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'ATOMIC WEIGHT'—THE NAME, ITS HISTORY, DEFINITION, AND UNITS

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'Atomic weight': The name, its history, definition, and units

Abstract—The widely used term "atomic weight" and its acceptance within the international system for measurements has been the subject of debate. This paper summarizes the history of positions taken and the reasons given by IUPAC's committees, commissions, and publications.

FOREWORD

Few scientific arguments are stated more firmly and defended more forcefully than those on nomenclature which is always rooted in history and respected by tradition. New insights give new meanings which may not always fit with earlier concepts. One should not underestimate the importance of relevant discussions. Clear words impose a discipline on mind and expressions of ideas. They help to clarify concepts until they are formulated clearly and unequivocally. Thus, names and definitions have a strong influence on thinking and analysis, and should therefore occupy a foremost place in education. They assist logical thinking in all professional activities and original work.

MAY WE NOT USE "WEIGHT"?

Well known is the bitter quarrel over the popular use of "weight" where physicists prefer to use "mass." A parallel exists for chemists, who hold on to the well established term, "atomic weight" against "logical" advice from some other scientists. In weighing materials by means of a balance one could argue that one truly compares weights, gravitational forces, at equal acceleration due to gravity. That defense is not valid for "atomic weight." Yet, Norman Holden, Chairman of the IUPAC Commission on Atomic Weights, (1979–83), and one of his predecessors (from 1969–75), Norman Greenwood, recommended repeatedly that no change be made in the name "atomic weight" because it is clearly understood by chemists without ambiguity. Most other European languages have direct and equivalent translations for "atomic weight" and "atomic mass."

JUSTIFICATION FOR THIS ARTICLE

We, the authors, were asked in August 1989 by the Commission on Atomic Weights and Isotopic Abundances (CAWIA) of the International Union of Pure and Applied Chemistry (IUPAC) at its Lund General Assembly to explain the background of the often renewed debate on the name, definition, and units of "atomic weight." Without taking sides in any disagreements, we tried to draft such a document for presentation to the Commission at its Hamburg General Assembly in 1991. By the time of that venue it included substantial improvements suggested by Norman Greenwood, Barry Taylor, and Masako Shima. Even so, it failed to gain consensus, and was criticized by H. Roy Krouse and by Richard Cohen who later formulated a clarifying statement which, the authors believe, may be found helpful to Commission members in understanding the concepts. Other comments have been received from T. Cvitaš, I. M. Mills, and N. Sheppard.

The Commission requested the authors to write and publish in Pure and Applied Chemistry this purely factual, historical statement on the same topic before the Lisbon General Assembly in 1993.

THE COMMISSION DECIDED FOR "ATOMIC MASS"

Let our analysis start, not at the beginning of the debate, but at the time physicists and chemists in 1961 had reached an historic agreement on the ^{12}C scale. The harmonious solution to what had been a long-standing problem led to further negotiations. The Commission responsible for data on nuclidic masses of the International Union of Pure and Applied Physics (IUPAP), at its Warsaw meeting in 1963, planned and in the event did adopt "atomic mass" for the mass of a nuclide, that is of a neutral atom of a specific isotope. The IUPAC Commission planned, in parallel, to cause IUPAC to adopt the "atomic mass" of an element.

T. Batuecas at the time was the Commission "President." Under his leadership, the Commission, at the Montreal IUPAC General Assembly in 1961, decided to abandon "atomic weight." The "summary minutes" were an integral part of the discussion and published with the 1961 Commission Report (ref. 1). After recommending the ^{12}C scale this summary continues as follows:

> **Following a suggestion from the President, the Commission agreed by unanimous opinion of the members present at Montreal to propose that its name be changed to "Commission on Atomic Masses" and that the Tables to be issued in future be entitled "Tables of Relative Atomic Masses." This matter, submitted to the IUPAC Bureau is still pending ...**

By the time the Report was published, it was known that the IUPAC Bureau had disagreed strongly and disallowed the change of name. The Commission Reports in those days were reprinted in several chemical journals around the world. The more commonly seen copies of the 1961 Report, such as the one from the Journal of the American Chemical Society, tactfully omitted (Note a) the summary of the Commission decisions. Under IUPAC Bureau guidance and the chairmanship of Edward Wichers, the Commission in 1969 overturned the decision at the Cortina d'Ampezzo IUPAC General Assembly.

Batuecas, no longer a Commission member, expressed his disagreement with the re-introduction of "atomic weight" (ref. 2). He clearly restated the arguments one more time:

1.) **Measurements of quantities should have dimensions.**

2.) **Mass is a base quantity and should always be measured on the same scale.**

3.) **Mass is invariant; weight varies.**

4.) **Physicists and chemists should not use different terms for the same quantity.**

5.) **A mononuclidic element could be said to have an "atomic mass," while other elements have "atomic weights" for the same quantity.**

THE COMMISSION CHANGED COURSE

In its 1969 Report, the Commission recommended that the traditional designation of "atomic weight" be retained. The reasons for this decision were as follows (ref. 3):

(a) **"Atomic weight" has a traditional meaning that is well understood by those who use the Table (of atomic weights). It is unambiguous when qualified by the language of this explanatory statement.**

(b) **The term "atomic mass" ... should be reserved for nuclides as distinguished from elements ...**

As explained above, the Commission in 1961 had also recommended, and to this the IUPAC Bureau was sympathetic, adding to the Table heading the adjective "Relative" by which emphasis would be given to atomic weights being pure numbers. The Commission, however, in 1969 chose not to change the table heading, declaring in its 1969 Report (ref. 3), "The modifier 'relative' is essentially redundant. The concept of relativity is implicit in the chemist's understanding of the term." This statement did not end that question on the use of the adjective "relative." At that time a more important decision was made—not within the Commission, and not even with the Commission's documented knowledge.

THE INTERNATIONAL MEASUREMENT SYSTEM

This event took place under the Commité Consultatif des Unités (CCU) under the Comité International des Poids et Mesures (CIPM), the International Committee of Weights and Measures and under the Conférence Général des Poids et Mesures (CGPM), the principal executive organization under the Treaty

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Note a: In a footnote a statement was added in fine print, "The text of this report is identical except for the omission of a brief introductory statement concerning administrative matters and ..."

of the Meter. Almost all highly developed and many other nations are members. The relevant discussions took place, with participation of IUPAC under the leadership of M. L. McGlashan, and were concerned with the increasing support for defining the "mole" as a new base unit of the SI, the International System of Units (for measurements), "Le Systěme International d'Unités" (ref. 4). That new unit was designed to bring chemical measurements into the SI. Originally that system was devised for use by physicists and engineers. They are used to measuring the quantity for matter by its mass. Chemical science, by contrast, depends on the amount of substance measured by simple multiples of the numbers of specific atoms, molecules, or radicals. In the past chemists have used Avogadro's Number, N—as distinct from Avogadro Constant, N_A—of chemical entities that have the mass, when expressed in grams, equal to the numerical value of their "atomic (molecular) weight." This then was their "molar mass," or "mole" as it was commonly called. Until then most chemists thought of that in grams. Chemical science was able to progress rapidly with the concept of N, albeit with only an approximate knowledge of its magnitude.

The simple new suggestion was to think of molar mass, $M_r(E)$, in terms of a mass per group of N atoms of element E. That group constituted a unit amount of substance to be called a mole, proposed as a new base unit in the SI. Molar mass was then to be measured in grams per mole, and N_A itself would thereby be given dimensions in the SI of "per mole." Henceforth, N_A would have to be called Avogadro Constant.

THE MOLE

CCU thus proposed at its very first meeting in April 1967: "The unit 'mole,' symbol 'mol,' should be added to the six existing basic (sic) units of the SI for the amount of substance or the amount of matter with the following definition:" (In what follows we use the slightly modified version adopted at the third meeting of CCU in August 1971): "The mole is the amount of substance of a system which contains as many elementary entities as there are carbon atoms in 0.012 kg of carbon 12." They appended the important, "Note: the elementary entities must be specified and may be atoms, molecules, ions, electrons, other particles, or specified groups of such particles." On October 4, 1971 CGPM adopted the mole as an addition to the base quantities of the SI. The agreed symbol for the quantity, the amount of substance, is n and the symbol for the unit is mol (ref. 4).

CHOICE OF BASE UNITS

Difficulties exist for establishing good base units for the SI. Macroscopic artifacts suffer from demonstrable difficulties in providing adequate precision and constancy, especially with the passage of time, changes in temperature, and normal use. Such units are destructible and, therefore, offer also a security risk. By contrast, atomic-scale quantities appear to provide unlimited replication and constancy. Therefore, they are suited to being base units for measurement. However, they impose considerable demands on the laboratories that attempt direct comparisons of properties of macroscopic objects with such atomic-scale units. The unit mole is different from both the above types of units in that it is a number of defined entities in a standard set. The unit could be fixed arbitrarily. By choice, it was linked to ^{12}C and the macroscopic mass unit, the kilogram of the SI. Nevertheless, one should note from the definition below that the magnitude of that link factor of N_A does not affect the amount of substance of any entity. Just as before the mole was introduced, most of chemistry would be able to develop, unconcerned with the exact magnitude of N_A. Chemical measurements in the future could conform exactly to SI without an exact value of N_A, that is, without the uncertainty from which, say, atomic scale-mass measurements suffer when expressed in the base mass unit of the SI (see below).

IF THERE ARE PROBLEMS, WHAT ARE THEY?

One of the cardinal principles of the SI is that a given property should be measured in terms of one and only one unit for that property (ref. 4). Thus, we have a small problem right away. Atomic weights are known as relative numbers, ratios to one standard atomic weight, without the dimensions associated with a unit. However, most scientists agree that an exception can be made by allowing atomic weights to be dimensionless.

For mass measurements another problem arises from the same principle of the SI. The unit for mass now is the kilogram. A major change would be needed to substitute an atomic mass unit, such as a twelfth of the rest mass of one atom of ^{12}C in its ground state. This is the current unified atomic mass unit, u, which is recognized for use with the SI and is so employed in the table of atomic masses (ref. 5). The two scales, based on the kg and u, respectively, are as uncertain relative to each other as is the Avogadro Constant, the factor that relates them to each other. Nevertheless, current definitions avoid inaccuracies in the comparison between amounts of substances. This is accomplished by reference to $\{N_A\}$ which itself is neither defined exactly nor known as accurately as achievable measurement precision under special circumstances for both macroscopic and microscopic mass quantities. In consequence, for example, the atomic masses, the molar masses, and the atomic weights of monoisotopic elements are numerically identical and more accurately known than $\{N_A\}$ itself. It is not surprising that people have difficulties in writing dimensionally correct equations involving mass and amount of substance.

B. N. Taylor (ref. 6) and most other metrologists believe that the kilogram prototype must be replaced as soon as reasonably possible. The kilogram could, for instance, be defined as $[1000\{N_A\}/12]$ times the rest mass of one ^{12}C atom in its ground state. That factor could be given a numerical value to correspond as closely as possible to the current best knowledge of N_A.

Unfortunately and exceptionally, the present SI unit of mass, the kilogram, itself carries a multiplier prefix (kilo) in its own name. So far there is no groundswell for changing the unit of mass to one gram. Chemists, however, want to avoid multiplying conventional atomic and molecular weights by one thousand. They wish the mole to remain, unchanged, based on the gram. Thus, one needs a factor of a thousand when relating certain values expressed in customary SI base units.

Robert Freeman, as editor of *Bulletin of Chemical Thermodynamics*, as long ago as 1982 wrote: "... the nomenclature and units associated with the concepts atomic weight, atomic mass, molecular weight, amount of substance, *etc.* need serious attention by IUPAC." The evidence of difficulty, however, continues to recent times by the lively correspondence in *Chemistry International* (ref. 7, 8, 9, 10, & 11). In a recent addition to that correspondence, Thornley and Johnson (ref. 12) point out that, "The increasingly widespread use of SI units has greatly improved communications within and between various branches of science." They fully accept the idea of a new SI unit for the amount of substance, but advocate a larger "MOLE" within SI by a factor of 1000. So far, there has not been much support for this change.

IS THE MOLE A SATISFACTORY BASE UNIT?

Basic objections to the mole were and continue to be voiced, but all of them appear to be open to rebuttals. The debates, centered in Russia, run along the following lines:

i) Objection: One can not devise a national or transfer standard of reference with an amount of substance that can be compared directly on an instrument with the amount of substance in a different standard.

   Rebuttal: One could have a single crystal of Si with n_i mol that could be compared with n_j mol of substance in another crystal also of Si or of Ge using an instrument that counts lattice planes or atoms. There is no difference from intercomparisons of kilogram weights on a balance.

ii) Objection: The definition of the "new" mole differs even in dimensions from the chemists' traditional idea of the "mole." A completely different name might have been more appropriate for the new SI unit.

   Rebuttal: Chemists by now are used to the new definition of the mole; the difference in dimensions has not been a major problem at all.

iii) Objection: For very many years, since the time of Newton and before the SI was adopted, the amount of substance was its mass.

   Rebuttal: True, but other words considered were less familiar or harder to translate to other languages. A distinction between "chemical amount of substance" and "physical amount of substance" may have some support. By this or other means one should emphasize the distinction between the two basically different ways of measuring matter.

iv) Objection: The mole is a count; counting is not measuring.

Rebuttal: In this quantum world, for the discontinuous emission process of radioactive particles, in view of the wave nature of phenomena with numerable crests, how can we possibly fail to accept a counting procedure as a measuring process?

v) Objection: The mole needs no national standard; see A.E. Bailey (ref. 13).

Rebuttal: Neither in the modern SI would one call for a national kelvin or any other SI unit quantity with the sole exception of the kilogram. It is the kilogram, not the mole, that is the oddity.

These objections have been restated in Yu. I. Aleksandrov's recent article (ref. 14). In addition, he examines the basic criteria by which the units of base quantities should be chosen. The arguments are too philosophical to be discussed here. G. D. Gurdun, too, in his Handbook on the SI (in Russian) (ref. 15) maintains that the mole is merely a unit to facilitate calculations. A. E. Bailey (ref. 13) also says that the concept of the mole is really that of the number of atoms in 0.012 kg of ^{12}C. One does not need the concept of a physical quantity or a unit. Determining the amount of substance is accomplished by a counting of the particles.

THE MOLE IS WIDELY ACCEPTED BY CHEMISTS

These arguments against the new mole, valid or not, seem to be not so serious, as to cause the CGPM to abolish that unit within the SI. A universal system of units is of great importance to science, technology, and trade. There exists no current alternative to SI. Chemists accept that position including the new mole. Only questions on the name and meaning of "atomic weight" in conformity with the mole are subjects for further analysis here.

"ATOMIC WEIGHT" WAS STILL A PURE NUMBER

The mole did not greatly influence discussions within the Commission. When Etienne Roth became Chairman of the Commission and published a perceptive paper entitled "Atomic Weights – Problems, Past and Present" (ref. 16), the problem of the mole was not mentioned. When, in turn, the Commission Chairmanship passed to Norman Holden, he discussed the definition and the objections to the name "atomic weight" (ref. 17) but not in relation to the SI and the mole. In any event he concluded, "The term 'atomic weight' ... should not be changed except for a very strong reason ... the suggested alternative 'relative atomic mass' is an extremely bad choice because of its long use by scientists to mean the mass of a nuclide relative to ^{12}C." The next Commission Chairman, Raymond Martin, also did not concern himself with the introduction of the mole, but suggested "atomic weight ratio" to be used instead of "atomic weight" (unpublished Commission report). This proposed name would highlight the dimensionless nature of atomic weight, as defined until now.

That suggestion was considered with other proposed names, such as Rigaudi's clever "Relatomass," Chatt's "Dalton Number," Johnson's "Average Atomic Mass," several advocates' "molar mass," and Whiffen's "Mean Relative Atomic Mass." That last proposal was given special attention and has been used by some, often without the "mean" for brevity. Others have adhered to "atomic weight."

CONSENSUS ON THE MEANING OF "ATOMIC WEIGHT"

During the years from 1975 (Madrid General Assembly of IUPAC) through 1977 (IUPAC Warsaw General Assembly) (ref. 18) to 1979 (Davos General Assembly of IUPAC) (ref. 19), lively discussions took place on the name "atomic weight." For this purpose joint meetings of the Commission were arranged with IUPAC's IDCNS (Interdivisional Committee on Nomenclature and Symbols), CTC, and (in Warsaw) the Divisions on Organic and Analytical Chemistry. Although progress generally was slow, a consensus on the meaning of "atomic weight" certainly emerged:

i) Atomic weights of elements are, in general, variable, even in their common natural terrestrial sources.

ii) An atomic weight should be defined as a property of a sample, that is any sample containing any number of atoms of the element in question.

iii) The IUPAC Tables should list "Standard" Atomic Weight values that correspond to "our best knowledge of the elements in natural terrestrial sources." Adjectives other than "standard" were proposed for the Tables such as "reference," "representative," "typical," "normal," and "standardized." "Conventional" has recently been suggested by B. N. Taylor. "Standard" was preferred at the time and used in the Tables since 1979. Nevertheless, in the IUPAC Compendium of Chemical Terminology by prepared Gold *et al.*, (ref. 20), "standard atomic weight" is not among the many terms listed and defined.

iv) With minor exceptions to be covered by footnotes, the implied range of the standard atomic weight value is intended to apply to all samples from natural terrestrial occurrences as well as to samples found in laboratories involved in chemical investigations, technological applications, or in materials of commerce. Future increased use of enriched stable isotopes may lead to a change of Commission policy on the treatment of materials with modified isotopic composition.

AN ALTERNATIVE DEFINITION OF "ATOMIC WEIGHT"

Although these aspects of the meaning of "atomic weight" were thus agreed, additional difficulties arose in reaching a consensus on the definition. Before 1975 the Commission used the following definition: "... the ratio of the average mass per atom of a natural nuclidic composition of an element to 1/12 of the mass of an atom of nuclide ^{12}C" [see "Atomic Weights of the Elements 1973" (ref. 21)].

In 1975 the Commission wanted to recognize the above-discussed new meaning of "atomic weight" and the introduction of the mole. So, the Commission proposed an alternative definition for "atomic weight." In one of its versions it read, "An atomic weight of an element is the ratio of the mass of one mole of the element in a specified source to 1/12 of the mass of one mole of chemically unbound ^{12}C in its nuclear and electronic ground state." The substitution of the indefinite for the definite article at the beginning of the definition was important. At least that change was readily agreed by all (see, for instance, ref. 21).

The above-quoted new alternative definition, embracing the concept and idea of the new "mole," was criticized by members of IDCNS. The introduction of the mole into the definition was considered unnecessary and, as recently emphasized by Richard Cohen, is undesirable because physical quantities should be defined independently of any unit of measurement. Since an agreed, IUPAC-sanctioned definition existed, a simple rejection of the new alternative might have ended the matter. But it did not.

THE NAME CONTROVERSY RESTARTED IN REVERSE

IDCNS is the Committee within IUPAC that has the voice of greatest impact and authority on questions of nomenclature. The IDCNS grasped the opportunity of the issue of definition of "atomic weight" for broadening the discussion on the name and reversing IUPAC's previous insistence on retaining the traditional term "atomic weight."

The Commission members had accepted the IUPAC Bureau's veto of "relative atomic mass" against the strong advice of their former President. Gradually members had rationalized that official position under the leadership of subsequent chairmen, especially E. Wichers, N. N. Greenwood, and N. E. Holden. There was advantage to be gained from retaining the distinction between "atomic mass" (of the nuclides) and "atomic weights" (of the elements) (ref. 22). This viewpoint is reflected in a paper entitled "Atomic Weight—Love it or Leave it" by Holden (ref. 23). To reflect the view expressed, the title might have read, "Love it or not, but leave it."

Since 1969 the defense of "atomic weights" by the majority of Commission members was carefully reasoned. Some unconvinced IDCNS members continued to prefer "relative atomic mass" (formerly known as "atomic weight"). This dispute had the effect for a while of blocking the entire Commission

Report for 1977, until the Commission by letter vote of all members accepted the responsibility for developing for the 1979 Assembly a compromise definition. They fulfilled that promise. The compromise was presented and favorably reviewed by the Commission members, IDCNS, the CTC, and the Inorganic Division of IUPAC. It reads as follows (ref. 19):

An atomic weight (relative atomic mass) of an element from a specified source is the ratio of the average mass per atom of the element to 1/12 of the mass of an atom of ^{12}C.

It has to be noted that atomic weights can be defined for any sample; that they are evaluated for atoms in their electronic and nuclear ground states; that the average mass per atom in a specified source is the total mass of the element divided by the total number of atoms of that element; that no stipulation is made for the element in the sample having the natural terrestrial nuclidic composition, but that the IUPAC Tables of Standard Atomic Weights refer to the best knowledge of the elements in natural terrestrial sources. As for the full name itself, it was to read: "atomic weight" (alternatively known as "mean relative atomic mass"). Thus, CTC itself, on behalf of IUPAC, distributed the Table of Atomic Weights to Four Significant Figures prepared by N. N. Greenwood and H. S. Peiser (ref. 24), and thus also CTC allowed the revised version to be re-issued in 1988 (ref. 25). A further reprinting is to be found in the International Newsletter on Chemical Education (ref. 26). The version reproduced in most textbooks throughout the world follows this convention. Moreover, the proposed compromise was published with full IUPAC authority in "Atomic Weights of the Elements 1977" (ref. 18) and similarly confirmed (in slightly abbreviated form) in "Atomic Weights of the Elements 1979" (ref. 19).

IUPAC–A HOUSE DIVIDED ON "ATOMIC WEIGHT"?

The Commission had every reason to believe that the above compromise on the name "atomic weight" had been accepted. At any rate, it came as an unpleasant surprise to Commission members when at the IUPAC General Assembly in Lund in 1989, we pointed out that the previously mentioned IUPAC Compendium of Chemical Terminology (ref. 20) fails to provide a full definition for "atomic weight." However, it does define "relative atomic mass of an element" (also known as "atomic weight").

In the recently republished IUPAC "Green Book" prepared by I. Mills *et al.*, *Quantities, Units and Symbols in Physical Chemistry* (ref. 22), the "standard atomic weights of the elements" are discussed and listed. However, that widely used text also fails to list "atomic weight" separately. It does use the term parenthetically after "relative atomic mass." A_r(E) is defined, but not listed in the list of symbols.

The situation might be called confusing (ref. 27). Therefore, at the 1991 General Assembly in Hamburg, it was agreed for a consensus to be reestablished between the Commission, IDCNS, and within IUPAC as a whole. That consensus should then be incorporated into future editions of the IUPAC Compendium of Chemical Technology (ref. 20) and other IUPAC publications.

NOT ALL THE DEBATE HAS BEEN SUMMARIZED HERE

For the sake of brevity we have not described all of the diverse discussions on the definition and name in the 1975 to 1979 period. We have not reproduced the questionnaires sent out to and answered by Commission members. For example, we have omitted a discussion on the minimum number of atoms to be counted for a statistically significant average. We believe members of IDCNS correctly thought that this was an irrelevant issue raised by the Commission. The entire record is available in Philadelphia at the Arnold and Mabel Beckman Center for the History of Chemistry, associated with the University of Pennsylvania.

SOME REMAINING ISSUES

One relevant proposal that still deserves mention is for "Dalton" (symbol Da) to be used as synonymous with unified atomic mass unit. It is so currently used by some chemists, especially biochemists. That practice is endorsed by some groups within IUPAC. It is disliked by others. The Dalton has been formally proposed, but never accepted by CGPM, IUPAP, or IUPAC. The naming of SI units by the first letters of the names of pioneer scientists has plenty of precedents (*e.g.* kelvin, K; newton, N; henry, H; hertz, Hz); but "u" is not an SI unit, and its designation as dalton, Da, is not really conventional.

Another important development is the widespread adoption of "molecular mass" with loss of a highly desirable correspondence with "atomic weight." "Mean relative molecular mass" would have a problem for polymer chemists who use "mean" in reference to a range of chain lengths, rather than in relation to isotopic composition.

Noteworthy is perhaps that the use of "molar mass" has been considered a problem for teachers because of the similarity of "molar" to "molecular." More serious is the fact that the "molar mass of oxygen," for example, is undefined without stating whether reference is made to the atom, O, or the molecule O_2.

On the question of the dimensionless character of "atomic weight," let it be noted that none recommends that it shall have the dimensions of weight. There are, certainly, many examples in which a quantity designated by a noun modified by an adjective does not have the same dimensions as the noun by itself—an "electromotive force" is not a force, "resolving power" does not have the dimensions of "power," specific volume is dimensionless, like "atomic weight." So "atomic weight" as a dimensionless quantity introduces no special problem. Equally, it could be given dimensions, such as mass. IUPAC is free to rule for or against the name "atomic weight" without endangering the adherence of chemical measurements to the rules of the SI and without entering the controversy about whether it is permissible to use "weight" with an adjective for a quantity in "mass" units. H. R. Krouse, a member of the Commission, believes that this kind of "bad" terminology elsewhere does not justify "atomic weight" with dimensions other than those of weight. Is he saying then, that we should give up the name of "atomic weight"? That term is widely accepted and deeply rooted in history. It should not be changed lightly (ref. 23)! With that warning based on the experience of history and in agreement with the consensus of recent Commission chairmen, the limited aim of this historical document has been completed.

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