Report of the ad-hoc Working Group on the mole to the 29th CCQM meeting

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Chair, ad-hoc Working Group on the mole (CCQM-ah-WG-mole)

1 Activities during the last year

The activities of the WG and its members in the past year have mostly been driven by the outputs of the CCU/CCQM Workshop on "The metrology of quantities which can be counted", held in March 2023, and the next steps agreed at the meeting. A published report of the workshop and its outcomes can be read here: https://doi.org/10.3390/metrology3030019.

1.1 Proposed revisions to the SI Brochure

Following the CCU/CCQM Workshop a Focus Group was formed within the CCU on Counting and Number Quantities (FG-CNQ). The terms of reference of the Focus Group were to review the SI Brochure and highlight the parts (text, tables, footnotes, etc) relevant to counting and number quantities and to attempt to reach consensus on updated entries for those parts where improvement would be beneficial. The FG-CNQ included several representatives from CCQM who presented at the CCU/CCQM workshop.

The FG worked entirely online. Initial proposals for edits to the SI Brochure were made by the chairman (R. Brown, NPL) in June 2023. There was then a commenting period until September 2023. These proposals were updated following the comments received and then were discussed at a meeting in September 2023, after which the proposals were finalised. These proposals were presented to the CCU meeting in April 2024 for approval.

1.2 Dialogue with IUPAC

The process of reviewing the SI Brochure highlighted a discrepancy between the definitions of elementary entity in the SI Brochure and in the IUPAC Gold Book.

- SI Brochure, 2.3.1, The mole: "An elementary entity may be an atom, a molecule, an ion, an electron, any other particle or specified group of particles."
- IUPAC Gold Book, https://doi.org/10.1351/goldbook.E02033: "Any countable object or event, but usually a molecule, an ion or a specified group of atoms."

There is now consensus that an elementary entity should not include any countable object, otherwise this leads to statements such as 'a mole of eggs', which is generally accepted as non-sensical. IUPAC have been contacted via Z. Mester (NRC) about reviewing the Gold Book definition and this is now in progress.

1.3 JCGM Working Group on the International Vocabulary of Metrology (JCGM-WG2:VIM)

The CCU/CCQM Workshop highlighted some new thinking about the treatment of counting and number quantities. These considerations are being taken forward separately by JCGM-WG2:VIM, many of whose representatives were present at the workshop. In particular, R. Brown (NPL), Z. Mester (NRC) and S. Ellison (LGC) attended the meeting of JCGM-WG2:VIM in December 2023.

2 Proposed future activities

2.1 Proposal for Task Group on Units and Quantities in Bioanalysis (TG-UQB)

At the CCU/CCQM workshop there was significant discussion about the various 'terms' or 'quantities identifiers' that are used in place of units to indicate the entities being considered when the values of quantities that are a number of entities are expressed – especially in chemistry and biology. Whilst this is not part of the SI it was recognised that this practice is widespread and there was agreement that it would be useful to harmonise the nomenclature and symbols used in this area. A presentation on this topic was made by R. Brown (NPL) to the joint Bioanalysis WGs meeting in Autumn 2023. The eventual aim could be for a documentary standard within the ISO/IEC 80000 *Quantities and units* series. To this end the ad-hoc WG mole proposes to form a new Task Group to progress this topic.

<u>Proposed TG Units and Quantities for Bioanalysis (TG-UQB)</u>

Proposed Chair: J. Huggett (LGC)

Draft Terms of Reference:

- Consult with the wider stakeholder community to identity key units and quantities relevant to CCQM that are commonly used in bioanalysis;
- Review the literature to identify the variety of terms employed to represent these units and quantities;
- Produce a document, along the lines of an ISO 80000 standard, proposing harmonisation of this usage, including guidelines for application to CCQM outputs;
- Engage with ISO TC12 on a new work item to formalise this document as part of the ISO 80000 series of standards.

If approved this TG would start work on its tasks during the coming year and report back on progress to CCQM at its 30th meeting.

2.2 Review of mise-en-pratique for the definition of the mole in the SI

In May 2024 it will be 5 years since the current *mise-en-pratique* for the definition of the mole in the SI was last updated and it is now due for review. The ad hoc WG mole will perform a review of the document in the coming year. An important input to the context of this review will be the proposed changes to the SI Brochure associated with counting and number quantities. Nonetheless, only minor changes to the *mise-en-pratique* are expected.

2.3 Terms of Reference

The terms of reference of the ad hoc WG mole are now out of date since they relate exclusively to activities prior to the 2019 redefinition of the mole. These will be updated during the coming year to better reflect current priorities and future activities of the WG.

2.4 Membership

The membership of the ad hoc WG mole is not well defined and will be reviewed during the coming year, most probably by asking for new nominations from each CCQM WG.