On 8 May 1790 the National Assembly of France passed a decree calling upon the French Academy of Sciences to develop a new standard of weights and measures which should be applicable over the whole of France. A commission of twelve French scientists was appointed to undertake the task, and they formulated the system which we know as the metric system.

The system was based on a new unit of length, to which they gave the name 'metre', and which they defined as (in layman's language) one ten-millionth of the distance from the North Pole to the Equator. They then named and defined other units as follows:

- **are**: ground measure, equivalent to a square of side 10 metres.
- **stere**: 1 cubic metre; 'the measure of volume chosen for wood cut for fuel'.
- **litre**: measure of liquid and dry capacity: contents of a cube with side 1/10 metre (i.e. 1000 c.c.).
- **gramme**: weight of one cubic centimetre of water at 4 degrees Centigrade and normal atmospheric pressure.

These names and the corresponding definitions became law in an Act of 7 April 1795.

The commission also established a set of prefixes to be used when referring to multiples or fractions of the basic units; they passed into law in the same Act. They were:

- myria- = ten thousand times
- kilo- = one thousand times
- hecto- = one hundred times
- deka- = ten times
- deci- = one tenth
- centi- = one hundredth
- milli- = one thousandth

The prefixes denoting multiples are derived from Greek words:
- myria- comes from the noun *myrias* (μυριάς -άδος, η) = (a group of) ten thousand.
- kilo- comes from the adjective *chilioi* (χιλιοι -αι -α) = one thousand.
- hecto- comes from the numeral *hekaton* (ἐκατόν) = one hundred.
- deka- comes from the numeral *deka* (δέκα) = ten.

3. ib.
4. ib.
The prefixes denoting fractions are derived from Latin words:

deci- comes from *decem* = ten (or perhaps from *decimus* = one tenth).

centi- comes from *centum* = one hundred.

milli- comes from *mille* = one thousand.

This set of prefixes\(^5\) remained in use until 1961, when a decree was passed extending the range and removing myria-.\(^6\) Additional prefixes were established for the extended range:

\[
\begin{align*}
\text{tera-} & = \text{one billion times} \\
\text{giga-} & = \text{one thousand million times} \\
\text{mega-} & = \text{one million times} \\
\text{micro-} & = \text{one millionth} \\
\text{nano-} & = \text{one thousand millionth} \\
\text{pico-} & = \text{one billionth}
\end{align*}
\]

All but one of these are of classical origin, but they are more fanciful than the earlier set.

Tera- is from a Greek noun *teras* (τέρας αος, τό), which has two basic senses:

(i) 'miracle' and (ii) 'monster'. In the first meaning it may refer to anything which surprises or astonishes you; Herodotus writes: 'if there is a thunderstorm in winter, this is regarded as a miracle (teras)'\(^7\). As a miraculous happening may portend evil, the word is sometimes extended in this sense to mean 'portent'. In the *Iliad*\(^8\) Odysseus reminds Agamemnon of an event which took place at Aulis before the Trojan war began: the Achaean army saw a snake catch and devour eight baby sparrows and their mother. The seer Calchas at the time described this scene as a *teras* ("portent")\(^9\), and interpreted it as indicating that the army would have to wait nine years before capturing Troy.

In the second meaning the word is applied to anything which fills you with horror and revulsion. The Gorgon's head is called a *teras* at *Iliad* V 742; and Cicero, in one of his letters, describes Caesar as a *teras*\(^10\).

It will be observed that size is not a necessary connotation of *teras* in either meaning; its choice as a prefix to denote one billion times was therefore to this extent inappropriate, though those not mathematically minded may well view such large numbers with both horror and revulsion.

Giga- is from a Greek noun *gigas* (γίγας αντος, ὅ) which means 'giant'; the mythological race of giants (*Gigantes*) is referred to in Homer's *Odyssey*.\(^11\) That

5. In 1795 they 'were not enthusiastically received' (ib. p.34), but managed to establish themselves.
6. ib. p.34.
7. IV, 28, 3; he is referring to Scythia, where the wet season was, and is, in summer (see e.g. How, W.W., and Wells, J.: *A Commentary on Herodotus*, ad loc.).
8. II 303ff.
9. Or 'prophetic scene' (E.V. Rieu).
11. VII 59 and 206.
size is one of the connotations of the Greek word is clear from Hesychius (5th to 6th cents. A.D.), who recorded its use in his time as an adjective meaning ‘large’.

Mega- is from a Greek adjective *megas* (*μέγας*), the regular Greek adjective meaning ‘big’.

Micro-. This prefix, from Greek *mikros* (*μικρός*), the regular adjective for ‘small’ (opposite of *megas*), violates the system whereby the multipliers are Greek and the fractions Latin. The symbol for micro- is μ, the first letter of the Greek word, and the only Greek letter used as a symbol for one of the prefixes.

Nano- is from a Latin noun *nanus* -i (m) = ‘dwarf’. This rare word was borrowed into Latin from Greek, where it was spelt either *nanos* (*νάνος*) or *nannos* (*νάννος*). According to Varro¹² (1st century B.C.) it came into Latin first as the name for a small container made in the form of a bearded dwarf and used for pouring water over guests’ hands at a banquet. The word was used by a few other Latin authors of the imperial period,¹³ and in Greek goes back to Aristotle¹⁴ (4th century B.C.) and Aristophanes¹⁵ (5th century B.C.). The prefix nano- appears in many French words in the meaning ‘dwarf’.

Pico-. With this prefix the classical link is broken; pico- is from Italian *piccolo* = ‘tiny’,¹⁶ whose roots are not classical.

Other prefixes that have been suggested for larger and smaller amounts are beyond the scope of this article.

Not only are the prefixes classically derived, but the names for the units themselves also go back to Greek and Latin.

**Metre**

The Greek word *metron* (*μέτρον*) was in origin an instrumental noun meaning ‘that with which you measure something’. Throughout the history of Greek it remained a general term for a measure of any sort: the Greek for ‘weights and measures’ is *stathmoi kai metra* (*σταθμοί καί μέτρα*). Unlike its modern derivative, ‘metre’, it was never the name for a specific measure of anything.

It occurs several times in Homer’s *Iliad*. At XII 421ff there is a simile describing the Greeks and Lycians as they fight over the wall of the Greek camp:

As when across the boundary-stones in the common land two men dispute, with their measures [metrical] in their hands... These *metra* are linear measures, but the word tells us nothing about their length.¹⁷ It appears again at *Iliad* VII 470-1:

Jason’s son, as a special gift to Agamemnon and Menelaus, the sons of Atreus, had given [the ships] wine to bring, a thousand measures [metrical]...
These *metra* are of liquid capacity,\(^{18}\) probably the measure which was later known as the *keramion*.\(^{19}\)

In choosing the word *metron* (in the form ‘metre’) for their standard unit of length the French scientists intended to convey that this was The Measure par excellence, the one on which all the others were based.

*Are and Stere*

These two little-known units may be briefly dismissed. Are is familiar only in the hectare, the 100-multiple of the are. The word was coined by the French scientists from Latin *area -ae* (f) = ‘area’, but was given masculine gender to conform with all the others.

Stere, for measuring the volume of timber, was also coined by the scientists, from the Greek adjective *stereos* (*στερεός*) meaning ‘solid’, ‘three-dimensional’. The Greek word is a familiar prefix in words such as ‘stereoscopic’ and ‘stereophonic’.

*Gramme*

In English this word may be spelt either gramme or gram. It comes ultimately from a Greek noun *gramma* (γράμμα - ατος, το), which is transliterated in certain Latin works as *gramma*.

The Greek word, which is derived from the root of the verb *grapho* (γράφω) = ‘I write’, denoted anything drawn or written down, whether a straight line or a picture or a letter of the alphabet. It does not appear in Homer,\(^{20}\) but Herodotus\(^{21}\) (5th century B.C.) tells us (rightly) that ‘the Phoenicians... introduced various arts to the Greeks, and in particular *grammata* [‘written letters’, i.e. the alphabet]’. From the New Testament (1st century A.D.) we may note Luke 23:38:

There was also an inscription over him in *grammata* [‘letters’] of Greek and Latin and Hebrew: ‘This is the king of the Jews’.\(^{22}\)

In the period of the Roman empire, however, the word shows an additional meaning; it is now also the name for a certain standard weight. What weight this was is indicated by a couplet from an anonymous poem on weights and measures:\(^{23}\)

*semioboli duplum est obolus, quem pondere duplo gramma uocant (scriplum nostri dixere priores).*

\(^18\). cf. *Iliad* XXIII 268.

\(^19\). Evidence for the *keramion*, the largest Greek unit of liquid capacity, goes back to Xenophon’s *Anabasis* (VI, 1, 15); the word does not occur in Homer, but we do find *keramos* (κέραμος) for an earthenware jar at *Iliad* IX 469.

\(^20\). The verb *γράφω* appears at *Iliad* VI 169; it meant originally ‘I scratch’.

\(^21\). V 58.

\(^22\). The best texts omit the words ‘in letters of Greek and Latin and Hebrew’, which are relegated to a footnote in the Revised Standard Version.

\(^23\). Lines 8-9. For the complete text of this work see F. Hultsch: *Scriptores Metrologici* (Teubner 1864-6, reprinted 1971), number 120. He gives the work the title *Carmen de Ponderibus*. It is preserved in certain MSS of the grammarian Priscian (I. A.D. 500) but is probably not by him.
Two *semioboli* make an *obulus*; and if you double this weight the result is called the *gramma* (our ancestors called it *scriplum*).\(^{24}\)

*Gramma*, then, was the Greek word denoting the weight for which the Latin word was *scrupulum*.\(^{25}\) This small weight was \(\frac{1}{24}\) of an *uncia* and \(\frac{1}{288}\) of a *libra*. It was a Roman, not a Greek weight; *gramma* was simply the word used when this Roman weight had to be translated into Greek. But why was this Greek word in particular chosen as the equivalent, when it had not previously denoted a weight?

The same poem\(^{26}\) has an answer to this question as well:

The *uncia* contains twice four *drachmae*; hence, we may suppose, comes the name *grammata*, because the *uncia* contains 24 of these within itself.\(^{27}\) For our language is written down by the same number of characters as the number of hours through which the world passes in a day and a night.

The author suggests that *gramma* was used to translate *scrupulum* because there are 24 *scrupula* in an *uncia* and 24 *grammata* in an alphabet.\(^{28}\) This seems far-fetched. The alternative spellings *scriplum* and *scriptlum\(^{29}\) suggest that *scrupulum* was wrongly connected with *scribo* and hence that *gramma* was used as a calque or literal translation.\(^{30}\)

What is the relation between the size of the modern gram and that of the ancient *gramma*? It is known that the Roman *libra* = 327.45 grams,\(^{31}\) hence 1 *uncia* = one twelfth of that, or 27.29 grams, and 1 *scrupulum/gramma* = one twenty-fourth of that, or 1.137 grams. It was because the new weight was so close to the value of the ancient *gramma* that the French scientists gave it the name *gramme*.\(^{32}\)

**Litre**

This word was introduced into French by the metric system, though there was a (French) word *litron* already in existence. Both words come from a Greek noun *litra* (λίτρα -ας, ή ), which had a very rare heteroclite form *litron* (Χίτρον -ου, τό).

This Greek noun is etymologically connected with Latin *libra*, and was characteristic of the Sicilian dialect of Greek, in which it denoted both a coin.\(^{24}\) Priores indicates that the word *scriplum* is Latin, not that it is obsolete; it lived on to provide the word ‘scuple’ in Apothecaries’ Weight.

25. Or *scriptum*; on the spelling see later.


27. There were three *scrupula* in a *drachma*.

28. The classical Latin alphabet contained 23 letters (see Diringer, D.: *The Alphabet*, Vol.I page 421). Perhaps 24 is an ad hoc approximation, though suggestions for extra letters in the alphabet were made from time to time.

29. See Lewis and Short (op.cit. note 13 above) s.v. *scrupulum*.

30. The etymology of *scrupulum* is not known for certain; it may be connected with *scrupus* and its diminutive *scrupulus*, both of which are used by Cicero to denote a minor hesitation or anxiety — what we still call a scruple.


32. op. cit. note 2 above, page 77.
and a standard weight (which was not the same as the Roman *libra*). It is traceable back to the 6th/5th centuries B.C. in Sicily, appearing in a fragment of Epicharmus, and a fragment of a lost work ascribed to Aristotle informs us that the Sicilians used it also as the name for a coin. The two words *litra* and *libra* represent borrowings into Sicilian Greek and Latin respectively of a word hypothetically reconstructed as *litra* which was used in some other Mediterranean language to denote a standard weight; Greek and Latin both took over the word in this meaning, but the standard differed in each case.

Mainland Greece never had a weight called *litra*; but from at least the time of Polybius (2nd century B.C.) the Greek language used the word as the Greek translation of Latin *libra*, and the word continued to be so used through the period of the Roman empire.

It is only in the works of Galen (2nd century A.D.) that *litra* is used to denote a measure of liquid capacity. He tells us that the *litra* was equivalent in capacity to the Roman *hemina*, and also that it was measured by means of a special horn measure. He describes this in the following passage:

> There is among them [i.e. the Romans] a measure by which they measure oil, incised with lines which divide the whole into twelve parts. The whole measure is called by them a *litra*, and the twelfth part an *uncia*. Metallic drugs and wax are weighed on the balance by means of different *unciae*, whereas oil is measured by this horn.

Elsewhere he calls this horn *keras litraion* (κέρας λιτραῖον, lit. 'litre-horn').

The passage just quoted shows that Galen was not responsible for this new use of the word *litra*. It appears to have arisen as follows. The first stage is the use of a special horn container to measure a *hemina*. According to the regular Roman usage this was divided into 12 parts called *unciae*. It thus became

33. This is deduced from an epigram in the Greek Anthology (VI 214 in the Loeb edition) which refers to a tripod dedicated at Delphi by the Sicilian princes after defeating the Carthaginians at Himera in 480 B.C. and describes it as weighing 50 talents 600 *litrai*. It would therefore appear that there were more than 600 Sicilian *litrai* in a talent, which was equivalent to 80 Roman *librae* (see Polybius XXI, 43, 19).

34. Reference in Liddell and Scott: *A Greek-English Lexicon* s.v.


36. See Chantraine, P.: *Dictionnaire étymologique de la langue grecque* s.v. λίτρα.

37. So Liddell and Scott, op. cit. note 34 above, s.v. λίτρα.

38. *On Maintaining Good Health* IV: see Hultsch, op. cit. note 23 above, number 30.

39. The list of larger Roman measures of liquid capacity under the empire, together with the equivalent Greek words, runs as follows:

- quadrantal/κεράμων (= 8 congii)
- congius/χοῦς (= 6 sextarii)
- sextarius/ξέντης (= 2 heminae)
- hemina/κορύλη.

40. *On Mixtures of Drugs, Arranged by Types* III: see Hultsch, op. cit. note 23 above, number 41.

41. Hultsch, op. cit. note 23 above, numbers 36, 37.

42. In Roman arithmetic the word *uncia* denotes one twelfth of anything.
necessary to distinguish stathmic *unciae* (i.e. *unciae* by weight), of which 12 made one *libra/litra*, from metric *unciae* (i.e. *unciae* by measure), of which 12 made one *hemia*,43 and someone extended the parallel by calling the product of 12 metric *unciae* one (metric) *litra*.

Using ancient tables of the density of liquids we can compare the size of this ancient *litra* with the modern litre. The ancient tables tell us that one *hemia* (= one *litra*) of water weighed ten *unciae*,44 and we have already seen that one *uncia* was approximately equal to 27.3 grams. Hence one *hemia* of water weighed 273 grams, which is equivalent to a volume of 273 c.c. The modern litre, at 1000 c.c., is thus approximately 3½ times the size of the ancient *litra*.

43. Galen makes this distinction more than once; see e.g. Hultsch (op. cit. note 23 above) numbers 33,41,49. The point is that the stathmic and metric *unciae* were not the same size. Galen himself established that one metric *litra* of water weighed ten stathmic *unciae* (see Hultsch number 49); and there is no liquid mentioned in the ancient tables of which one metric *litra* weighed one stathmic *litra*.

44. Compare the previous note.