Time Conventions and Symbols for use in the Earth and Planetary Sciences and Nuclear Chemistry

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A short article published recently in *Episodes* (Holden, N.E., Bonardi, M.L., De Bièvre, P., Renne, P.R., and Villa, I.M., 2011. IUGS common definition and convention on the use of the year as a derived unit of time (IUPAC-IUGS Recommendations 2011): *Episodes*, v. 34, No. 1, pp. 39-40) sets out to rationalize the definition and symbols for units of time for use in the Earth and planetary sciences and nuclear chemistry. Given that the authors constitute a task group established jointly by the International Union of Geological Sciences (IUGS) and the International Union of Pure and Applied Chemistry (IUPAC), and that publication was approved by both bodies, one might reasonably assume that the recommendations reflect a workable consensus. Regrettably, they don't (Christie-Blick, Geological time conventions and symbols: *GSA Today*, submitted June 10, 2011).

At stake is whether or not a necessary distinction exists between geohistorical dates and unconstrained spans of geological time. The task group (TG) argues that they are one and the same; the symbols 'a' (for 'annus', or year) and ka, Ma and Ga (for 10^3 , 10^6 and 10^9 years, respectively) will suffice for both purposes. However, the distinction has proven vital for communication among Earth scientists for more than thirty years. And according to that well established convention, the symbols ka, Ma and Ga refer explicitly to points in time. Intervals of time require a different abbreviation or symbol: for example, m.y. or Myr in the case of millions of years.

The critical issue is not whether a single set of symbols will work, or whether language will become unnecessarily cumbersome to avoid confusion (though in my view it will). It is whether the adoption of two sets of *symbols*, not *units*, is in fact "inconsistent both internally and with respect to SI" because that is the justification being offered in support of a change. Neither assertion can be sustained. No-one objects to the storming of the Bastille on July 14, 1789 or to the construction of Stonehenge from 2600-1600 BC. And with reference to the latter, we say that the job took 1000 years, not 1000 BC. The distinction between dates and spans of geological time is conceptually analogous. There is no internal inconsistency and SI rules don't apply to dates in either case because points in time are not units, even if they are specified in years. The year, moreover, is a non-SI unit. It cannot be a "derived unit of time," the designation proposed by the TG, because under SI conventions derived units are products of powers of base units (seconds in this case). The TG is thus intent on fixing a problem that doesn't exist, and in a manner that is at odds with their stated goal of "adherence to SI rules."

A possible compromise exists. That is to reserve the symbols ka, Ma and Ga for geohistorical dates in 10^3 , 10^6 and 10^9 years before present (consistent with present usage), and to express geohistorical time in yr, kyr, Myr and Gyr (again adopting SI prefixes). The latter could then be used in the manner that the TG recommends, with no conflict, and with the outcome eventually to be determined by usage

rather than by fiat. IUGS would be well advised to place a moratorium on the new convention until a true consensus of those affected can be established.

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Christie-Blick suggests that many users in the geological community apply a diversity of usage. Firstly, there is no such thing as a monolithic "geological community". A significant part (one would be tempted to say "the best part") of the isotope geological community uses rigorous definitions. Certain islands in the stratigraphical subcommunity of the geological community may be slower in coming around. We have repeatedly read the statement by Christie-Blick that "According to this convention, and as noted in Christie-Blick (2009), "'90 Ma' and '100 Ma' refer to specific datums in the Cretaceous Period. The 10 million year interval between those datums is not written as '10 Ma' because that invites immediate confusion with a different moment in time, in the Miocene Epoch." The "invitation to confusion" might be problematic for one who is impervious to context, but strikes us as analogous to saying that "I eat lunch at 12:00 hours" is easily confused with "I eat lunch for 12:00 hours". We have yet to hear from Christie-Blick a specific and realistic case wherein real ambiguity (a) exists and (b) cannot be easily resolved with modest command of language.

Christie-Blick's objections to the Task Group's work had been widely circulated in 2009, again in 2010, and again in 2011, evaluated in depth at different levels (the Task Group itself, formed by reputed experts from both Unions; the reviewers of the two journals that simultaneously printed the convention: 'Episodes' and 'Pure and Applied Chemistry'; and the Executive Committees of IUPAC and IUGS), and invariably rejected.

It should be pointed out that the Systeme International d'Unites (SI) units are used both to denote an interval (the meter, the second, the kelvin, the ampere) and an absolute point. A current of 2 A (absolute point) is 0.1 A stronger (relative amount) than a current of 1.9 A (absolute point) and heats up a resistor by 0.2 K (relative amount) from an initial temperature of 298 K (absolute point). If Christie-Blick's point were justified, the use of the same unit, K, for a relative amount and an absolute point would cause confusion: every scientist would think that a temperature of 0.2 K is below the boiling temperature of liquid helium, and would expect this resistor to become a superconductor.

There is no need here for a moratorium. Scientific conventions do not have the power to enforce a ban. Feet and firkins are still used in parts of the world in lieu of m and m³. Units such as "knot" are even used in different meanings by carpet sellers and by seamen. What a scientific convention can do is point to what is considered correct as a result of very long and very careful evaluations of all possible arguments that are available at a given time. As is natural, those who hold an opinion that has been weighed on its merits and found too light are unhappy. Oh well.