= 1 @,@ 000 Linie (lines) =
10 @,@ 000 Punkt (points) while the Pfund was defined as being 500 g , divided into 30 Loth , each of 16 @.@ 67 g . Bavaria , in its reform of 1811 , trimmed the Bavarian Pfund from 561 @.@ 288 g to 560 g exactly , consisting of 32 Loth , each of 17 @.@ 5 g while the Prussian Pfund remained at 467 @.@ 711 g .

After the Congress of Vienna there was a degree of commercial cooperation between the various German states resulting in the setting of the German Customs Union (Zollverein) . There were however still many barriers to trade until Bavaria took the lead in establishing the General German Commercial Code in 1856 . As part of the code the Zollverein introduce the Zollpfund (Customs Pound) which was defined to be exactly 500 g and which could be split into 30 ' lot ' . This unit was used for inter @-@ state movement of goods , but was not applied in all states for internal use .

Although the Zollverein collapsed after the Austro @-@ Prussian War of 1866 , the metric system became the official system of measurement in the newly formed German Empire in 1872 and of Austria in 1875 . The Zollpfund ceased to be legal in Germany after 1877 .

= = = Italy = = =

The Cisalpine Republic , a North Italian republic set up by Napoleon in 1797 with its capital at Milan first adopted a modified form of the metric system based in the braccio cisalpino (Cisalpine cubit) which was defined to be half a metre . In 1802 the Cisalpine Republic was renamed the Italian Republic , with Napoleon as its head of state . The following year the Cisalpine system of measure was replaced by the metric system .

In 1806 , the Italian Republic was replaced by the Kingdom of Italy with Napoleon as its emperor . By 1812 , all of Italy from Rome northwards was under the control of Napoleon , either as French Departments or as part of the Kingdom of Italy ensuring the metric system was in use throughout this region .

After the Congress of Vienna , the various Italian states reverted to their original system of measurements , but in 1845 the Kingdom of Piedmont and Sardinia passed legislation to introduce the metric system within five years . By 1860 , most of Italy had been unified under the King of Sardinia Victor Emmanuel II and under Law 132 of 28 July 28 , 1861 the metric system became the official system of measurement throughout the kingdom . Numerous Tavole di ragguaglio (Conversion Tables) were displayed in shops until 31 December 1870 .

= = = Spain = = =

Until the ascent of the Bourbon monarchy in Spain in 1700 , each of the regions of Spain retained its own system of measurement . The new Bourbon monarchy tried to centralise control and with it the system of measurement . There were debates regarding the desirability of retaining the Castilian units of measure or , in the interests of harmonisation , adopting the French system . Although Spain assisted Méchain in his meridian survey , the Government feared the French revolutionary movement and reinforced the Castilian units of measure to counter such movements . By 1849 however , it proved difficult to maintain the old system and in that year the metric system became the legal system of measure in Spain .

= = = United Kingdom and the Commonwealth = = =

In 1824 the Weights and Measures Act imposed one standard ' imperial ' system of weights and measures on the British Empire . The effect of this act was to standardise existing British units of measure rather than to align them with the metric system .

During the next eighty years a number of Parliamentary select committees recommended the adoption of the metric system each with a greater degree of urgency , but Parliament prevaricated . A Select Committee report of 1862 recommended compulsory metrication , but with an " Intermediate permissive phase " , Parliament responded in 1864 by legalising metric units only for ' contracts and dealings ' . Initially the United Kingdom declined to sign the Treaty of the Metre , but did so in 1883 . Meanwhile , British scientists and technologists were at the forefront of the metrication movement ? it was the British Association for the Advancement of Science that promoted the CGS system of units as a coherent system and it was the British firm Johnson Matthey that was accepted by the CGPM in 1889 to cast the international prototype metre and kilogram .

In 1895 another Parliamentary select committee recommended the compulsory adoption of the metric system after a two @-@ year permissive period , the 1897 Weights and Measures Act legalised the metric units for trade , but did not make them mandatory . A bill to make the metric system compulsory in order to enable British industrial base to fight off the challenge of the nascent German base passed through the House of Lords in 1904 , but did not pass in the House of Commons before the next general election was called . Following opposition by the Lancashire cotton industry , a similar bill was defeated in 1907 in the House of Commons by 150 votes to 118 .

In 1965 Britain commenced an official program of metrication that , as of 2012 , had not been completed . The British metrication program signalled the start of metrication programs elsewhere in the Commonwealth , though India had started its program before in 1959 , six years before the United Kingdom . South Africa (then not a member of the Commonwealth) set up a Metrication Advisory Board in 1967 , New Zealand set up its Metric Advisory Board in 1969 , Australia passed the Metric Conversion Act in 1970 and Canada appointed a Metrication Commission in 1971 . Metrication in Australia , New Zealand and South Africa was essentially complete within a decade while metrication in India and Canada is not complete . In addition the lakh and crore are still in widespread use in India . Most other Commonwealth countries adopted the metric system during the 1970s .

= = = United States = = =

The United States government acquired copies of the French metre and kilogram for reference purposes in 1805 and 1820 respectively . In 1866 the United States Congress passed a bill making it lawful to use the metric system in the United States . The bill , which was permissive rather than mandatory in nature , defined the metric system in terms of customary units rather than with reference to the international prototype metre and kilogram . By 1893 , the reference standards for customary units had become unreliable . Moreover , the United States , being a signatory of the Metre Convention was in possession of national prototype metres and kilograms that were calibrated against those in use elsewhere in the world . This led to the Mendenhall Order which redefined the customary units by referring to the national metric prototypes , but used the conversion factors of the 1866 act . In 1896 a bill that would make the metric system mandatory in the United States was presented to Congress . Of the 29 people who gave evidence before the congressional committee who were considering the bill , 23 were in favour of the bill , but six were against . Four of the six dissenters represented manufacturing interests and the other two the United States Revenue service . The grounds cited were the cost and inconvenience of the change @-@ over . The bill was not enacted . Subsequent bills suffered a similar fate .

= = Development of a coherent metric system = =

From its inception , the metric system was designed in such a manner that the various units of measure were linked to each other . At the start of the nineteenth century , length , mass , time and temperature were the only base unit units that were defined in terms of formal standards . The beginnings of a coherent system were in place with the units of area and volume linked to the unit of length , though at the time science did not understand the concepts of base units and derived units , nor how many physical quantities were inter @-@ related . This concept , which enabled thermal , mechanical , electrical and relativistic systems to be interlinked was first formally proposed in 1861 using length , mass and time as base units . The absence of an electrical base unit resulted in a number of different electrical systems being developed in the latter half of the nineteenth century . The need for such a unit to resolve these problems was identified by Giorgi in 1901 . The SI standard which was published in 1960 defined a single coherent system based on six units .

= = = Time , work and energy = = =

In 1832 Carl @-@ Friedrich Gauss made the first absolute measurements of the Earth 's magnetic field using a decimal system based on the use of the millimetre , milligram , and second as the base unit of time . In his paper , he also presented his results using the metre and gram instead of the millimetre and milligram , also using the Parisian line and the Berlin pound instead of the millimetre and milligram .
In a paper published in 1843 , James Prescott Joule first demonstrated a means of measuring the energy transferred between different systems when work is done thereby relating Nicolas Clément 's calorie , defined in 1824 , to mechanical work . Energy became the unifying concept of nineteenth century science , initially by bringing thermodynamics and mechanics together and later adding electrical technology and relativistic physics leading to Einstein 's equation <formula> . The CGS unit of energy was the " erg " , while the SI unit of energy was named the " joule " in honour of Joule .
In 1861 a committee of the British Association for Advancement of Science (BAAS) including William Thomson (later Lord Kelvin) , James Clerk Maxwell and Joule among its members was tasked with investigating the " Standards of Electrical Resistance " . In their first report (1862) they laid the ground rules for their work ? the metric system was to be used , measures of electrical energy must have the same units as measures of mechanical energy and two sets of electromagnetic units would have to be derived ? an electromagnetic system and an electrostatic system . In the second report (1863) they introduced the concept of a coherent system of units whereby units of length , mass and time were identified as " fundamental units " (now known as base units) . All other units of measure could be derived (hence derived units) from these base units . The metre , gram and second were chosen as base units .
In 1873 , another committee of the BAAS that also counted Maxwell and Thomson among its members and tasked with " the Selection and Nomenclature of Dynamical and Electrical Units " recommended using the CGS system of units . The committee also recommended the names of " dyne " and " erg " for the CGS units of force and energy . The CGS system became the basis for scientific work for the next seventy years .

= = = Electrical units = = =

In the 1820s Georg Ohm formulated Ohms Law which can be extended to relate power to current , potential difference (voltage) and resistance . During the following decades the realisation of a coherent system of units that incorporated the measurement of electromagnetic phenomena and Ohm 's law was beset with problems ? at least four different systems of units were devised . In the three CGS systems , the constants <formula> and <formula> and consequently <formula> and <formula> were dimensionless .
Electromagnetic system of units (EMU)
The Electromagnetic system of units (EMU) was developed from André @-@ Marie Ampère 's discovery in the 1820s of a relationship between the force between two current @-@ carrying conductors . This relationship is now known as Ampere 's law which can be written
<formula> where <formula> (SI units)
In 1833 Gauss pointed out the possibility of equating this force with its mechanical equivalent . This proposal received further support from Wilhelm Weber in 1851 . The electromagnetic (or absolute) system of units was one of the two systems of units identified in the BAAS report of 1862 and defined in the report of 1873 . In this system , current is defined by setting the magnetic force constant <formula> to unity and potential difference is defined in such a way as to ensure the unit of power calculated by the relation <formula> is identical to the unit of power required to move a mass of one gram a distance of one centimetre in one second when opposed by a force of one dyne . The electromagnetic units of measure were known as the abampere , the abvolt , the abcoulomb and so

on .
Electrostatic system of units (ESU)

The Electrostatic system of units (ESU) was based on Coulomb 's discovery in 1783 of the relationship between the force exerted between two charged bodies . This relationship , now known as Coulomb 's law can be written

<formula> where <formula> (SI units)

The electrostatic system was the second of the two systems of units identified in the 1862 BAAS report and defined in the report of 1873 . In this system unit for charge is defined by setting the Coulomb force constant (<formula>) to unity and the unit for potential difference were defined to ensure the unit of energy calculated by the relation <formula> is one erg . The electrostatic units of measure are now known as the statampere , the statvolt , the statcoulomb and so on .

Gaussian system of units

The Gaussian system of units was based on Heinrich Hertz realization , made in 1888 while verifying Maxwell 's Equations , that the CGS system of electromagnetic units to were related to the CGS system of electrostatic units by the relationship :

<formula>

Using this relationship , he proposed merging the EMU and the ESU systems into one system using the EMU units for magnetic quantities (subsequently named the gauss and maxwell) and ESU units elsewhere . He named this combined set of units " Gaussian units " . This set of units has been recognised as being particularly useful in theoretical physics .

Practical system of units

The CGS units of measure used in scientific work were not practical when used in engineering leading to the development of the practical system of electric units . At the time that this system of units was proposed , the dimension of electrical resistance was modelled in the EMU system as the ratio L / T and in the ESU system as its inverse ? T / L.

The unit of length adopted for the practical system was 107 m (approximately the length of the Earth 's quadrant) , the unit of time was the second and the unit of mass an unnamed unit equal to 10 ? 11 g and the definitions of electrical units were based on those of the EMU system . The names , but not the values , amp , volt , farad and ohm were carried over from the EMU system . The system was adopted at the First International Electrical Congress (IEC) in 1881 . The second IEC congress (1889) defined the joule and the watt at the practical units of energy and power respectively . The units were formalised as the International System of Electrical and Magnetic Units at the 1893 congress of the IEC in Chicago where the volt , amp and ohm were formally defined . The SI units with these names are very close , but not identical to the " practical units " .

= = = A coherent system = = =

The electrical units of measure did not easily fit into the coherent system using length , mass and time as its base units as proposed in the 1861 BAAS paper . Using dimensional analysis the dimensions of voltage as defined by the ESU system of units was identical to the dimensions of current as defined by the EMU system of units <formula> while resistance had the same dimensions as velocity in the EMU system of units , but had the dimensions of the inverse of velocity in the ESU system of units .

From the mid @-@ 1890s onwards Giovanni Giorgi and Oliver Heaviside corresponded with each other regarding these anomalous results . This led to Giorgi presenting a paper to the congress of the Associazione Elettrotecnica Italiana (A.E.I.) in October 1901 in which he showed that a coherent electro @-@ mechanical system of units could be obtained by adding a fourth base unit of an electrical nature (ampere , volt or ohm) to the three base units proposed in the 1861 BAAS report . This gave the constants ke and km physical dimensions and hence the electro @-@ mechanical quantities ?0 and μ0 were also given physical dimensions . His work also recognized the unifying concept that energy played in the establishment of a coherent , rational system of units with the joule as the unit of energy and the electrical units in the practical system of units remaining unchanged .

The 1893 definitions of the ampere and the ohm by the IEC led to the joule as being defined in accordance with the IEC resolutions being 0 @.@ 02 % larger than the joule as defined in accordance with the artefacts helds by the BIPM . In 1908 , the IEC prefixed the units of measure that they had defined with the word " international " , hence the " international ampere " , " international volt " etc . It took more than thirty years before Giorgi 's work was accepted in practice by the IEC . In 1946 the CIPM formally adopted a definition of the ampere based on the original EMU definition and redefined the ohm in terms of other base units . In 1960 , Giorgi 's proposals were adopted as the basis of the Système International d 'Unités (International System of Units) , the SI .

= = = Naming the units of measure = = =

In 1861 , Charles Bright and Latimer Clark proposed the names of ohm , volt , and farad in honour of Georg Ohm , Alessandro Volta and Michael Faraday respectively for the practical units based on the centimetre @-@ gramme @-@ second absolute system . This was supported by Thomson (Lord Kelvin) These names were later scaled for use in the Practical System . The concept of naming units of measure after noteworthy scientists was subsequently used for other units .

= = Convention of the metre = =

With increasing international adoption of the metre , the short @-@ comings of the mètre des Archives as a standard became ever more apparent . Countries which adopted the metre as a legal measure purchased standard metre bars that were intended to be equal in length to the mètre des Archives , but there was no systematic way of ensuring that the countries were actually working to the same standard . The meridianal definition , which had been intended to ensure international reproducibility , quickly proved so impractical that it was all but abandoned in favour of the artefact standards , but the mètre des Archives (and most of its copies) were " end standards " : such standards (bars which are exactly one metre in length) are prone to wear with use , and different standard bars could be expected to wear at different rates .

The International Conference on Geodesy in 1867 called for the creation of a new , international prototype metre and to arrange a system where national standards could be compared with it . The international prototype would also be a " line standard " , that is the metre was defined as the distance between two lines marked on the bar , so avoiding the wear problems of end standards . The French government gave practical support to the creation of an International Metre Commission , which met in Paris in 1870 and again in 1872 with the participation of about thirty countries .

On 20 May 1875 an international treaty known as the Convention du Mètre (Metre Convention) was signed by 17 states . This treaty established the following organisations to conduct international activities relating to a uniform system for measurements :

Conférence générale des poids et mesures (CGPM or General Conference on Weights and Measures) , an intergovernmental conference of official delegates of member nations and the supreme authority for all actions ;

Comité international des poids et mesures (CIPM or International Committee for Weights and Measures) , consisting of selected scientists and metrologists , which prepares and executes the decisions of the CGPM and is responsible for the supervision of the International Bureau of Weights and Measures ;

Bureau international des poids et mesures (BIPM or International Bureau of Weights and Measures) , a permanent laboratory and world centre of scientific metrology , the activities of which include the establishment of the basic standards and scales of the principal physical quantities , maintenance of the international prototype standards and oversight of regular comparisons between the international prototype and the various national standards .

The international prototype metre and kilogram were both made from a 90 % platinum , 10 % iridium alloy which is exceptionally hard and which has good electrical and thermal conductivity properties . The prototype had a special X @-@ shaped (Tresca) cross section to minimise the effects of torsional strain during length comparisons. and the prototype kilograms were cylindrical in shape . The London firm Johnson Matthey delivered 30 prototype metres and 40 prototype kilograms . At the first meeting of the CGPM in 1889 bar No. 6 and cylinder No . X were accepted as the international prototypes . The remainder were either kept as BIPM working copies or distributed to member states as national prototypes .

= = Twentieth century = =

At the beginning of the twentieth century , the BIPM had custody of two artefacts ? one to define length and the other to define mass . Other units of measure which did not rely on specific artefacts were controlled by other bodies . In the scientific world , quantum theory was in its infancy and Einstein had yet to publish his theories of relativity . By the end of the century , a coherent system of units was in place under the control of the bodies set up by the Treaty of the Metre , the definition of the second relied on quantum theory , the definition of the metre relied on the theory of relativity , and plans were being made to relegate the international prototype kilogram to the archives .

= = = Metre = = =

The first (and only) follow @-@ up comparison of the national standards with the international prototype metre was carried out between 1921 and 1936 , and indicated that the definition of the metre was preserved to within 0 @.@ 2 µm . During this follow @-@ up comparison , the way in which the prototype metre should be measured was more clearly defined ? the 1889 definition had defined the metre as being the length of the prototype at the definition of melting ice , but in 1927 the 7th CGPM extended this definition was to specify that the prototype metre shall be " supported on two cylinders of at least one centimetre diameter , symmetrically placed in the same horizontal plane at a distance of 571 mm from each other " . The choice of 571 mm represents the Airy points of the prototype ? the points at which the bending or droop of the bar is minimized .

In 1887 Michelson proposed the use of optical interferometers for the measurement of length , work which contributed to him being awarded the Nobel Prize in 1907 . In 1952 the CIPM proposed the use of wavelength of a specific light source as the standard for defining length and in 1960 the CGPM accepted this proposal using radiation corresponding to a transition between specified energy levels of the krypton 86 atom as the new standard for the metre . By 1975 , when the second had been defined in terms of a physical phenomenon rather than the earth 's rotation and Einstein 's assertion that the speed of light was constant , the CGPM authorised the CIPM to investigate the use of the speed of light as the basis for the definition of the metre . This proposal was accepted in 1983 .

= = = Kilogram = = =

Although the definition of the kilogram remained unchanged throughout the twentieth century , the 3rd CGPM in 1901 clarified that the kilogram was a unit of mass , not of weight . The original batch of 40 prototypes (adopted in 1889) were supplemented from time to time with further prototypes for use by new signatories to the Metre Convention .

During the course of the century , the various national prototypes of the kilogram were recalibrated against the International Prototype Kilogram (IPK) and therefore against each other . The initial 1889 starting @-@ value offsets of the national prototypes relative to the IPK were nulled. and any subsequent mass changes being relative to the IPK . A technique for steam cleaning the prototypes to remove any contaminants was developed in 1946 as part of the second recalibration .

The third periodic recalibration in 1988 @-@ 1989 revealed that the average difference between the IPK and adjusted baseline for the national prototypes was 50 ?g ? in 1889 the baseline of the national prototypes had been adjusted so that the difference was zero . As the IPK is the definitive kilogram , there is no way of telling whether the IPK had been losing mass or the national prototypes had been gaining mass .

Time

Until the advent of the atomic clock , the most reliable timekeeper available to mankind was the earth 's rotation . It was natural therefore that the astronomers under the auspice of the International Astronomical Union (IAU) took the lead in maintaining the standards relating to time . In 1988 , responsibility for timekeeping passed to the BIPM who took on the role of coordinating a number of atomic clocks scattered around the globe . During the twentieth century it became apparent that the earth 's rotation was slowing down resulting in days becoming 1 @.@ 4 milliseconds longer each century ? this was verified by comparing the calculated timings of eclipses of the sun with those observed in antiquity going back to Chinese records of 763 BC .

In 1956 the 10th CGPM instructed the CIPM to prepare a definition of the second ; in 1958 the definition was published stating that the second would be calculated by extrapolation using earth 's rotational speed in 1900 . Astronomers from the US Naval Observatory (USNO) and the National Physical Laboratory determined a relationship between the frequency of radiation corresponding to the transition between the two hyperfine levels of the ground state of the caesium 133 atom and the estimated rate of rotation of the earth in 1900 . Their value was adopted in 1968 by the 13th CGPM .

Electrical units

In 1921 the Treaty of the Metre was extended to cover electrical units with the CGPM merging its work with that of the IEC . At the 8th CGPM in 1933 the need to replace the " International " electrical units with " absolute " units was raised . The IEC proposal that Giorgi 's proposal be adopted was accepted , but no decision was made as to which electrical unit should be the fourth base unit . In 1935 Sears proposed that this should be the ampere , but World War II prevented this being formalised until 1946 . The definitions for absolute electrical system based on the ampere was formalized in 1948 .

Temperature

At the start of the twentieth century , the fundamental macroscopic laws of thermodynamics had been formulated and although techniques existed to measure temperature using empirical techniques , the scientific understanding of the nature of temperature was minimal . Maxwell and Boltzmann had produced theories describing the inter @-@ relational of temperature , pressure and volume of a gas on a microscopic scale but otherwise , in 1900 , there was no understanding of the microscopic or quantum nature of temperature . Within the metric system , temperature was expressed in degrees Centigrade with the definition that ice melted at 0 ° C and at standard atmospheric pressure , water boiled at 100 ° C. A series of lookup tables defined temperature in terms of inter @-@ related empirical measurements made using various devices .

When , in 1948 the CGPM was charged with producing a coherent system of units of measure , definitions relating to temperature had to be clarified . At the 9th CGPM , the centigrade temperature scale was renamed the Celsius temperature scale and the scale itself was fixed by defining the triple point of water as 0 @.@ 01 ° C , though the CGPM left the formal definition of absolute zero until the 10th GCPM when the name " Kelvin " was assigned to the absolute temperature scale and triple point of water was defined as being 273 @.@ 16 ° K. In 1967 , at the 13th GCPM the degree Kelvin (° K) was renamed the " kelvin " (K) .

Over the ensuing years , the BIPM developed and maintained cross @-@ correlations relating various measuring devices such as thermocouples , light spectra and the like to the equivalent temperatures . Increasingly the use of the Boltzmann Relationship was used as the reference point and it appears likely that in 2015 the CGPM will redefine temperature in terms of the Boltzmann constant rather than the triple point of water .

Luminosity

Prior to 1937 , the International Commission on Illumination (CIE from its French title , the Commission Internationale de l 'Eclairage) in conjunction with the CIPM produced a standard for luminous intensity to replace the various national standards . This standard , the candela (cd) which was defined as " the brightness of the full radiator at the temperature of solidification of platinum is 60 new candles per square centimetre " . was ratified by the GCPM in 1948 and in 1960 was adopted as an SI base unit . The definition proved difficult to implement so in 1967 , the definition was revised and the reference to the radiation source was replaced by defining the candles in terms of the power of a specified wavelength of visible light .

In 2007 the CIPM and the CIE agreed a program of cooperation with the CIPM taking the lead in defining the use of units of measure and the CIE taking the lead in defining the behaviour of the human eye .

Mole

The mole was originally known as a gram @-@ atom or a gram @-@ molecule ? the amount of a substance measured in grams divided by its atomic weight . Originally chemists and physicists had differing views regarding the definition of the atomic weight ? both assigned a value of 16 atomic mass units (amu) to oxygen , but physicists defined oxygen in terms of the 16O isotope whereas chemists assigned 16 amu to 16O , 17O and 18O isotopes mixed in the proportion that they occur in nature . Finally an agreement between the International Union of Pure and Applied Physics (IUPAP) and the International Union of Pure and Applied Chemistry (IUPAC) brought this duality to an end in 1959 / 60 , both parties agreeing to define the atomic weight of 12C as being exactly 12 amu . This agreement was confirmed by ISO and in 1969 the CIPM recommended its inclusion in SI as a base unit . This was done in 1971 at the 14th CGPM .

International System of Units (SI)

The 9th CGPM met in 1948 , fifteen years after the 8th CGPM . In response to formal requests made by the International Union of Pure and Applied Physics and by the French government to establish a practical system of units of measure , the CGPM requested the CIPM to prepare recommendations for a single practical system of units of measurement , suitable for adoption by all countries adhering to the Metre Convention . At the same time the CGPM formally adopted a recommendation for the writing and printing of unit symbols and of numbers . The recommendation also catalogued the recommended symbols for the most important MKS and CGS units of measure and for the first time the CGPM made recommendations concerning derived units .

The CIPM 's draft proposal , which was an extensive revision and simplification of the metric unit definitions , symbols and terminology based on the MKS system of units , was put to the 10th CGPM in 1954 . In accordance with Giorgi 's proposals of 1901 , the CIPM also recommended that the ampere be the base unit from which electromechanical would be derived . The definitions for the ohm and volt that had previously been in use were discarded and these units became derived units based on the metre , ampere , second and kilogram . After negotiations with the CIS and IUPAP , two further base units , the degree kelvin and the candela were also proposed as base units . The full system and name " Système International d 'Unités " were adopted at the 11th CGPM .

During the years that followed the definitions of the base units and particularly the mise en pratique to realise these definitions have been refined .

Proposed revision of unit definitions

After the metre was redefined in 1960 , the kilogram remained the only SI base defined by a physical example or artefact . Moreover , after the 1996 ? 1998 recalibration a clear divergence between the various prototype kilograms was observed .

At its 23rd meeting (2007) , the CGPM mandated the CIPM to investigate the use of natural constants as the basis for all units of measure rather than the artefacts that were then in use . At a meeting of the CCU held in Reading , United Kingdom in September 2010 , a resolution and draft changes to the SI brochure that were to be presented to the next meeting of the CIPM in October 2010 were agreed to in principle . The proposals that the CCU put forward were that :

in addition to the speed of light , four constants of nature ? Planck 's constant , an elementary charge , Boltzmann constant and Avogadro 's number ? be defined to have exact values ;

the international prototype kilogram be retired ;

the current definitions of the kilogram , ampere , kelvin and mole be revised ;

the wording of the definitions of all the base units be tightened up .

The CIPM meeting of October 2010 found that " the conditions set by the General Conference at its 23rd meeting have not yet been fully met . For this reason the CIPM does not propose a revision of the SI at the present time " ; however the CIPM presented a resolution for consideration at the 24th CGPM (17 ? 21 October 2011) to agree the new definitions in principle , but not to implement them until the details have been finalised . This resolution was accepted by the conference and in addition the CGPM moved the date of the 25th meeting forward from 2015 to 2014 .