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UNITY IN SYMBOLS OF UNITS

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Very much is being written today about the air-age and its implications. Continents seem to shrink, and nations although thousands of miles separated become close neighbors. The main points of planning a lasting peace are considered mutual understanding and respect for international agreements. There are international agreements of diplomatic as well as scientific nature. More than 150 years ago scientists struggled for an universal system of measurements, and today the metric system is adopted legally by almost all nations on the earth. Scientists use it exclusively in their publications.

Although the metric system was accepted by scientists long ago, and has been in use for more than 100 years, there is still today a great confusion concerning the use of abbreviations. A survey the author made during the last two years covering 51 scientific periodicals and 178 monographs and textbooks printed in USA revealed a distressing discrepancy in using abbreviations of the fundamental units of the metric system and their fractions and multiples. The study also included a few journals and books of foreign origin and revealed similar misuse of symbols as found in American publications.

You can read e.g. for gram: gm, gm., Gm, GM, Gr., GR, G; for meter: M, m., mtr, MTR, Mtr, mr; for second: Sec., Sec, sec. In a few instances you find an expression for plurality: 1 gm, but 10 gms, or 1 m or 1 mtr but 10 ms or 10 mtrs, or 1 sec but 10 secs or 10 scs.

There is no great unity in abbreviating area and volume but you find for square-meter m^2 as well as sq-m, Sqm, SQM, SQm, squ m, etc., and for cubic-meter besides m^3, cum, cu-m, Cu m, CU m, CUM, etc.

The metric system is based not only upon the fundamental units the meter, gram, second, but also upon the decimal system of numbers when we consider its fractions and multiples. For tenths of units (deci) the prefix d, dc, Dc, for hundredths (centi) the prefix c, C, for thousandths of units (milli) M, m, mll were found in many publications. Micro (millionths of unit) was abbreviated exclusively with μ; a few used micro-gm for micro-gram.

Cubic-centimeter has a special place in the realm of abbreviations. You can see it as cc, Cc, CC, ccm, Ccm even c^3m.

The multiples ten times the unity (Deca), hundred times the unity (Hecto), thousand times the unity (Kilo), million times the unity (Mega) were abbreviated d, dk, Dk, DK; h, Hto; k, Kl; and m, mg respectively.

Combined fractional subdivisions like milli-micro-second ($= 10^{-9}$

second) were abbreviated Mμ sec, μm sec, μM sec. Of course you could find correct abbreviations but they were rare.

Scientists of the last century who worked on the problems of establishment of an universal system of weights and measures not only specified the abbreviations of the fundamental units (meter, gram, second) but also provided abbreviations for fractions and multiples. These fractions and multiples are used as prefixes of the symbol of unit and can be used with derived units as well as with British units. All abbreviations are singularotanta and, therefore, if used to indicate the amount of the unit are devoid of an affixed s (10 gms is incorrect; it should be written 10 g).

The fundamental units meter, gram, second are abbreviated by a single small letter (never capital letter) without subsequent period. (meter=m, gram=g, second=s). The fractions are abbreviated as prefixes, single *small* letters, without subsequent period or hyphen: deci=d, centi=c, milli=m, micro=μ, e.g. mg for milli-gram. Fractional subdivisions are indicated by the smallest fraction as closest prefix to the unit (mμg=milli-micro-gram=10^{-9} g). Apparently for reasons of convenience the usage of μ (micron), γ (gamma), ó (sigma) for μm (=10^{-6} m=10^{-3} mm), μg (=10^{-6} g=10^{-3} mg), μs (=10^{-6} s) developed without international sanction, however. Abbreviations of multiples are prefixes using single *capital* letters, without subsequent period or hyphen: Deca (=D), Hecto (=H), Kilo (=K), Mega (=M), e.g. Kg for Kilogram.

The second and third dimension of a unit shall be abbreviated as power of the unit (cm^2, mm^3).

Actually the metric fractions and multiples should be called decimal fractions and multiples for they can be used not only in connection with the metric system but with the British system also. It is evident that fractions and multiples can be used with any derived unit as cubic-centimeter, kilo-calorie, micro-volt.

The author did not attempt to approach the problems of abbreviation of derived units for there are apparently no international rules established yet. However there were suggestions made to abbreviate derived units by capital single letters of the Latin and Greek alphabet. Small Latin letters (with exception of g, m, s) are reserved for mathematical operations, and small Greek letters (with exception of μ) for designation of angles.

It also was noticed that in many publications if decimal fractions were less than unity the decimal point not always succeeded the zero. From mathematical point of view it seems to be correct to use e.g. 0.1 instead of .1 for one tenth, etc. Fortunately only certain groups of publications use .1, etc., such as mathematics textbooks, publications pertaining to engineering and a very few others.

Throughout the investigation there was the impression that the main reason for the use of contradictory and confusing abbreviations is the different policies of the publishing houses. It is up to the

individual scientists to insist upon the correct use of abbreviations and symbols, and it is very understandable that the publishers will consider this request of the publishing scientist.

In order to spare a lot of explaining and argumentation the author suggests that the Minnesota Academy of Science, as an organized body of scientists, shall make recommendations to publishers to use abbreviations of the metric system and their multiples and fractions as adopted by the International Bureau of Weights and Measures, excepted and ratified by most of the nations, including the United States of America (in 1868).

Science which claims to be international shall set an example by using its units with all implications uniformly. It would be a noble contribution of the Minnesota Academy of Science to science as well as to the world of tomorrow, if the Academy would initiate and sponsor the promotion of unification of symbols and abbreviations.

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TWO PHYSICAL METHODS FOR THE QUANTITATIVE DETERMINATION OF ONE COMPONENT OF A MIXTURE OF GASES*

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It is often desirable to make a quick and fairly accurate determination of the relative percentages of the constitutents of a mixture of gases. The most common method used for making a quantitative analysis of a mixture of gases is that of measuring the volume of the gas before and after passing it through each of a series of absorption chambers, one constituent of the mixture being removed in each chamber by absorption or by a chemical reaction. This method may not be satisfactory for the complete analysis of a mixture of gases if two or more of the constituents are chemically inert, such as mixtures containing both nitrogen and helium. The two methods to be described can be used for the quantitative analysis of two of the constituents of a mixture if the relative percentages