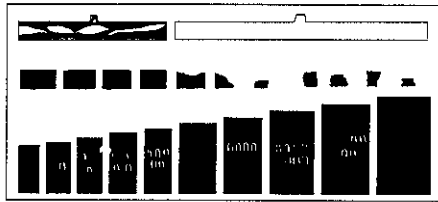
The vacuum balance is a rather young instrument: its history goes back 140 years for the vacuum macrobalance [1] and 80 years for the vacuum microbalance [2]. In contrast, the balance itself is a very old instrument, with 5.000-year-old findings [3].

## **History of balance**

Figure 1 shows the oldest balance beam known, found in Upper Egypt, made of limestone and only 6 cm long. Figure 2 depicts a mural painting from an Egyptian tomb, with a set of weights and two balance beams [4]. It is an early demon-



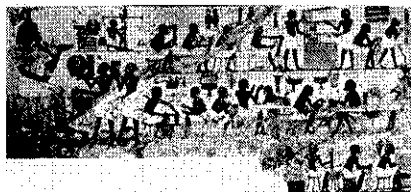
**Fig. 1** Oldest balance beam known, probably pre-dynastic, found in Upper Egypt. 6 cm long, limestone. Petrie Collection, London



**Fig. 2** Mural painting of a wooden box containing two wooden balance beams 20.3 and 34.3 cm long. A set of weights, rectangular blocks of black stone, is marked in an ascending series up to 100 units. Assuming that this stone is basalt, we obtain the Egyptian national standard of the Quedet=144 Grains=9.3 g. Tomb of Hesy, Saqqarah, 3rd Dynasty, 2650 B.C.

stration of standardization work. Disregarding some primitive tools such as yardstick and calibrated beakers, we can say that the balance was the earliest measuring instrument [5, 6]. Today, scales are the most widely used instruments, found in almost all laboratories [7], factories and households.

Old Egyptian pictures demonstrate the use of the balance for weighing tributes and tax duties. Precious metals were weighed in order to control the goldsmith [8] (Fig. 3). In metallurgical workshops, the constituents of alloys were weighed. However, in market scenes from the Old Empire, no balance can be detected, because commerce in those times primarily involved barter, without the use of measures [9]. Initially, by means of weighing, not the mass was deter-

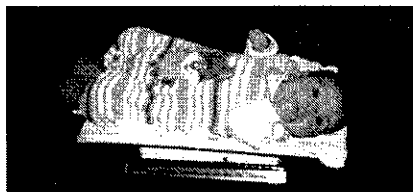


**Fig. 3** Egyptian workshop with jewellers and joiners. At the upper left, gold is weighed. Tomb Neb-Amun and Ipuki, Schech abd el Gurna No. 181, 1500 B.C.



**Fig. 4** Goddess Juno Moneta (or Aequitas) on the reverse of an aureus of the Roman emperor Titus Aurelius Fulvius, surnamed Pius. About A.D. 148. Collection of Dr. H. Koch, Bad Godesberg

mined, but the value of the weighed goods. The double meaning has survived up to the present in the unit pound for both mass and money, and in the annual balance of accounts. The Romans had a special goddess who supervised the public mint: Juno Moneta. She (or Aequitas [10]) is often depicted on coins (Fig. 4).

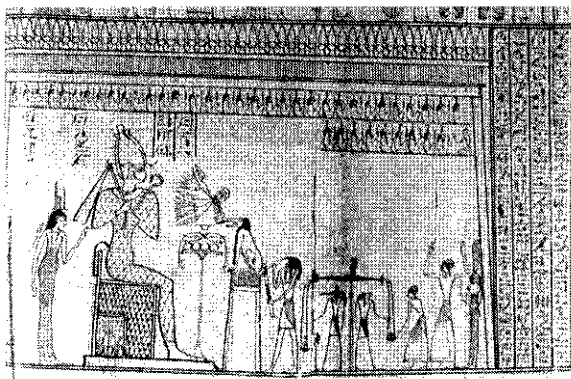


**Fig. 5** Jonas, 6 weeks old

The balance was the most sensitive instrument until its position was taken over by spectroscopic methods. The relative resolution [11]=discrimination threshold relating to the maximum capacity of the Egyptian balance in the New Kingdom reached down to  $10^{-4}$ . This value was maintained for thousands of years. Not until the 19th century were balances improved to a relative resolution of down to  $10^{-9}$ , and a balance of the Bureau International des Poids et Mesures has now reached  $5 \cdot 10^{-11}$ .

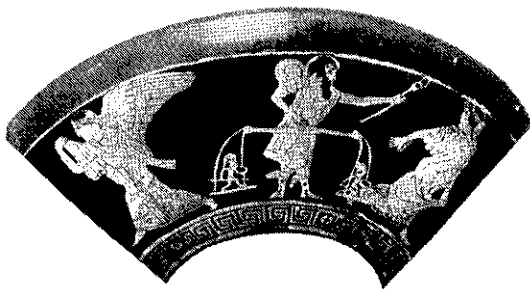
The balance accompanies us from birth (Fig. 5) through the weightiest highlights of our life (Fig. 11) to death, the Last Judgement and eternity [12, 13] (Figs 6 and 8). The oldest reports suggest that scales were used for weighing anything other than masses and forces. As an instrument in a death tribunal, we find the balance in several oriental religions in Persia, India and Tibet, but its origins seem to lie in Egypt. With the beginning of the New Empire in 1551 B.C., the idea arose that not only the Pharaoh, but all human beings could enter eternity.

The dead were mummified and buried in the western desert, as close as possible to tombs of highly-placed officials, and provided with a Book of the Dead, something like scribes, which could help them to come off victorious in the dangers of a voyage on the underground Nile and at its end to pass an examination. Then, in front of the throne of Osiris, their hearts were weighed against an ostrich feather as the symbol of Maat, the goddess of truth (Fig. 6). If the dead person's life was in balance with the moral laws, the balance did not tilt.



**Fig. 6** Egyptian Death tribunal. From left to right: Isis, Nephtis, Osiris, Guzzler, Thot, Maat on the balance pan, Anubis, Thot as an ape sitting on top of the stand, Horus, the heart of the deceased on the balance pan, the deceased (2 x) and Maat

An air of mystery clung about the balance, for in early times nobody understood its physical background until Archimedes (285–212 B.C.) developed the theory of levers [14]. As regards Fig. 6, we notice that several gods were occupied in one particular weighing. Anubis and Hours operate the scales, and the ape, as an attribute of science, controls the indicator. Thot records the result. We may conclude, therefore, that in those times the gods had difficulties with the balance similar to those we humble experimenters have today. Perhaps on account of a curse of the Pharaohs, we still have to muddle with its development and its application; the theory is not yet perfect and we do not understand gravity.



**Fig. 7** Greek fate balance, with Zeus weighing Hector against Achilles, and Moira

In many old writings, we find warnings against false weighing and faked weights. Correct weighing may be the origin of the idea to choose the balance as the attribute of justice. This symbol was found mainly in the Roman cultural complex, probably taken over from the Judaic-oriental world of thought. The idea of the weighing of words and deeds can be found repeatedly in the Old Testament. One well-known example is the 'tekel', which was interpreted by Daniel as 'you have been weighed in the balance and found wanting' [15].

The superstitious meaning of the symbol may have its origin in ancient Greece as the balance of fate. Zeus lets Moira decide the fate of Achilles and Hector by weighing the two heroes (Fig. 7). The one whose balance pan sinks is doomed to die. Homer reports that, to get the corpse of Hector, he was weighed against gold.

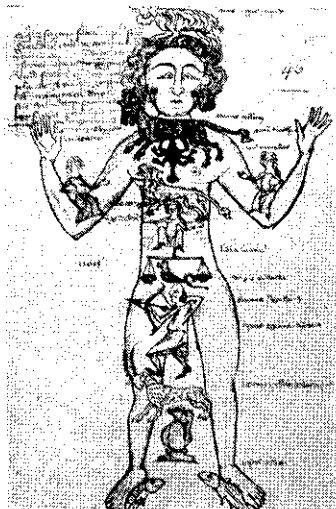
In the New Testament, the balance is mentioned merely in Revelations [16], in connection with the announcement of imminent inflation. Only at the beginning of the 4th century, when Christianity became a state-supporting religion, did the balance regain symbolic significance. We find it as the attribute of St. Anthony of Florence and of the archangel Michael. In the 12th century, representations of Michael as the weigher of souls suddenly appeared in almost all parts of the occident (Fig. 8). He was charged with this business in addition to his task of guiding souls to the throne of God. While the devils put millstones and even themselves on the scales as a counterweight, Mary occasionally assisted in a manner setting a poor example to laboratory assistants: She falsified the result by drawing down the scale of the Poor Soul by means of holy water or a chaplet of beads.

Caricaturing the idea of balancing good and bad, at some places of pilgrimage the sinner or a sick person was weighed against money, precious metals, candle-wax, or natural products which had to be consecrated to obtain absolution or health. In the times of witch-hunting, the Dutch community of Oudewater had a



Fig. 8 St. Michael weighing a deceased sinner. The devil tries to pull down the scales

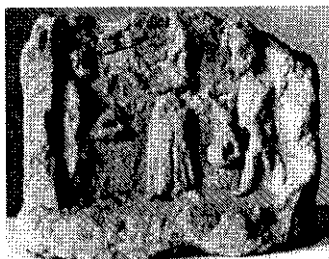
profitable idea: They used the public balance to weigh suspicious women coming from the neighbouring Germany and certified their mass after the payment of a fee. Since a witch does not have a normal weight, this weighing proof of innocence. To exclude fraud, the weighed person had to undress in public.



**Fig. 9** Zodiac-man

The balance is very familiar as a sign of the zodiac (Fig. 9) and the balance is reigned over by Venus. Although the origin of this meaning remains obscure, we all estimate the balanced character of a person born under the sign of Libra.

We often find scales depicted and sometimes used for strange purposes (Fig. 10). In trade and commerce, the sign of the balance is often utilized as a guarantee of confidence. Several trade and handicraft guilds use the balance as an attribute, in this way demonstrating sincerity and accuracy. With this aim, pharmacists even depict Jesus operating the balance.



**Fig. 10** Roman sculpture of a woman which compares the penises of two men by weighing.  
Landesmuseum Trier

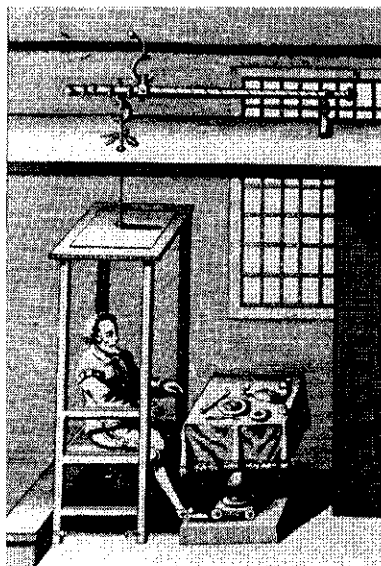


Fig. 11 Weight-watcher

Today, mass is a topic of daily discussion, for many of us have too much of it. As you can see, this is not a new problem (Fig. 11). Indeed, it is usually not the mass, but the volume that distresses us. There is a story, the author of which has unfortunately been forgotten, in which a man made a pact with the devil and asked for his weight to be diminished. The devil granted this, but did not reduce his volume, and the man was not very happy. Moreover, the devil reduced the mass to such a degree that, in consequence of buoyancy, the man rose to the ceiling. He needed his second wish to ask for soles made of lead.

All these examples, from very different fields, demonstrate that 'weighing' is a fundamental feature of human thinking [17]. Human freedom exists only in that we can weigh our actions in advance; after they have been put into effect,



Fig. 12 Stein depicting a man weighing a beer-barrel vs. some beer-mugs

they are weighed by others against the existing moral code. We always balance effort and worry against satisfaction, joy or money as the fruits of our work. Finally, Fig. 12 has some reference to our sponsor Okocim: Na zdrowie!

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