

Is a Crystal a Quasi-Crystal?

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With interest I recently have read the discussion in *Zeitschrift für Kristallographie* on „What is a crystal?“ (Steurer, 2007). It served me as an excellent basis to learn (also from some other sources) the basics of what stands behind the term “quasi-crystal” I had heard and read of several times before (but without seeking for deeper insight). Some things – not all if we come to the more mathematical parts – have become much clearer now, but something confused me during my efforts to gain understanding and still continues to bother me: I think there is an inherent problem which is of primarily semantic nature.

The prefix “quasi” stands for “*as if*” or “having some resemblance”. And that’s why the inventors of the word “quasi-crystal” used it: their samples showed some resemblance to (“real”) crystals without being (“real”) crystals (referring here to the classical definition of “crystal”).

Now, the *new* definitions of the word “crystal” due to the IUCr commission (IUCr, 1992) and to R. Lifshitz (2007) pertain intentionally also to “quasi-crystals”. Thus, the latter now are “quasi-crystals” and “crystals” at the same time, which inevitably leads to semantic and mental confusion (are quasi-corporations corporations? Clearly not!). Moreover, the common non-mathematician’s brain refuses to accept that (classical) crystals are supposed to be a subclass of quasi-crystals (Baake & Frettlöh, 2007; Lifshitz, 2007). This may be correctly following from naming conventions in mathematics but it implies that *any* crystal (except if it happens to be an almost-crystal) is a quasi-crystal which sounds even more weird and proves – together with the above statement – that the terms “crystal” and “quasi-crystal” mean exactly the same (in contrast to the situation at the time the latter term was invented!). Ants are a subclass of insects, thus, we can safely state that fire ants are insects. But should we also tell our students that diamonds are quasi-crystals (or quasi-periodic crystals)?

To my opinion, there is only one real solution to these problems (which all newcomers trying to make themselves familiar with this matter will probably have to fight with): for the new “crystal” definitions to be less confusing, some other names and/or their meanings should be changed or re-defined, too. Suggestions follow (which neglect the potential existence of real “almost crystals”):

1. The name for “classical” crystals can be turned whenever required into “periodic crystal”, but “crystal” may still be appropriate as well.
2. The name for “quasi-crystals” with $D > d$ (Lifshitz, 2007) should be turned **without exception** into “quasi-periodic crystal” to avoid the equality between “crystal” and “quasi-crystal”,
3. The name “quasi-periodic crystal” should be used – as it is often done implicitly – **exclusively** for crystals with $D > d$ (including incommensurately modulated crystals),
4. If we mean **both**, periodic crystals and quasi-periodic crystals (as defined by 3.) the term “crystal” is completely sufficient (wasn’t the reason to redefine this term that it should cover both species? So why use an additional, pretendingly restricting term [quasi-periodic crystal] for this purpose?).

Items 2 and 3 would imply the change or re-definition of terms that have been in use for several years. This might look impertinent, on the other hand it would simply be a

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consequence of the paradigmatic change in a definition which was in use for several *hundreds* of years.

Anyway, if these rules were followed, everything would fit and sound reasonable: periodic crystals would be [a subclass of] crystals and quasi-periodic crystals would be [a subclass of] crystals. “Crystal” could mean both: either “periodic crystal” or “quasi-periodic crystal”, but the statement “a quasi-crystal is a crystal” would be obsolete. Diamonds would be periodic crystals as well as crystals, but they would have ceased to be quasi-periodic crystals. In other words: the common non-mathematician’s brain could breathe a sigh of relief.

References

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