

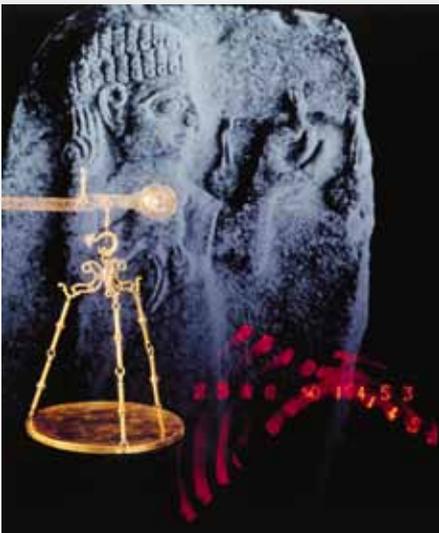
History of scales – Part 1

... Scales and weighing in the course of time ...

By Wolfgang Euler,

Engineer, adviser and consultant for international statutory measuring and calibration systems and scales technology

Weights and measurements are something self-evident for us, because everything at Bizerba revolves around this topic. But when were weighing scales actually invented? Why do we have this measuring device at all? These are only a few of many questions which we will answer in a 4-5 part series on the history of scales.



The origin of weighing scales

How unimaginably vast is time and space. Our earth is at least three and a half billion years old. A grain of dust in the universe circling around the sun, along with the other planets of our solar system. And this sun in turn is only one of about fifty billion fixed stars which fill the Milky Way system.

The beginnings of life likewise lie billions of years in the past. However only two million years ago the so-called „primates“ formed, creatures who walked upright. „Homo sapiens“, the first human beings, still had to develop from them.

The human being is the feeblest and most helpless of all creatures as a newborn infant, with scarcely any physical abilities. But behind the low and bulging brow glows the divine spark of the mind, in his slumbering soul shines the presentiment of a higher mission. And thus the future lord of the earth begins along a path which, with sacrifice and struggle, leads to the enlightened gate of culture and onward to the bright path of history.

The Neanderthals traveled over the world for many millennia. They were hunters and gatherers and lived, as one might say, „from hand to mouth“.

Approximately 10,000 years ago, at some time and somewhere, the first peasants then formed in the early dawn of human history. At other places a band of wandering nomads settled along the shores of a lake and devoted themselves to fishing. And with the changed mode of living, they also created the first successful tools.

Step by step they conquered the plant kingdom, cultivated the first field crops and planted cereals such as barley and einkorn wheat. The origins of the first agricultural cultivations presumably go back to former Mesopotamia.

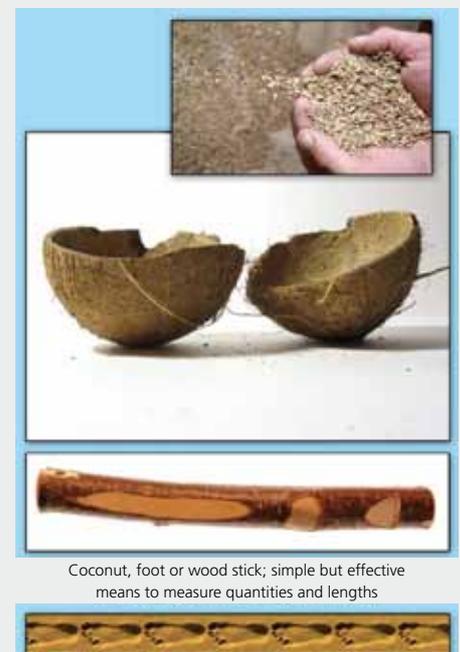
The humans who had led an existence as hunting and gathering nomads until then eventually became sedentary. And with this significant

jump in development, mankind began to measure for the first time, because people needed to determine the quantity of types of grains and figure out the size of lands, property, and surfaces.

The first measuring implements

Hollow and simple linear rulers are probably the oldest measuring instruments of mankind. Weighing scales, as suspected, come immediately thereafter. Containers of similar size were initially employed for determining quantity, for example a hollowed-out coconut. And a wood stick or forearm helped to determine lengths, distances, surfaces, and goods. This simple but effective method only presupposes that two or more individuals accept the measure. And the ensuing measurements were nevertheless so beneficial that we in part know and employ them to this very day.

- **Bushels:** German measure of capacity for bulk solid bodies (e.g. cereals) used until 1872
- **Yard:** as measure of length
- **Foot:** common in the Anglo-American region then as now
- **Litre:** today our most common measure of capacity



Coconut, foot or wood stick; simple but effective means to measure quantities and lengths

History of scales – Part 1

... Scales and weighing in the course of time ...

„The human is the measure of all things“ – this figure of speech applies also to the development of scales. With arms outstretched to the side, the human torso forms the scales beam and the accompanying weighing pans with his hollowed hands. The barter transactions of original peoples were probably concluded in this way to compare weights.

The origin of the scales – symbol for equality, truth and justice – extends back to the oldest ancient cultures. In the Neolithic period (10,000 B.C.), the first mechanization and cultivation of human life begins. Stone weights (around 7000 B.C) were found in Egypt – historical testimony which speaks for the fact that scales must have existed in this ancient culture.



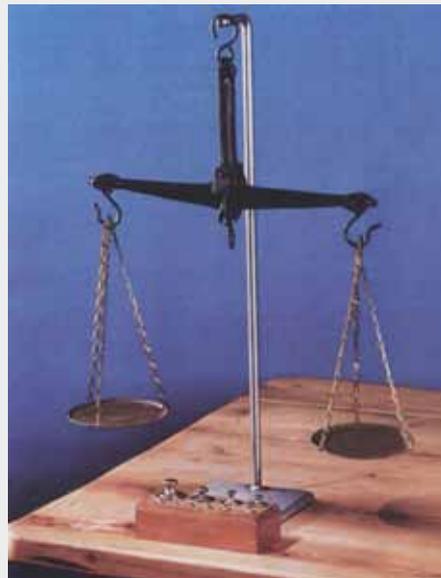
Carrier



Yoke employed by coolies

Around the world today, primarily in Asia, the yoke employed by coolies or the bearing yoke to carry water, milk, cheese, or similar loads employed in many countries soon gave primitive peoples the idea of balancing two loads. The pivoting point of the beam soon migrated from the human shoulder to a stone or wooden column, and for smaller scale beams to a middle bearing eye, and in later times to a middle cutting edge. The

basic form of the equal-armed beam balance was thus invented, probably in different places around the same time. Where precisely scales were developed in ancient times can still not be determined to this day.



Equal-armed beam balance

The oldest conserved equal-armed beam balance was found in a prehistoric tomb in Egypt and is dated at the time around 5,000 B.C. Its scale beam consists of reddish limestone and is pierced in the centre and at both ends, and is furnished with strings which guaranteed free play and great sensitivity. Origins of measuring devices are to be sought especially in lands of the Babylonians between the Euphrates and Tigris (today Iraq) as well as in the valley of the Egyptian Nile. The first known measurement and weight system, which was trend-setting for the metrological* development in antiquity, was located in the ancient Babylonian city of Ur northwest of Basra (Iraq) around 2600 B.C.

* Metrology is the study of weights and measures.

Both Bible and Koran insist on balance. Examples of quotations indicating the importance of scales and units of measure:

Bible, Old Testament:

- Leviticus 19, 35
Do not use dishonest standards when measuring length, weight or quantity.
- Leviticus 19, 36
Use honest scales and honest weights, an honest ephah and an honest hin.

Koran:

- Verse 86, 7th Sure:
Therefore keep measures and weights fair and honest / and do not reduce the property of the people / and do not damage the land once it has healed.

In the next part of this series, we will undertake a „time travel with the equal-armed beam balance through the millennia up to the present“.

About the author of the article:

Mr. Wolfgang Euler is an engineer, adviser and consultant for international statutory measuring and calibration as well as for scales technology, and was the former chairman for automatic scales in the European metrology association CECIP and Group Legal Metrology Manager for Chronos in Hennef. He worked 48 years for this company world-wide in the fields of design, service, training, & legal metrology. Mr. Wolfgang Euler has been in close contact with the technical development of Bizerba GmbH & Co. KG for over 10 years and has kindly declared himself willing to write this series for our Bizerba News. ■

History of the scale – Part 2

... Scales and weighing through the ages ...

By Wolfgang Euler,

Engineer, adviser and consultant for international statutory measuring and calibration systems and scales technology

Part 1 described the origins of the equal armed beam scale that has accompanied mankind for many thousands of years. The first part ended with the announcement: "A time journey through the ages with the equal armed beam scale". This time, we will report about this unique and major world invention in much greater detail.

The Roman steelyard with sliding weight and the equal sided beam scale. Around 500 BC

The Roman steelyard with its sliding weight is a further development of the *equal armed beam scale*. It has been established that the sliding weight beam scale had its origins in Egypt at about 1400 BC. For the ancient Romans, this scale was an important basis for their trade empire. This is how sliding weight scales gradually became known as the "Roman scale" over the course of time. The various terms used here all refer to the same scale type.

Sliding weight scales consist of a beam with a scale and two unequal lever arms. On one arm there is a balance weight and on the other a hook to suspend the item to be weighed. Many sliding weight scales even had two hooks for hanging the load. This provided two weighing ranges. The distance between the lever arms can be changed by moving the sliding weight until the suspended object comes into balance. The sliding weights normally had geometric shapes or were reproductions of commodities such as fruit, animals or human busts.

The invention of the Roman sliding weight scale of course had an immense significance in trade since it offered enormous advantages over the equal armed scale. It is much quicker and easier to weigh using a sliding weight that is several times lighter than the load depending on the relative distance between the lever arms. The same operation is much more difficult using an equal armed scale with its many weight units. But it must be clearly pointed out that the steelyard can only be used if no high demands are placed on accuracy. In fact, the Roman steelyard can be very imprecise when determining weight.

Remains of this scale or its rests have been found in all countries conquered by Rome. The scale still renders good service today. The Roman steelyard scale is still the main scale used in Mediterranean countries.

Market, mass and weight in the Middle Ages

Mass and weight have been linked to the right to hold markets from time immemorial, as quoted by Pippins (744): "... that all towns shall apply, maintain in proper order and keep statutory markets and mass units." In the cultural history of mankind, a market provides the opportunity to exchange goods in large settlements and towns. The market privileges bestowed upon local rulers normally went hand in hand with the right to mint coins, the right to levy customs duties and the right to organise public markets. These privileges also included the standardisation of mass units and weights for supervising the market. Without this, a public market would not be possible.

Remark: Weights and weighing still determine the flow of money and goods today to a great extent. Without scales it would also be impossible to maintain a properly functioning economy.

History of the scale – Part 2

... Scales and weighing through the ages ...

The platform scale and the equal armed beam scale. From 1669

Platform scales belong to the group of mechanical scales and function on the principle of the *equal armed beam scale*. They are normally made for weighing ranges up to 10 kg. During the weighing operation, the platform scale compares the mass of a known object, e.g. a commercial weight (standard weight) with that of goods weighed. The weight of the goods weighed matches that of the commercial weight when *equilibrium* is attained. On a platform scale, this is recognisable when the two tongues in the middle are aligned along the same line.

The platform scale was invented in 1669.



The platform scale works on the principle of the equal armed beam scale.

The analogue signal and the equal sided beam scale

Before I deal with the invention of the binary number system, I would like to again explain the term **"analogue"**. In the meantime, this term has become lost on most people, and I can confirm this every time I meet people at seminars. It is not easy to come about a simple explanation. I hope that the explanations below are easy for reader to follow.

Analogue (Greek): proportionate, ratio, account. Freely translated, analogue means something like "similar."

A signal is referred to as **analogue** when its parameters bearing the information, e.g. momentary value, can assume continuously any *variable* value between a minimum and a maximum. This relates to almost all real processes or states.

**"In Fate's balance as it sways,
Seldom is the cock at rest;
Thou must either mount, or fall,
Thou must either rule and win,
Or submissively give in,
Triumph, or else yield to clamour:
Be the anvil or the hammer."**

Johann Wolfgang von Goethe, *28.08.1749, † 22.03.1832



History of the scale – Part 2 ... Scales and weighing through the ages ...

Examples of analogue conditions:

The tacho generator voltage proportional to the rotational speed or the speed of a dynamo on a bicycle (low speed = less light, high speed = bright light) is an analogue function. An office door is open slightly, open slightly more, half open or fully open (but it is either open or closed = digital). The voltage of an SG* load cell proportion to force is also an analogue signal.

Equal armed beam scales operate on the analogue principle: a proportionally greater or smaller pointer deflection results from a rising or falling weight load.



Continuous-value and continuous-time.
The binary number system and the equal armed beam scale. From 1697. By and with Gottfried Wilhelm Leibniz (1646–1716)

* SG strain gauge.



Gottfried Wilhelm Leibniz deduced the method of calculating with the two digits 0 and 1 by dividing the weights on the **analogue equal armed beam scale**. As a result, he developed the binary number system that is still in use today and that is indispensable for the computer industry. He wrote about this far-reaching discovery in his New Year's letter to Duke Rudolf August in Wolfenbüttel in 1697.

8	4	2	1			Our usual numbering system today based on 10
2 ³	2 ²	2 ¹	2 ⁰			Calculating with the two figures 0 and 1
				Binary	Decimal	
0	0	0	1	= 1	= 1	Example 1
1	0	0	0	= 8	= 8	Bizerba a new star in the scale heavens
0	4	2	0	= 4 + 2	= 6	
0	4	2	0	= 4 + 2	= 6	
0	0	0	1	= 1	= 1	Example 2
1	0	0	0	= 8	= 8	Chronos scale, the first trade-approved automatic scale in the world
1	0	0	0	= 8	= 8	
0	0	1	1	= 2 + 1	= 3	
0	1	0	0	= 4	= 4	Example 3
0	1	1	1	= 7	= 7	only for advanced explanation
0	0	1	1	= 2 + 1	= 3	

Examples of converting binary to decimal figures: 1866



1866 "Bizerba" a new star in the scale heavens
Andreas Bizer in Balingen (Photo: Bizerba Archive)
The Bizerba company name today originates from the names Bizer and Balingen.

Outlook: In Part 3 of ... Scales and weighing through the ages ... we will first turn our attention again to Gottfried Wilhelm Leibniz and the binary number system. 1764 is the next milestone in the history of the scale. For this we go to the Swabian Alb, to Philipp Matthäus Hahn in Albstadt-Onstmettingen. He is regarded as the founder of all scale technology and manufacture in the entire region of the Zollernalb. In addition, it is thanks to his work that a new and major star rose in the scale heavens with Bizerba in 1866. ■

History of the scale – Part 3

... Scales and weighing through the ages ...

Wolfgang Euler, Ing. Consultant for international statutory measurement and verification and for weighing technology,

Heinz Weisser, Chairman of the Bizerba Group Works Council,

Rudi Keinath, Head of the Philipp Matthäus Hahn Museum, Onstmettingen

In Part 2 we will also be looking at how the centre beam balance works on the analogue principle as well. A greater or lesser weight in the scales results in a proportionally larger or smaller movement of the pointer.



Gottfried Wilhelm Leibniz
* 01.07.1646 / † 14.11.1716

From the centre beam balance known for thousands of years and Gottfried Wilhelm Leibniz to the latest digital technology.

Gottfried Wilhelm Leibniz (* 01.07.1646 Leipzig, † 14.11.1716 Hanover) deduced a system of calculation that uses just two numbers, 0 and 1, from the division of weights on the analogue, centre beam balance. A brilliant idea for the human race, or perhaps not? But how did Gottfried Wilhelm Leibniz, living in Wolfenbüttel near Brunswick, discover the binary system with just 0 and 1 that is still in widespread use today and forms the foundation of computer technology?

Let's take a closer look at the centre beam balance without any weights on it: the pointer is clearly pointing to 0. If any weight is placed in the scale of a centre beam balance, the pointer shows "just one position", and that is then the number 1. If the weight is removed from the scale, the pointer returns to the position 0. It is an incredible achievement that Gottfried Wilhelm Leibniz was able to work this out from looking at the centre beam balance. As far as I'm concerned there is no doubt that he really changed the world with his discovery and that this is the greatest invention of the modern era. Today, not only computers, scales and satellite navigation systems work using the binary system, but also almost anything and everything that has to do with data. And of course all the current weighing scales and data systems at Bizerba.



Grave in Neustadt Church, Hanover

Leibniz died out of favour in Hanover on 14 November 1716 at the age of 70 - his funeral was only attended by his secretary. He was buried in the court and town church of St Johannis in the Neustadt district.

It may be that a similar fate befell other important and less important researchers and mechanics from the Swabian mountains, because their outstanding work remained largely unknown to the people in their home region and the surrounding areas. But that will all be revealed by my future research. Assistance and support are being kindly provided by Heinz Weisser from Bizerba and



History of the scale – Part 3 ... Scales and weighing through the ages ...

Philipp Matthäus Hahn and the pendulum scales

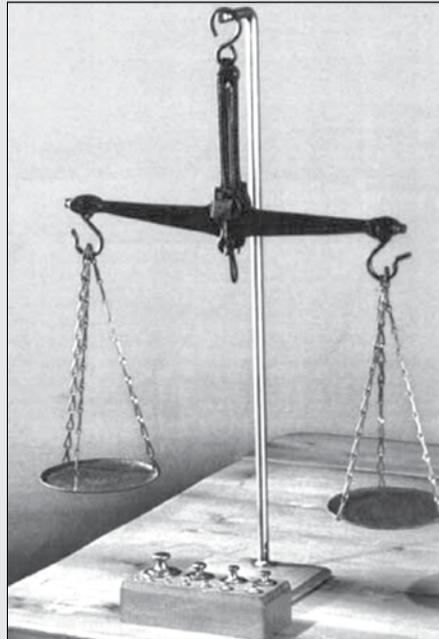
Philipp Matthäus Hahn came to Onstmettingen for the first time in 1756. There he became friends with Philipp-Gottfried Schaudt, who was the same age.

Both were exceptionally curious about the natural sciences and enthusiastic about technology.

The brilliant leadership of Philipp Matthäus Hahn together with the active assistance provided by Schaudt and the Sauter brothers resulted in clocks, calculating machines and pendulum scales. But on this occasion we would like to take a closer look at the first pendulum scales designed and built as a simple household scale by the team mentioned above.

So how did the development work begin on these pendulum scales, which are so different from the centre beam balance in terms of their physical properties? The centre beam balance (Fig. above) shows the result of the measurement when the beam is horizontal and the pointer is vertical. This type of scales therefore has one single point of equilibrium. The off-centre pendulum scales by contrast (Fig. below) reach a new equilibrium each time depending on the weight that is placed on it. The pendulum scales therefore have an infinite number of points of equilibrium. In other words: "In contrast to the centre beam balance the pendulum scales measure mass not by means of compensation with another mass, but via the deflection, which can be read off on a scale. The pendulum scales therefore calculates the result itself, automatically."

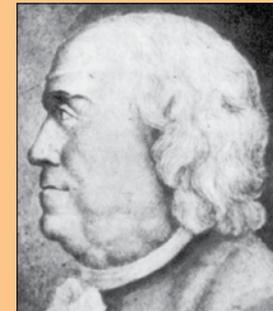
This principle of Hahn's pendulum scales was used 161 years later in the first German pendulum scales with sliding reference weights, which was manufactured by Bizerba in 1924 in Balingen/Zollernalbkreis.



Centre-beam balance



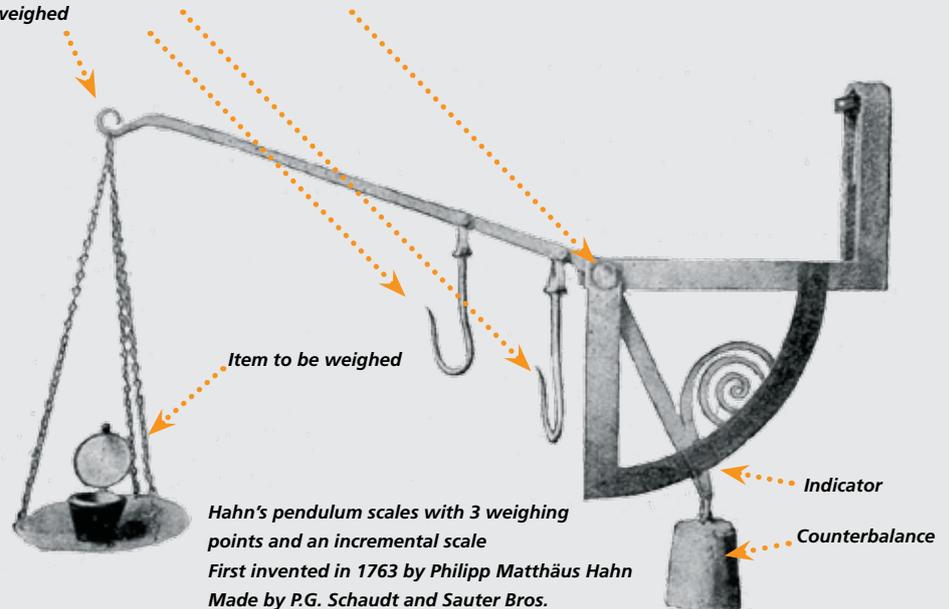
P. M. Hahn (25 November 1739 in Scharnhausen; † 2 May 1790 in Echterdingen) was a German parson and engineer.*



*Philipp-Gottfried Schaudt, German schoolmaster and mechanic, * 11 October 1739 in Onstmettingen, † 21 June 1809 ibid. Schaudt was the congenial assistant of Philipp Matthäus Hahn and in the whole of his life never left his birthplace in the Swabian mountains. Without him, Hahn would on his own admission never have been able to put the devices and inventions he designed into practice.*

Three different points to hang the item to be weighed

The beam is angled at the fulcrum



*Hahn's pendulum scales with 3 weighing points and an incremental scale
First invented in 1763 by Philipp Matthäus Hahn
Made by P.G. Schaudt and Sauter Bros.*

History of the scale – Part 3 ... Scales and weighing through the ages ...

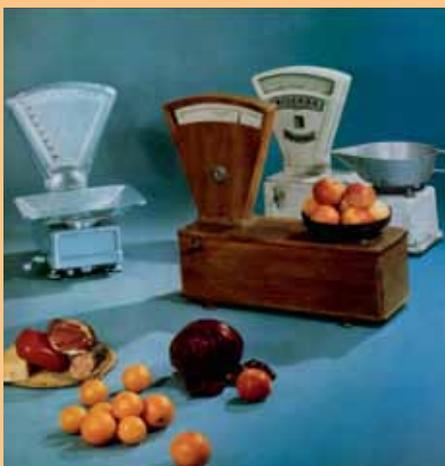
Bizerba, a major new star in the weighing firmament ... The pioneers of the early years and the great expansion!

In 1866 Bizerba became involved in the ongoing history of weighing scale development. This was the year that Andreas Bizer established a workshop in Ebingen to manufacture and repair scales. In 1868 he moved the workshop to Balingen. In this section we would like to talk about the main milestones on the way from this simple engineering workshop for scales to the modern, high-tech company of today, the star in the weighing firmament.

After setting up his company Andreas Bizer concentrated mainly on producing counter scales of the Roberval Balance type. During this period he gained considerable experience of non-self-indicating scales. These are scales which require the operator to manipulate weights or poises during the weighing process. In 1871 Andreas Bizer was appointed a master calibrator in conjunction with the introduction of the metric system of weights and measures.

The roll-out of the first off-centre beam counter scales in Germany

The picture shows the historic development of the first off-centre beam balances, which were produced successfully for many years. In 1924 the prototype of the off-centre beam balance with variable reference weights was built with a wooden casing. In the same year these Bizerba

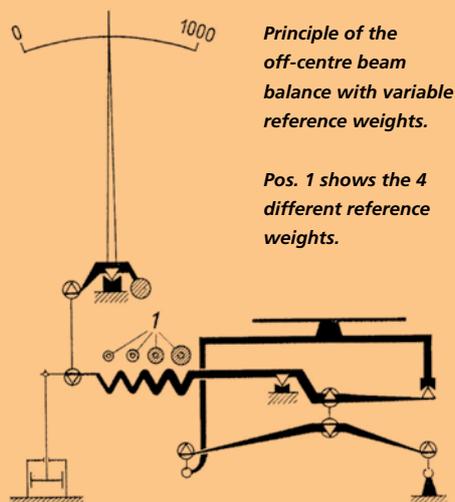


The first family of Bizerba off-centre beam balances.

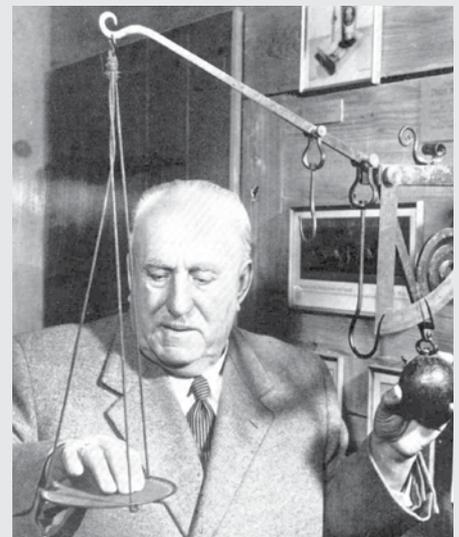
Of course Andreas Bizer was aware of the invention of the pendulum scales by Philipp Matthäus Hahn in 1763. This was the start of a period of rapid expansion which took the company from being a small scale-maker to the brightest new star in the weighing firmament. The pendulum scales were the cornerstone and the catalyst for Bizerba's unique success story.

The middle photograph shows the later Professor Wilhelm Kraut with the original of Hahn's pendulum balance scales, the principle of which was incorporated into the world famous pendulum scales first produced by Bizerba in 1924.

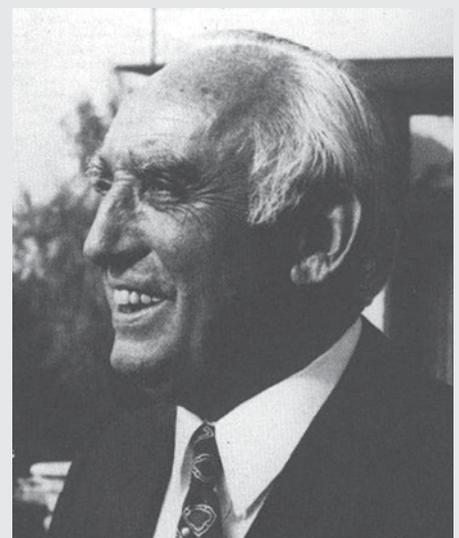
scales were given component-type approval for verification for the first time in Germany. The scales at the back is an early mass-production model. On the left is the highly successful model of the off-centre beam balance with sliding poise developed in 1954. By 1928 Bizerba had become the largest manufacturer of weighing scales in Germany.



Andreas Bizer
Bizer Balingen became Bizerba
*** 2 Sept 1839 † 7 Dec 1914**



Prof. Wilhelm Kraut sen.
Son-in-law of Andreas Bizer
*** 9 May 1875 † 26. Sept 1957**



Wilhelm Kraut jun.
Honorary senator of University Tübingen
*** 17 March 1906 † 13 July 1992**

History of the scale – Part 3 ... Scales and weighing through the ages ...

From the pendulum scale with variable weights to the optical price-indicating scales, Bizerba's flagship model.

The later versions of the pendulum scales with variable poise weights enabled the operator to read the weight and the corresponding price from a chart.



Pendulum scales with variable weights and price-indicating scale

This process required the operator to read the weight and price data very carefully, as the chart consisted of a large number of figures and combinations.

The designers at Bizerba therefore set about developing scales with an optical price indicator, which were brought to market in 1952. The great advantage of these counter scales was that they showed the price and the weight directly beneath one another. It became much faster and easier for the operator to determine the correct price.

*Weight display
Price display*



Double-pendulum scales with optical price (OP)

display (direct)

optional entry of basic price per kilogram.



OP scales in operation

This marks the end of the first chapter in the history of Bizerba, the new star in the weighing firmament. Bizerba's success story continues with the development of electronic weighing scales. But to keep things in the right order we will first take a look at the Chronos scales from Hennef a. d. Sieg dating from 1883, the first automatic weighing scales in the world.



It is to Prof. Wilhelm Kraut and his passion for collecting that the town of Balingen owes the genesis of the Museum for Scales and Weights in the Zollern castle. In 1943 he made his entire private collection available to the museum. The collection has since been extended considerably.

With a view of the Zollern castle in Balingen and the Museum for Scales and Weights we would like to conclude with the words of the Spanish cultural philosopher Jose Ortega y Gasset.

“Progress does not consist of destroying the past, but of preserving its essence, which had the power to create a better today.”

To which we could add: “The future has a past!” This is particularly important because scales regulate and control flows of money and goods as they did thousands of years ago. They must therefore be kept permanently up to date with the latest technology. Without scales it would not be possible to organise an orderly economy, even in our computer-driven age. Scales are also a guarantee of consumer protection everywhere in the world. And ultimately we are all consumers.

In this spirit we wish the new managing shareholder Mr Andreas W. Kraut and the entire workforce of Bizerba good health, good fortune and success in the future. After weighing all the options, may their decisions always be the right ones!

History of weighing – Part 4

... The evolution of weights, scales and weighing ...

Wolfgang Euler, Ing., Berater und Consultant für Internationales gesetzliches Mess- und Eichwesen und für Waagentechnologie,
Heinz Weisser, Vorsitzender Gesamtbetriebsrat Bizerba,
Rudi Keinath, Leiter Philipp-Matthäus-Hahn-Museum, Onstmettingen

Not only the Bizerba scales was a new star in the weighing firmament at that time, but also the Chronos scales, which originated 400km north of Balingen in Hennef an der Sieg (Cologne/Bonn). In Part 3 of the History of Weighing, Heinz Weisser, who has been my fellow author since the last issue, and I reported on the Bizerba company from Balingen, Zollernalbkreis. The firm ascended into the sky over the Swabian Alps like a shining star. What neither of us recognised when we were researching the last article was that weighing history was being written at almost the same time in Balingen as in Hennef a.d. Sieg.

Just looking at the year 1886 in which Bizerba was founded it is apparent that both before this date and afterwards intensive research and development work was taking place in Hennef a.d. Sieg to prepare for manufacturing the first automatic weighing scales.

The real trailblazers were Carl Reuther and Eduard Reisert.

Eduard Reisert attended professional training schools in Aschaffenburg and Würzburg. In 1866 he then found employment as a young engineer in Augsburg. From there Eduard Reisert moved on to Cologne. In 1876 he founded the company Munnem & Reisert with the manufacturer Munnem from Cologne.

Eduard Reisert was fascinated by the idea of using the forces of nature to do work for mankind, so he applied the gravity that pulled on the item to be weighed as a source of power to fill and empty a weighing container shaped like a drum. The groundbreaking idea of an automatic flow measurement device for loose and bulk goods was born.

In 1877 Eduard Reisert manufactured a measurement device similar to a weighing scales known as No. 66 under the name of Munnem & Reisert in Cologne.



Eduard Reisert,
* 16.02.1847 in Alzenau/ Lower Franconia
† 20.01.1914 in Cologne



Carl Reuther,
* 17.02.1834 in Hennef
† 09.02.1902 *ibid*

However, it was still a long way from the bulk flow measurement device to the approval and calibration of an automatic mechanical weighing scales. Around this time Eduard Reisert met the innovative, dynamic entrepreneur Carl Reuther.

Carl Reuther had run a mechanics workshop from 1859–1869 and later founded a factory in Hennef. There he build a variety of agricultural machines, and also the familiar decimal weighing scales, but not in an automatic version. The products he offered for sale were of a very high quality, which soon secured his commercial success.

History of weighing – Part 4 ... The evolution of weights, scales and weighing ...

But where did Carl Reuther acquire the knowledge he would have needed?

After qualifying as a metalworker in Bonn, Carl Reuther travelled as a journeyman through Germany, Belgium and France. In particular during his time working in Liège in Belgium he gained a vast amount of professional know-how. At that time mechanical engineering was in its heyday in Liège and so for the mechanic and engineer from Hennef there was a great deal to learn. Carl Reuther was also particularly skilled and knowledgeable in mathematics and physics.



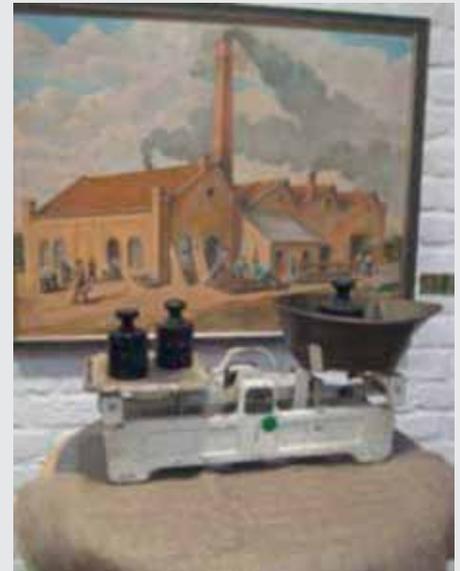
Company nameplate

Carl Reuther's knowledge of weighing scales and Eduard Reisert's know-how relating to the forces of gravity acting on bulk goods led them to establish the machine factory C. Reuther & Reisert on 1.7.1881 in Hennef, the predecessor of the Chronos factory. This was the birthplace and the continuation of the brilliant evolution of automatic weighing scales.

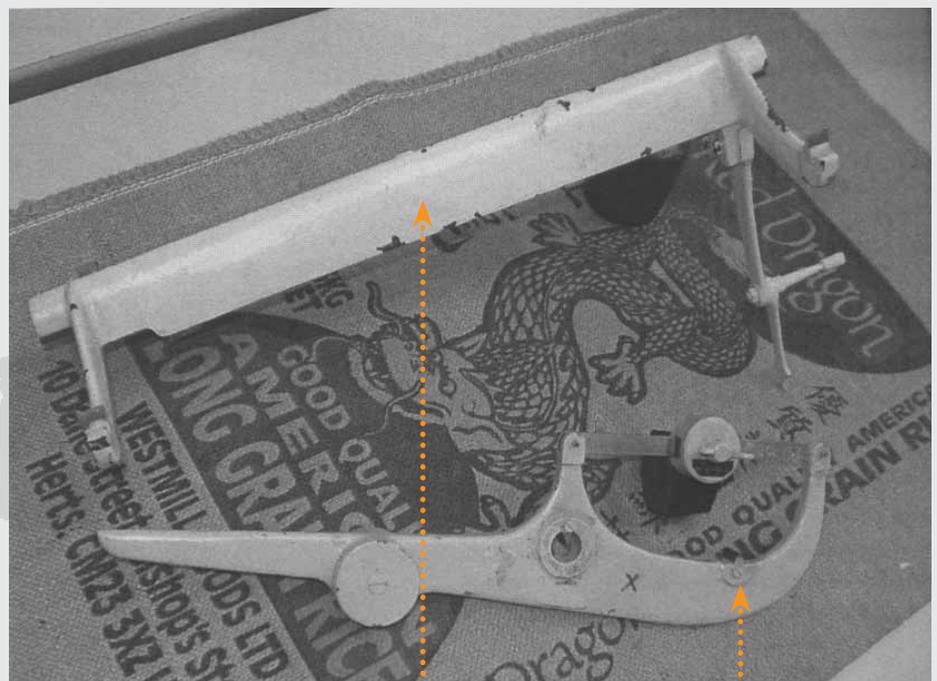


Former company logo
Centre beam balance

Exactly 128 years ago Carl Reuther and Eduard Reisert invented the **Chronos scales, the first calibratable automatic weighing scales in the world**. This pioneering act put an end to a 10,000 year-old tradition of weighing by hand. The era of automatic weighing had begun. Approved for calibration as a measuring device with the seal of the "Imperial Standard Calibration Commission" on 12.04.1883 in Berlin, the invention of the Chronos scales revolutionised weighing and measuring worldwide. It is particularly remarkable that the Chronos scales functioned fully automatically according to the principle of the **centre beam balance** which had been known for millennia (and was formerly used the company logo), for both fast and fine flows and including an after-flow regulator by using the **earth's gravity**. This meant that the Chronos scales required **no energy input** to carry out the precise weighing process.



The company when it was founded in 1881,
Roberval balance since 1669



Tandem centre beam balance

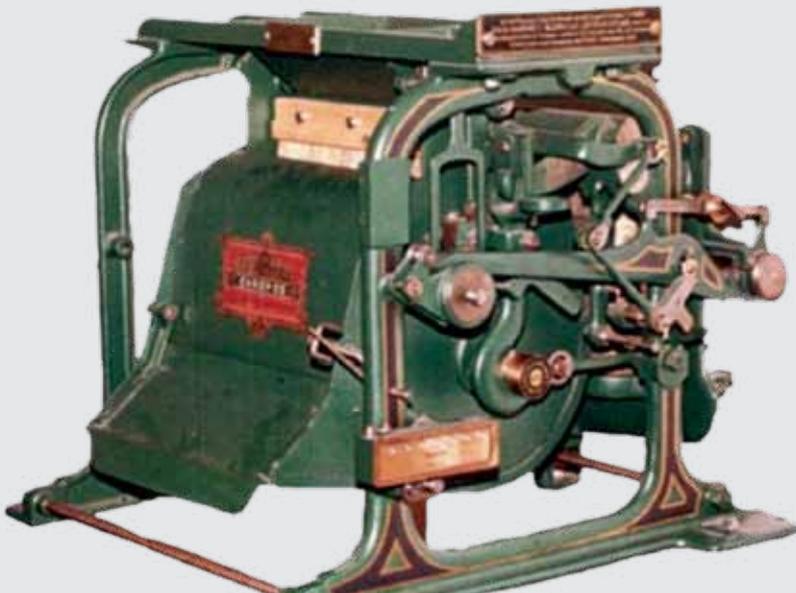
After-flow regulator

History of weighing – Part 4 ... The evolution of weights, scales and weighing ...

In principle the Chronos scales is a centre beam balance. However, a "normal" centre beam balance could not be used, as neither the large hoppers for the produce nor the large pans to hold the weights could be attached to it. This spurred the development

of the heart of the Chronos weighing scales, the tandem beam balance. Setting the Chronos scales for various types of goods with different flow densities and flow properties was no problem and could be carried out easily.

The Chronos scales from Hennef an der Sieg; the first calibratable automatic scales in the world. Approved for calibration as a measuring device on 12 April 1883 in Berlin.



A worldwide hit! The successful automatic Chronos scales from 1883. Here for 10kg amounts.

The Chronos scales were made for weighing fixed amounts of between 0.2 kg and 3,000 kg..



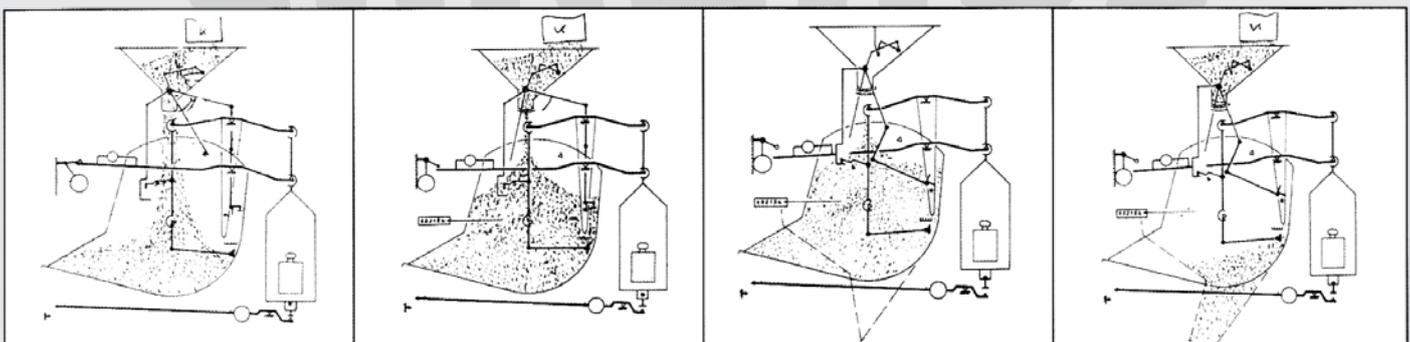
Extracts from a letter by Carl Reuther and Eduard Reisert dated May 1896.

„When some 20 years ago (in 1876) we began to build and commercialise our own invention, an automatic weighing scales for grain etc., this endeavour might have been considered to be quite bold, because all attempts in this direction undertaken hitherto by others had failed and served only to confirm the general opinion at the time that the manufacture of a useful automatic weighing scales was completely impossible. Today however, nobody can deny that we solved the task we set ourselves with the utmost success.

Our automatic scales are well known and in operation at all the relevant major industrial sites at home and abroad around the world, whether they be grain warehouses, mills, breweries, oil factories or cement works.

They meet the needs of rational manufacturing, which abhors the interruption of mechanical conveyance for manual weighing, to such a degree that they have become practically indispensable. Since our automatic weighing scales were approved for calibration and for customs and excise purposes in Germany and almost all other countries of the globe they have completely supplanted the old, non-automatic weighing devices at all the pertinent larger factories.“

The phases of the automatic Chronos scales



Filling with fast flow

switch to fine flow before desired weight is reached

after-flow regulator and Desired weight is reached

emptying. Then repeated filling with fast flow

History of weighing – Part 4 ... The evolution of weights, scales and weighing ...

Shared success:

The foundation of the CARL REUTHER BERUFSSCHULE 1897 in Hennef.

Carl Reuther founded this vocational training school in 1897 with the motto *“To help build a better world was this institution founded. May its work join hand to hand, may it bind land to*

land, heart to heart” and endowed it with considerable funds. It was the first professional training school in the Sieg district (Cologne/Bonn) and the wider area. In memory of this

foundation the present-day vocational training institution of the Rhine-Sieg district in Hennef has been known as the Carl Reuther Berufskolleg since 2.2.2010.



Chronos weighing scales – the first calibratable automatic scales in the world, 1883-2008



Physikalisch-Technische Bundesanstalt
Braunschweig und Berlin



Since 1955

1881-2005

Since 1866

The evolution of weights, scales and weighing

Greeting

More than 120 years ago, on 12 April 1883, the Chronos weighing scales became the first automatic scales to be approved for calibration by the Imperial Standard Calibration Commission in Berlin.

The metrology institute Physikalisch-Technische Bundesanstalt in Braunschweig and Berlin, which is the successor to the Imperial Standard Calibration Commission, and the International Organisation of Legal Metrology in Paris send their congratulations on this outstanding technical achievement from Hennef.

These scales, an invention of truly global significance, are not in the museum just to look back fondly on old times. This centenarian is much too busy and active to spend all its time dwelling in the past. It continues to weigh what it has always weighed - albeit in a more modern form today - flows of bulk goods with great precision. Today we can barely imagine that a technology can remain on the market for 120 years, because we have accustomed ourselves to seeing current innovations, above all computer technology, land on the scrapheap of history after just a few years. A comparison may help to appreciate just how long this period is, in a technical sense even more so than in a biological one. In 1883 the inventor Gottlieb Wilhelm Daimler was just beginning to experiment with combustion engines; he had not yet invented his first motor car. The groundbreaking invention by the two great pioneers Carl Reuther and Eduard Reisert 125 years ago put an end to the manual weighing of bulk goods and ushered in the era of automatic scales.

I wish you and Mr Wolfgang Euler continued success and all the best for the future.

Prof. Dr. Dr. h.c. Manfred Kochsiek
Vice President of the Physikalisch-Technische Bundesanstalt
President of the International Organisation of Legal Metrology



Metrology is the science of weights and measures



History of weighing – Part 4 ... The evolution of weights, scales and weighing ...

Generally speaking, weighing scales control and regulate flows of goods and funds today as they did millennia ago. Without scales it would not be possible to organise an orderly economy, even in our computer-driven age. Scales are also a guarantee of consumer protection everywhere in the world. And ultimately we are all consumers.

At the end of Part 4 we are particularly happy to note that both Bizerba in Balingen and the Chronos scales in Hennef wrought profound and far-reaching changes to the world of weighing. Via and thanks to the invention of the parson P.M. Hahn and P.G. Schaudt in Albstadt-Onstmettingen Bizerba brought the pendulum scales with variable weights to market for the first time. This made it easier and safer to operate the scales, which also saved time and enabled a more precise result to be displayed. These pendulum scales were mainly used throughout the food retailing business, by butchers, bakers and grocers.

The term and the balance symbol Chronos (Greek for time) were chosen as the name for the scales and subsequently as the company name because they represented time and accuracy. The explanation is simple. For around 10,000 years bulk goods were weighed by hand with manual scales. The invention of the automatic mechanical Chronos scales drastically reduced the time need to weigh or weigh out bulk goods. This saved a great deal of time and made the weighing process much more accurate, precise and tamper-proof. Today's modern industrial and computer-controlled weighing

technology would be unthinkable without automatic mechanical scales. They are one of the topics of our next article.

The term Chronos in combination with the centre beam balance of the same name therefore has a common significance for the scales developed at Bizerba in the Swabian Alps and for the Chronos scales from Hennef an der Sieg (Cologne/Bonn). In their day, both companies were world leaders in the production of weighing scales. The authors cannot help but wonder whether there was any contact between the two manufacturers, one in the Swabian Alps and one in the Rhineland, in 1859, 1866, 1877 and 1881.

We would like to take this opportunity to thank most sincerely Mr Helmut Reitemann, Mayor of Balingen and Klaus Pipke, Mayor of Hennef, for their support in matters relating to weighing scales, which was always forthcoming, even when it was not visible to outsiders. The same applies in equal measure to the Chairman of the Executive Board of the Bizerba Group, Mr Andreas Wilhelm Kraut.



Helmut Reitemann



Klaus Pipke



Andreas W. Kraut



Balingen
Zollern-Alb district



Hennef
Rhein-Sieg district



On 1.7.2011 the venerable company would have been 130 years old.



Saturday, 27.9.2007
Opening of the weighing-scale footpath in Hennef and the permanent Chronos scales exhibition at the Meys factory, „The evolution of weights, scales and weighing“



In the midst of it...
North Rhine-Westfalia...
full of treasures!

Hennef, the Chronos scales exhibition „The evolution to weights, scales and weighing“ and the weighing-scale footpath are two of NRW's treasures.

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