

A brief history of systems of measurement

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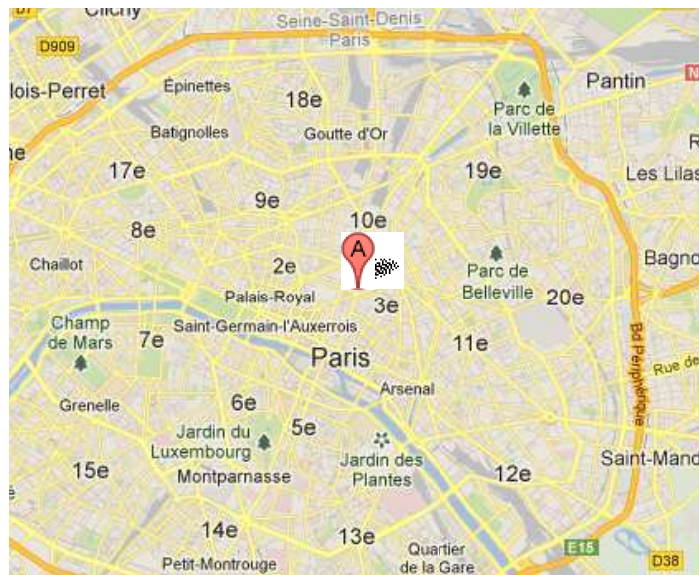


20th IFCC-EFLM European Congress
of Clinical Chemistry and Laboratory Medicine
48th Congress of the Italian Society of
Clinical Biochemistry and Clinical Molecular Biology (SIBioC)



7th CIRME International Scientific Meeting
Metrological traceability and assay standardization
Stresa, Italy

POST-CONGRESS SATELLITE MEETINGS
May 24th, 2013





musée
des arts et métiers
le cnam

Aujourd'hui au musée | Lettre d'information | Point presse | Nous soutenir | Handicap

INFORMATIONS PRATIQUES ACTUALITÉS VISITES ET ACTIVITÉS SCOLAIRES ET PÉRISSCOLAIRES CONFÉRENCES ET DÉBATS COLLECTIONS RESSOURCES DES LIEUX ROUTIQUE JUNIORS

D'après vous, s'agit-il ?
 de l'ancêtre de la boîte de vitesses
 de la première machine à calculer
 de l'origine du lecteur MP3

Découvrez nos visites familiales
Tous les dimanches, un thème différent ! Le 19 mai : les transports. [...]

Didier Graffet, de vapeur et d'acier
Une installation du 14 au 19 mai dans le cadre de la Nuit européenne des musées [...]

LA NUIT EUROPÉENNE DES MUSÉES
Nuit du 18 mai 2013

La Nuit européenne des musées, un programme autour du rétro-futurisme le samedi 18 mai de 18h à minuit. [...]

Ces emballages qui changent nos vies



- musée du Louvre -

LA « PILE DE CHARLEMAGNE » EST, AVANT LA RÉVOLUTION FRANÇAISE, L'ÉTALON ROYAL DE POIDS. ELLE A ÉTÉ FABRIQUÉE VERS LA FIN DU XV^E SIÈCLE ET TIENDRAIT SON NOM D'UNE PILE ANTÉRIEURE, DISPARUE, ÉLABORÉE DU TEMPS DE CHARLEMAGNE. SA MASSE TOTALE EST DE 50 MARCS ET L'UNITÉ PRINCIPALE EST LA « LIVRE POIDS-DE-MARC », QUI VAUT 2 MARCS DE CETTE PILE, SOIT 489,5 G.

À la base du kilogramme

La pile de Charlemagne sert de base en 1767 pour calculer les étalons français et ceux des principales villes d'Europe. C'est à partir de sa masse que sera déterminée en 1792 l'unité de poids, le grave, devenu en 1795 le kilogramme provisoire, puis le kilogramme définitif en 1799.



- musée du CNAM à Paris -



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Units of measurement based on the human body

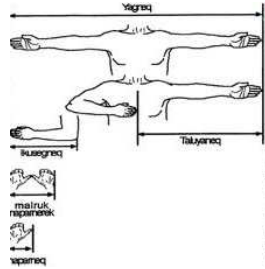


Diagram of Yup'ik
(Alaska Native) units of
length



photo credit: Xavier de Jauréguiberry

Relief carving of
Ancient Greek
measurement using
hand span and foot

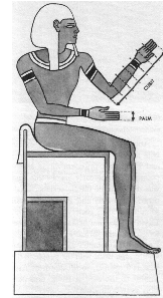


Diagram of Egyptian
definitions of cubit and
palm

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Egyptian Cubit

- Used to build pyramids
- Dependent on the pharaoh
- Missed calibration was punishable by death!



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Tablettes de comptabilité mésopotamiennes



Cérémonie de la psychostasie.

La mesure est inscrite dans les rites religieux d'Égypte. Osiris préside à la psychostasie. Le coeur est siège de l'âme pour les Égyptiens. Lors des funérailles, il est posé sur un des plateaux d'une balance sacrée, la Maât, ou plume de la Vérité sur l'autre. Si le coeur du défunt est plus lourd que la plume de la vérité, il est dévoré par le terrible dieu Ammit.



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first trials...

Charlemagne, 7th century

Just one currency in order to facilitate the exchanges...and to make them more fair...

Silver pound (240 ounces)
20 solidus
12 denarius

Montecassino ounce (490 g)
King's foot (30.5 cm)
Moggius (liquids: 52 L, 3.3+6.2L)



"The Magna Carta" 1215 Clause 35

"There shall be one measure of wine throughout our whole realm, and one measure of ale and one measure of corn--namely, the London quart;--and one width of dyed and russet and hauberk cloths--namely, two ells below the selvage...."



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The meter: a revolutionary invention

- Need for constant measurements for science and commerce
- 1775 Condorcet raises the problem for a reference system:
 - - not linked to any national claim: worldwide acceptability
 - - a natural phenomenon: base for computation

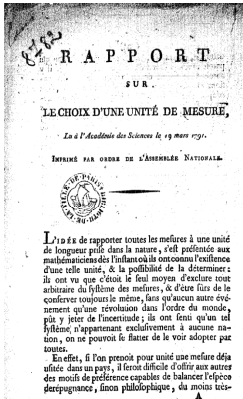
1790-1792

- 1790: decision to have uniform measurements
- Board established:
Borda, Condorcet, Lagrange, Laplace, Lavoisier and Monge
- 1792: report produced

The 1792 report

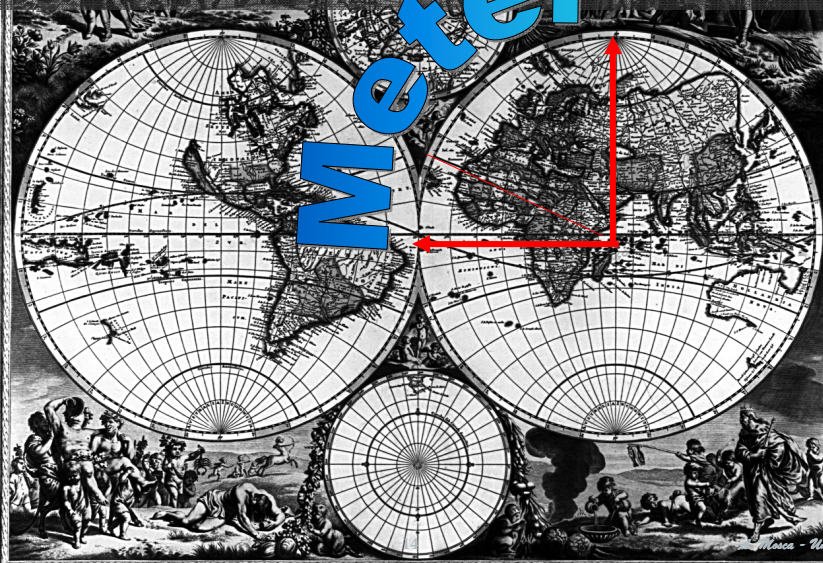
Hypotheses

- the seconds pendulum
- a quarter of the meridian
- a quarter of the equator



On peut réduire à trois les unités qui paroissent les plus propres à servir de base: la longueur du pendule, un quart de cercle de l'équateur, enfin un quart du méridien terrestre.

By dividing the distance from the equator to the north pole by 10 million, a convenient length was defined.



The law of 18 Germinal, III year (1792)

Art. 5

- Meter...length equal to 1/10.000.000 of the meridian arch between North pole and equator....
- Liter...capacity of a cube of 1/10 of a meter....
- Gram...the absolute weight of a pure water volume equal to 1/100 of a meter at the temperature of ice melting...



Commemorative stamp showing the French Republic measuring one quarter of the earth's circumference – the original idea behind the meter

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The measurement of the terrestrial meridian during centuries

Author	year	units	value	Km	
Eratostene	III B.C.	stadium	250.000	40.000	
Caliph-Al Mamun	820	Arab mile	56 2/3	39.986	
Fernel	1525	toise		39.816	
Picard	1670	toise		40.036	
Cassini	1718	toise		40.062	
Lacaille	1740	toise		40.013	
Delambre and Mehan	1799	toise	20522960	40.000	

Present value: m 40,008.152

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The seven-year odyssey that transformed the world

Two teams for measuring the meridian arc passing Paris from Dunkerque to Barcelona

from Rodez to Barcelona

P. Méchain (1744-1804)

from Dunkirk to Rodez

J.B. Delambre (1749-1822)

1 meter = 3 Paris feet
and 11,296 lines

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Standardization in the XVIII century

February 1796, Paris: 16 reference meters installed in town

13, Place Vendome
36, rue Vaugirard



1840, France: meter is mandatory

1875: diplomatic treaty "Meter convention"

1889: reference prototype deposited in Sevres (Pt-Ir) and B.I.M.P. is founded



1960

"optical meter"

Krypton lamp: 1,650,763.73
times the wavelength,
under vacuum

1983

The meter has been
defined as the
distance that light
travels in 1
299,792,458th of a
second



The difference in units led to a miscalculation

the story: NASA's Mars Climate Orbiter



Accidentally destroyed on a mission to Mars in September 1999 instead of entering orbit, due to miscommunications about the value of forces: different computer programs used different units of measurement (newton versus pound force).

April 15, 1999

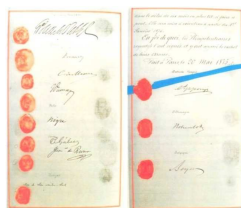
Korean Air cargo flight 6316 from Shanghai to Seoul lost due to the crew confusing tower instructions (in metres) and altimeter readings (in feet).

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World Metrology Day

- The lack of uniformity in making copies, limited the desired international standardization. To overcome these difficulties, the Bureau International des Poids et Mesures (BIPM) was founded by the terms of the diplomatic treaty known as the Metre Convention on 20 May 1875.
- To celebrate the signing of the Metre Convention, **the date of 20 May is known as World Metrology Day.**



La copia della Convenzione del metro con le firme dei rappresentanti dei paesi aderenti tra cui l'Italia del 1875



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Press release!
WORLD METROLOGY DAY 2013!



Measurements in daily life!

Release!

May 20 is World Metrology Day, commemorating the anniversary of the signing of the Metre Convention in 1875. This treaty provides the basis for a coherent measurement system worldwide.

The theme chosen for 2013 is **Measurements in daily life**. In the course of a typical day it is surprising how often measurements come into play, whether (among many possible examples) checking the time, purchasing food or produce, filling up a vehicle with fuel, or undergoing a blood pressure check.

These, and countless other activities in daily life, require measurements of one sort or another. Yet accurate measurements are taken for granted nowadays. Not surprisingly, most people are unaware that in the background there is a worldwide community specializing in metrology, the science of measurements, making sure it all works. Everybody depends on this community doing its job, and doing it well.