

History of Length Measurement

Body parts

One of the oldest units of length measurements used in the ancient world was the 'cubit' which was the length of the arm from the tip of the finger to the elbow. This could then be subdivided into shorter units like the foot or hand (which is still used today for expressing the height of horses), or added together to make longer units like the stride. This could vary considerably due to the different sizes of people.

As early as the middle of the tenth century it is believed that the Saxon king Edgar kept a 'yardstick' at Winchester as the official standard of measurement. A traditional tale tells the story of Henry I (1100-1135) who decreed that the yard should be 'the distance from the tip of the King's nose to the end of his outstretched thumb'.

It was not until the reign of Richard the Lionheart that the standardisation of units of measurement was first documented. In the Assizes of Measures in 1196 it was stated that 'Throughout the realm there shall be the same yard of the same size and it should be of iron'. The Magna Carta (1215) also attempted to standardise measurements throughout the kingdom, although it concentrated on measures of wine and beer!



International Bureau of Weights and Measures

In 1875 the Metre Convention was signed by participating nations and the International Bureau of Weights and Measures (BIPM) was established just outside Paris. In 1889 a number of platinum-iridium metre bars were produced and one of these (number 6) replaced the Mètre des Archives to become the International Prototype Metre. The remaining bars were distributed to the representative nations, lots were drawn and Britain received bar number 16.

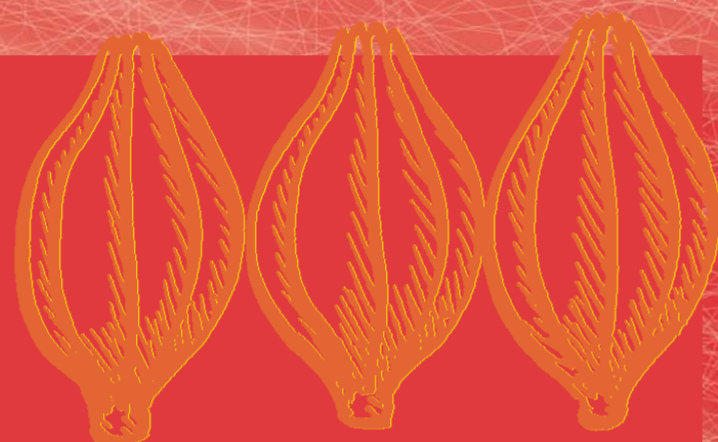
Britain did not sign the Metre Convention until 1884 and even then was not willing to implement the clause that referred to the introduction of metric measures into signatory countries. The use of metric weights and measures in trade only became lawful in Britain in 1897.

Barleycorns and the rod



In Edward I's reign (1272-1307) the yard (or alna) and its sub- and aggregated divisions were defined.

'It is ordained that three grains of barley, dry and round make an inch, twelve inches make a foot; three feet make an alna; five and a half' alna makes a perch (rod); and forty perches in length and four perches in breadth make an acre.'



The perch or rod, as it was also known, was a traditional Saxon land measure and survives in the twentieth century. It had originally been defined as the total length of the left feet of the first sixteen men to leave church on Sunday morning.

Krypton

The convenience and stability of the metre in terms of the International Prototype Metre led to its worldwide adoption in preference to the earlier meridian definition. However the advantage of the permanence of a 'natural' standard had not been forgotten and it was suggested that the wavelength of light could be used to establish a natural standard of length. Once the metre had been defined in terms of the wavelength of light from an atomic discharge lamp it could be reproduced in any well equipped laboratory.



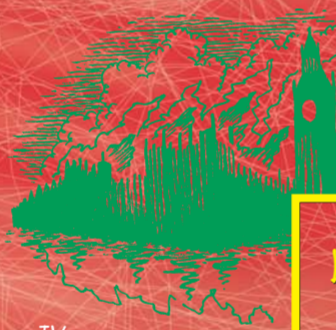
Between 1892 and 1940 nine determinations of the metre bar in terms of the wavelength of light were made in various laboratories (including two at NPL between 1932 and 1935). The mean of these nine results became the basis of the new definition of the metre as 'the length equal to 1 650 763.73 wavelengths in a vacuum of the radiation ... of krypton-86'.

This was the way that the metre was defined in 1960 and at the same time the International Prototype Metre was replaced.

The fine

It is thought that Henry VII (1485-1509) went back 350 years to obtain his standard, and it is likely that it may have been a direct copy of the old standard of Edgar, 'the yardstick', one of the earliest Anglo-Saxon standards.

In 1588 Elizabeth I issued a new standard yard which remained the legal British standard until 1824, when it was superseded by an Act of Parliament under George IV. This act attempted to introduce systems of measures more widely into British society and remove inaccuracies associated with measurement. The new yard became the first imperial standard and was actually a standard that had been commissioned by the Royal Society in 1742, which in turn had been based on an earlier Elizabethan standard. In fact this yard had a very short official life (9 years and 198 days) as in 1834 it was damaged in a fire that burned down both Houses of Parliament. A new standard was eventually legalised in 1855 and was based on unofficial standards that had been compared to the Imperial Yard before it was damaged.

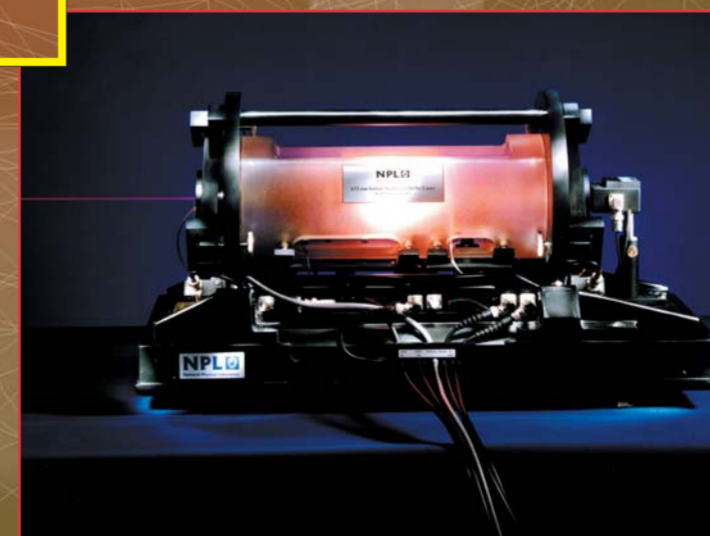


Length measurement today

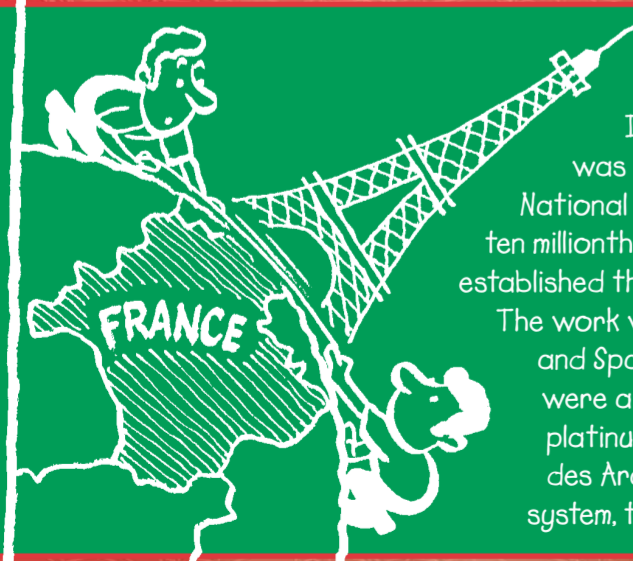
Today length measurement is used in every sphere of life to enable fair trading conditions and to develop new and improved products and processes that enhance our standard of living. This ranges from the production of microscopic electronic devices with circuit dimensions made to accuracies of some sixty thousand millionths of a metre, to millimetre accuracy in distance measurement in construction over many kilometres, for example to enable the channel tunnel works from France and England to meet in the middle. This also extends to everyday life where accurate length measurement is central to the production of nearly all high-tech products, for example, to enable car fuel injection nozzles and video recorder heads to work.

Lasers

It was also in 1960 that the first laser was constructed and by the mid 1970s lasers were being used as length standards. In 1983 the Krypton-86 definition was replaced and the metre was defined as 'the length of the path travelled by light in a vacuum during a time interval of 1/299 792 458 of a second' and it is realised by iodine-stabilised helium-neon lasers which have a reproducibility of better than ±3 parts in 100 000 000 000.



Date	Measurement Standard
3000 BC	Egyptian cubit
10th Century	Saxon yardstick
1588	Elizabethan yard
1791	1/4 meridian of the earth
1889	International Prototype Metre
1960	1st quantum length standard
1983	Speed of light



The polar quadrant survey

It had long been realised that a universal standard of measurement was needed, and that it should be a natural constant. In 1791 the French National Assembly decided in favour of a standard that would be one ten millionth part of a quarter of the earth's circumference. The survey which established the length was made from Dunkirk, in France, to Barcelona, in Spain. The work was long, difficult and was carried out during a time when France and Spain were heading to war. On a number of occasions the surveyors were arrested as spies and nearly lost their heads! From this survey a platinum 'end bar' was produced in 1799 which was known as the 'Mètre des Archives' and was the master standard for the world's new measuring system, the so-called metric system.

If you have a measurement related scientific question contact us on: telephone 020 8943 6880 email: enquiry@npl.co.uk or visit our web site which has lots of measurement related information at <http://www.npl.co.uk>

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