Bureau International des Poids et Mesures

Consultative Committee for Amount of Substance: metrology in chemistry (CCQM)

Report of the 17th meeting
(13-15 April 2011)
to the International Committee for Weights and Measures

Comité international des poids et mesures

Note:

Following a decision made by the International Committee for Weights and Measures at its 92nd meeting in October 2003, reports of meetings of Consultative Committees will henceforth be published only on the BIPM website in the form presented here.

Full bilingual printed versions in French and English will no longer appear.

M. Kühne,
Director BIPM

LIST OF MEMBERS OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE: METROLOGY IN CHEMISTRY AS OF 13 APRIL 2011

President

Dr R. Kaarls, member of the International Committee for Weights and Measures.

Executive Secretary

Dr R. Wielgosz, International Bureau of Weights and Measures [BIPM], Sèvres.

Members

Centro Nacional de Metrología [CENAM], Querétaro.

D.I. Mendeleyev Institute for Metrology, Rostekhregulirovaniye of Russia [VNIIM], St Petersburg.

Danish Fundamental Metrology Ltd [DFM], Lyngby.

Federal Office of Metrology [METAS], Bern-Wabern.

Institute for Reference Materials and Measurements [IRMM].

International Atomic Energy Agency [IAEA].

International Federation of Clinical Chemistry and Laboratory Medicine [IFCC].

International Organization for Standardization, Committee on Reference Materials [ISO REMCO].

International Union of Pure and Applied Chemistry [IUPAC].

Istituto Nazionale di Ricerca Metrologica [INRIM], Turin.

Korea Research Institute of Standards and Science [KRISS], Daejeon.

Laboratoire National de Métrologie et d'Essais [LNE], Paris.

National Institute of Metrology [NIM], Beijing.

National Institute of Metrology, Standardization and Industrial Quality [INMETRO], Rio de Janeiro.

National Institute of Standards and Technology [NIST], Gaithersburg.

National Measurement Institute, Australia [NMIA], Lindfield.

National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology [NMIJ/AIST], Tsukuba.

National Metrology Institute of South Africa [NMISA], Pretoria.

National Physical Laboratory [NPL]/Laboratory of the Government Chemist [LGC Ltd], Teddington.

National Research Council of Canada Institute for National Measurement Standards [NRC-INMS], Ottawa.

Physikalisch-Technische Bundesanstalt [PTB]/Bundesanstalt für Material-forschung und –prüfung [BAM]/Federal Institute for Materials Research and Testing, Braunschweig and Berlin.

Slovak Institute of Metrology/Slovenský Metrologický Ústav [SMU], Bratislava.

SP Technical Research Institute of Sweden (SP) [SP], Borås.

State Laboratory [SL], Co. Kildare.

VSL [VSL], Delft.

The Director of the International Bureau of Weights and Measures [BIPM], Sèvres.

Observers

Agency for Science, Technology and Research [A*STAR], Singapore.

Bulgarian Institute of Metrology, General Directorate "National Centre of Metrology" [BIM], Sofia.

Central Office of Measures/Glówny Urzad Miar [GUM], Warsaw.

Centro Español de Metrología [CEM], Madrid.

Cooperation on International Traceability in Analytical Chemistry [CITAC], Trappes.

Hungarian Trade Licensing Office [MKEH], Budapest.

Instituto Português da Qualidade [IPQ], Caparica

National Institute of Metrology [NIMT], Pathumthani

National Metrology Institute of Turkey/Ulusal Metroloji Enstitüsü [UME], Gebze-Kocaeli.

National Physical Laboratory of India [NPLI], New Delhi.

National Physical Laboratory of Israel [INPL], Jerusalem.

1. OPENING OF THE MEETING

The Consultative Committee for Amount of Substance: metrology in chemistry (CCQM)* held its seventeenth meeting at the International Bureau of Weights of Measures (BIPM), at Sèvres on 13-15 April 2011.

The following were present: H. Andres (METAS), L. Besley (NMIA), G. Carroll (SL), V.S. Da Cunha (INMETRO), R. Daroda (INMETRO), P. De Bièvre (IUPAC), S. Ellison (LGC Ltd), H. Emons (IRMM, ISO REMCO), A. Fajgelj (IAEA, IUPAC), P. Fisicaro (LNE), T. Fujimoto (NMIJ/AIST), B. Güttler (PTB), Q. Han (NIM), E. Hwang (KRISS), H.D. Jensen (DFM), R. Kaarls (President of the CCQM), K. Kato (NMIJ/AIST), M. Kühne (BIPM Director), Y. Kustikov (VNIIM), H. Li (NIM), W. Louw (NMISA, CITAC), L. Mackay (NMIA), B. Magnusson (SP), M. Máriássy (SMU), W.E. May (NIST MML), J. Meija (NRC-INMS), Z. Mester (NRC-INMS), M.J.T. Milton (NPL), Y. Mitani (CENAM), U. Panne (BAM), H. Parkes (LGC Ltd), M. Sargent (LGC Ltd), M.P. Sassi (INRIM), M. Sega (INRIM), H.-Y. So (KRISS), R. Sturgeon (NRC-INMS), W. Unger (BAM), S. Vaslin-Reimann (LNE), R. Wessel (VSL), S. Wise (NIST).

Observers: O. Cankur (UME), T.C. Chye (A*STAR), F. Dias (IPQ), P.K. Gupta (NPLI), W. Kozlowski (GUM), I. Kuselman (INPL), K. Obromsook (NIMT), A. Rakowska (A*STAR), A. Rojo Sebastan (CEM), Z.N. Szilágyi (MKEH), P. Totarong (NIMT), A. Zoń (GUM).

Invited: M. Buzoianu (INM), L. Caleb (KEBS), M. Cox (NPL), L.T. Kooi (HSA), E. Lampi (EXHM GSCL-EIM), J. Marriott (LGC Ltd), G. O'Connor (LGC Ltd), O.T. Owiti (KEBS), R. Parris (NIST MML), C. Puglisi (INTI), A. Rosso (INTI), D. Wai Mei Sin (GL), S. Stein (NIST), M. Suchanek (Eurachem), P. Ulbig (PTB), L. Wu (NIM), Y.-H. Yim (KRISS).

Also present: A. Daireaux (BIPM), R. Davis (BIPM), E. Flores Jardines (BIPM), R. Josephs (BIPM), S. Maniguet (BIPM), P. Moussay, T.J. Quinn (BIPM Emeritus Director), N. Stoppacher (BIPM), C. Thomas (BIPM), J. Viallon (BIPM), S. Westwood (BIPM), R. Wielgosz (Executive Secretary of the CCQM, BIPM).

Sent regrets: D. Craston (LGC Ltd), M. Fernández Vicente (CEM), M. Müller (IFCC), M. Pérez-Urquiza (CENAM), M. Rocío Arvizu-Torres (CENAM), N. Gonzalez-Rojano (CENAM), S. Prins (NMISA), A. Squirrell (ILAC), R. Watters (NIST).

*For the list of acronyms, click here

Dr Kaarls, President of the CCQM, officially opened the 17th meeting of the CCQM, noting that a CCQM mini-workshop on relative molecular mass measurements for the identification of peptides, proteins and other molecules had been successfully convened the afternoon of 13 April (see note in section 3). Dr Kaarls passed the floor to Prof. Kühne, Director of the BIPM, who extended a general welcome to all participants and observers, noting that the CCQM is by far the largest committee to meet at the BIPM, especially when taking into consideration the large number of experts attending the meetings of the working groups. Following some brief housekeeping announcements and a round table self-introduction by all participants and observers, the President announced the death of two long-standing active members of the metrological community during the past year, Dr Philippe Charlet (LNE) in December 2010, and Dr Margherita Plassa (INRIM) in June 2010. He provided brief eulogies for both and subsequently invited all participants to observe a one minute silence in their memory.

2. APPOINTMENT OF A RAPPORTEUR

Dr Kaarls proposed that Dr Sturgeon act as rapporteur for the meeting. Dr Sturgeon agreed.

3. APPROVAL OF THE AGENDA

Dr Kaarls noted that the Plenary session officially started on 12 April 2011 with the successful hosting of a 'mini-workshop' on relative molecular mass measurements for the identification of peptides, proteins and other molecules. Presentations were made by Dr Meija, Dr Yim, Dr O'Connor, Dr Stein and Dr Liqing with a wrap-up panel discussion moderated by Dr O'Connor. Dr Kaarls noted that many issues remained to be addressed and that additional resources need to be devoted to this area. Dr Kaarls requested that, in consultation with other experts, Dr O'Connor prepare a summary report, to outline the principal issues and define what needs to be addressed to better formulate the way forward.

The agenda was subsequently approved without change and no additional points were raised.

4. REPORT ON THE SIXTEENTH MEETING OF THE CCQM

No comments were made with respect to the report of the 16th meeting of the CCQM, which Dr Kaarls subsequently declared approved; Dr Sturgeon was thanked for his work in preparing the report.

5. REPORT AND DISCUSSION ON THE REDEFINITION OF THE MOLE AND DRAFT *MISE EN PRATIQUE*

Three speakers were invited to initiate the discussion on this subject: Dr Thomas, Prof. De Bièvre and Dr Milton. Dr Kaarls noted that the CCQM *ad hoc* working group on the redefinition of the mole had met on 12 April 2011 and that Dr Milton would present the outcome of the meeting.

Dr Thomas, Executive Secretary of the Consultative Committee for Units (CCU), made a presentation on behalf of Prof. I Mills (President of the CCU) on the possible future revision of the International System of Units (SI). At the 99th meeting of the CIPM in October 2010, a draft resolution was prepared for the CGPM, based on advice offered by the CCU at its 20th meeting in September 2010. This included CCU Recommendation U 1 (2010) – "Proposal to the CIPM on elements for a draft resolution for the CGPM at its 24th meeting on the revision of the International System of Units, the SI".

In an effort to enhance awareness of the possible future revision of the SI, the BIPM launched an open access website (http://www.bipm.org/en/si/new_si/) in February 2011 devoted to the "New SI" which contains presentations given at the Royal Society discussion meeting on 24-25 January 2011, together with an assortment of frequently asked questions. National Metrology Institutes (NMIs) are invited to link their homepages to this new website. It was noted that Chapter 2 of the 9th edition of the SI Brochure is now in draft form, and is available on the BIPM website. It informs SI users of the proposed changes to the SI. It will continue to be amended and will be proposed to the CIPM for approval when the redefinition has taken place.

A brief discussion followed. Dr Kaarls noted that there should be no debate during the meeting of the CCQM about the definitions of any of the other SI units. Prof. De Bièvre questioned whether the topic was still open for discussion and asked about the impact of the next CODATA evaluation on changes to values of the fundamental constants. Dr Thomas reminded everyone that Draft Resolution A remains a draft and that it only expresses an intention to move forward. With regard to CODATA, the most recent adjustment of all numerical data for the constants will be taken into account when a redefinition occurs. Prof. De Bièvre questioned what would happen to these constants 10 years into the future, to which Prof. Kühne replied that value adjustments had previously been made every 4 years but would no longer be undertaken after they are numerically fixed (as is the current case for the speed of light). Dr So asked for an explanation of the

relationship between CODATA and the CCU to which Dr Quinn (BIPM Emeritus Director) clarified that CODATA is an organization under the auspices of the International Council of Scientific Unions and independent of the CCU. The CODATA Task Group on Fundamental Constants is, however, an official member of the CCU.

Prof. De Bièvre proceeded to present some key concepts which he asserted should not be overlooked by the CCQM in the discussion on the redefinition of the mole. He stressed a point raised in the minutes of the 16th meeting of the CCQM that, prior to any change, a more widespread understanding of the concepts and their acceptance within the chemical community must be achieved and that the BIPM, the NMIs and other official representatives to the CCs should increase their efforts to spread awareness. Prof. De Bièvre noted that the Interdivisional Committee on Terminology, Nomenclature and Symbols (IUPAC-ICTNS) is in accord with a definition of the mole as stated by the CCU wherein the value of N_A is fixed as 6.022 14X $\times 10^{23}$ per mole and that the change in definition is supported by IUPAC. However, this support is given with a recommendation to change the name of the base quantity "amount of substance" in the International System of Quantities (ISQ) at the same time that a new definition of the mole is approved. It is also recommended that a note should accompany the new definition to explain that the molar mass of ^{12}C will be a quantity to be experimentally determined, with a relative standard uncertainty in the order of 10^{-9}. Prof. De Bièvre proceeded to summarize a number of his own observations from the chemical measurement community which reflected on the difficulties related to teaching and understanding the concept of the mole. Prof. De Bièvre believes that these arise from the ambiguity in its definition and the discontinuity of matter, and provides arguments that chemical principles are most easily and conceptually treated from the viewpoint of entities, numbers and number ratios. Prof. De Bièvre proposed that since numerosity is a property of matter, it follows that the base quantity should be "number of entities". Prof. De Bièvre suggested that the unit of measurement for "number of entities" should be the mole (symbol mol), being the number of entities exactly equal to 6.022 14X $\times 10^{23}$. After noting that an in-depth discussion of these concepts will take place at the IUPAC general Assembly in San Juan, Puerto Rico, in July/August 2011 he reiterated his high regard for the relationships which exist between the fundamental constants, but restated his strong belief that the units must be understandable and teachable.

Dr Kaarls noted that many new points had been raised, and that there was no opportunity at this CCQM meeting to undertake an in-depth discussion of everything that had been mentioned. Prof. Kühne pointed out that the proposed new definition of the mole was entirely consistent with a fixed value of the Avogadro constant as described by Dr De Bièvre; he thus could not foresee a problem with its understanding. Prof. De Bièvre stated that although he had earlier been inclined to agree with this new definition, he could no longer support it because of the issues surrounding how easily it could be taught. Dr Quinn clarified that the issue being targeted is not that of counting but of quantity and what that quantity should ultimately be named. This raises a problem because the names of quantities are agreed by ISO and IUPAC and if the name is to be changed there needs to be a discussion between these two bodies and others affected by the proposed change.

Dr Quinn agreed that it is a difficult task to consult with the wider chemical community about proposed changes but at least the process had been initiated within IUPAC. Dr Fajgelj stated that the comments expressed by Prof. De Bièvre must be considered as his own personal views, and not those of the IUPAC. Dr Wielgosz clarified and commented on Dr Quinn's earlier remarks that for the quantity 'amount of substance' the unit is the mole, whereas for the quantity 'number of entities' the unit is one. Dr Wielgosz noted that there is a need to clarify quantities and units which are to be used for enumeration, especially for the biotech sector. Prof. De Bièvre reiterated that he is concerned about the future impact of such change and argued again that clarification is required over the quantity. Dr Kaarls closed the debate noting that IUPAC would have further discussions on the matter.

Dr Milton, the chair of the *ad hoc* working group on the redefinition of the mole, presented the outcomes of the second meeting of the *ad hoc* working group held on 13 April 2011. He began by suggesting that the origin of the term "amount of substance" was not well understood within the chemical community and he reviewed its historical evolution. Dr Milton showed that the origins of the use of the term mole could be traced back to the 1893 texts by Ostwald and Nernst in the terms Kilogrammolekuel and g-Molekuel, shortened to Mol. The origin of the term "amount of substance" was due to Guggenheim [*Phil. Mag*. **33**, 479-496 (1942); *J. Chem. Ed*., **38**, 86-87 (1961)]. The current definition of the mole was adopted in 1971 by the 14th CGPM. Dr Milton described how the atomic mass scale and the macroscopic world are linked to the Avogadro constant. He explained that the proposed new definition of the mole will lead to a reversal of the current situation, in that the number of entities in one mole would be in the future, exactly specified, whereas the mass of one mole of ^{12}C will acquire a relative standard uncertainty approaching 1×10^{-9} dominated by contributions from the fine structure constant (squared). The redefinition of the mole may take the form: "the mole is the amount of substance of a specified elementary entity, which may be an atom, molecule, ion, electron, any other particle or a specified group of such particles; its magnitude is set by fixing the value of the Avogadro constant to be equal to exactly 6.022 14X $\times 10^{23}$ when it is expressed in the unit mol^{-1}".

Dr Milton reported that the second meeting of the *ad hoc* working group on the mole reviewed the 2009 CCQM Resolution CCQM/09-24 and noted that, although 10-fold smaller, the discrepancies between the watt balance and International Avogadro Project determinations of N_A have not been resolved, nor have those for the determination of N_A based on natural and enriched silicon. Furthermore, overall awareness of the proposed change within the chemical community remains low. Among the outcomes of the working group meeting were suggestions to encourage members of the CCQM to approach influential national and international bodies with responsibility for chemical measurements. Dr Milton noted that NIST had been active in engaging the American Chemical Society at several meetings, but that this is not reflected by other NMIs world-wide. The working group proposed that a written request should be sent from the BIPM to the President of IUPAC to inform about the proposed redefinition and the consequent proposal to redraft the *mise en pratique* for the mole, and request that the President of

IUPAC informs the BIPM of progress in the consultation with members and stakeholders. Work on redrafting the *mise en pratique* will be undertaken and a CCQM workshop to be held in April 2012 has been proposed as a forum to invite speakers to deliver feedback on the nature of the engagement they have had.

Dr Kaarls thanked Dr Milton for the historical background and the proposal for a CCQM workshop; he requested a draft Statement for the CCQM to be available for 15 April 2011 and that a final version could be tabled before closure of the meeting. Dr Wielgosz read the draft Statement (see Appendix 1, "On the need for consultation over possible redefinition of the mole"). Dr Quinn expressed surprise over the wording of the request because IUPAC had already expressed support for the changes. Prof. De Bièvre noted that he attended the IUPAC General Assembly meeting in 2009 and it had been apparent that deep reflection had not been given to the subject; he therefore supported the draft Statement. Dr Fajgelj strongly supported the draft Statement because it would expand debate on the subject. Dr Milton believed that there had indeed been approval from the Interdivisional Committee on Terminology, Nomenclature and Symbols (ICTNS) for the proposed changes, but his preference is to formally invite further engagement with IUPAC at the next meeting of the CCQM. Prof. Kühne will issue a letter that will note that IUPAC approval had been obtained and will enquire about progress under the consultation among member bodies of IUPAC. Dr Kaarls assured that appropriate language will be used and recognized that there is a clear need to ensure the widest consultation is achieved.

6. SUMMARY OF THE CCQM WORKSHOP ON MICRO-BIOLOGY

Dr Kaarls presented a brief summary of the meeting held on 6-7 April 2011 at the BIPM headquarters which focused on food quality and safety. A wide stakeholder community (45) from around the globe representing farms and the food industry, food testing laboratories, food testing kit manufacturers, the International Dairy Federation, regulators and food safety authorities (FDA, USDA, EU-RL, FAS), members of APEC, standardization bodies (AOAC, ISO/CEN), CRM producers (ATCC, IRMM, LGC), proficiency providers and NMIs discussed current measurement problems/issues relating to sampling, cell/organism growth, colony count, detection, isolation, identification, characterization, methodology, reference methodologies and assay techniques for the assessment of pathogens (bacteria, viruses, fungi, moulds, yeasts, etc). Problems associated with ill-defined measurands, unsound (metrological) reference methods, insufficient global harmonization, lack of calibration chain/hierarchy and a lack of CRMs were identified. It was unanimously agreed that urgent cooperation between the metrology and the microbial food communities is desirable and, as a consequence of this agreement, an *ad hoc* joint steering group will be created to further this aim. The CCQM agreed to organize the steering group by appointing a group chair (a metrologist) from one of the participating NMIs.

Dr Emons opened the comments with a confirmation that the real issue revolves around the question of the measurand and not what is intended to be measured but what exactly is

being measured; noting that there is a need to firmly integrate the various standards bodies into the process, otherwise there can be no progress. Dr Kaarls confirmed that this has been done. Ms Parkes noted that this was a very participative workshop and that the key issue was standardization and that this need was not being met. Both the AOAC and ILAC technical committees present agreed, together with the chair of the ISO/TC 34 SC 9 (Microbiology), that they will work with the metrology community to assure success. Dr Kaarls reiterated that counting techniques were essential to this community and that this needs to be revisited by the CCU so that it can be recognized also within the CIPM as a means of measurement; a note was made that a Recommendation (Q1, see Appendix) will be drafted to the CIPM so that the SI brochure can be extended to provide guidance on units for the expression of measurement results based on counting. Dr Besley asked if there were plans to publish the presentations made at the workshop to promote their wider readership, to which Dr Kaarls replied that plans were being made to make them publicly available.

7. STUDY ON METROLOGY FOR THE BIOSCIENCES

Dr Marriott addressed the development of the document, "Study of Measurement Service Comparison Needs for an International Infrastructure for the Biosciences and Biotechnology: Input for the BIPM Work Programme" released as a hard copy (document BIPM-2011/02) by the BIPM on 4 March 2011 and also made available on the BIPM website (http://www.bipm.org/utils/en/pdf/Biostudy_report_final.pdf). The study was commissioned by the BIPM to provide input into the future requirements for the BIPM laboratory programme, and to act as a useful reference for NMIs developing similar programmes, with a focus on protein and nucleic acid measurements for healthcare. Specific objectives were: the determination of the measurement services required to establish an international measurement infrastructure for biosciences covering the next 3–10 year period; the determination of international comparisons required to demonstrate equivalence of measurement services; and to determine the R&D activities needed to develop higher order measurement standards and methods. To aid in this task, a review of published roadmaps (NIST documents, Euramet programme outline, UK National Measurement Office, ISO Task Force on Biotechnology) and strategies was undertaken, CCQM BAWG activities were studied, visits and interviews with selected NMIs and other measurement institutes were completed together with those of representatives from key sectors of the bio-industry and regulators. The study commenced in September 2009, a draft document completed in July 2010 was submitted for public consultation, and the final version forwarded to the BIPM in January 2011. In regard to those NMIs with bio-activities considered in this study, typically 10 full time equivalent staff have been allocated to such programmes, with an expected growth of 10 %–25 % over the next few years primarily in areas devoted to diagnostics, with an emphasis on the determination of proteins and nucleic acids. Less comprehensive interviews with industrial organizations revealed similar principal activities together with cell-based bioassays. Within the

diagnostics industry, methods are based primarily on mass spectrometry, with an expressed need for reference materials. Regulators had expressed concern over the confusion which is likely to arise during migration from IU to SI units, a process which will require careful coordination, and the length of time needed prior to the release of new reference materials. The biopharmaceutical industry highlighted the need for well characterized reference materials to help with calibration of "black box" instruments, and in bio-pharma products standards for water content were highlighted as a requirement. Primary amino acid calibrators and improved mass spectrometric methods for peptide mapping, glycan measurements and tertiary structural mapping of proteins, reference methods or standards for bio-assays and validated methods for nucleic acid analysis were also proposed. Major conclusions relating to proteins included work to underpin traceability of quantitative measurements to the SI, particularly for simple proteins such as insulin and hGH; a strengthening of cooperation between the WHO, IFCC, BIPM and NMIs to ensure a coordinated approach to the migration from IU to SI units; further work to develop an approach to metrological principles, where traceability to the SI is unlikely to be feasible, in more complex proteins; validation of measurement approaches for personalized medicine; and how to develop traceability chains for inherently unstable proteins. Due to the sheer magnitude of the number of measurands, serious thought must be given to alternative means of assuring the validity of all protein measurements to enable development of bio-measurement CMCs. With regard to nucleic acids, there is a need to develop techniques to treat measurement uncertainty in sequence determinations; improve procedures for "total" DNA and RNA measurements and multiplexed nucleic acid measurements; and consider the implications for the use of counting techniques and the relationship to the mole and availability of international reference DNA databases.

Dr Emons noted that during the time taken for this study some progress had been made in the field, citing that several PCR reference materials are now available and that others are on their way. The frustration frequently raised by stakeholders over the slow progress in the development of reference materials lies primarily with the community itself. There is no community agreement on what to measure, hence the problem of what to develop, either with respect to a harmonized reference method or a reference material, appears to be an impasse. Dr Marriott stated that the technology is moving quickly and that perhaps the issue is how to short-circuit these issues and move forward with a view that "something may be better than nothing". Dr Güttler agreed that one problem arises because there is a need to identify (disease) biomarkers and determine, with feedback from the biomedical community, whether the measurand is relevant to illness or not. Dr Wielgosz thanked Dr Marriott and the working group for conducting the study on behalf of the BIPM and noted that it fulfils the needs of the BIPM and provides a useful reference for stakeholders, predicting that it will be cited many times in the future.

8. SUMMARY OF ACTIVITIES RELATED TO MATERIALS METROLOGY

Dr Kaarls explained that the issue of moisture in grain was tabled because a number of NMIs were interested in making CMC claims in this area, but faced problems because the

determination is not ‘measurand defined’ but ‘method defined’. After having been referred to the IAWG for initial discussions, it was concluded that there was no expertise therein to support such an activity. However, it was noted that the CCT WG on humidity reported that Euramet Project 1061 was engaged in the evaluation of the current status of work in NMIs on the measurement of moisture in materials, and was gathering opinions on future directions. It was concluded that measurement of weight loss on drying (i.e. moisture) relies on industry standard protocols and this measurand may not be in the scope of the CCQM. Irrespective of this, there is a need to address this issue, and Dr Kaarls called upon Dr Güttler for input. Dr Güttler referred the issue to the legal metrology group at PTB and asked Dr Ulbig to make a presentation to the CCQM on this matter because he has experience in the subject.

8.1. Moisture in grain

Dr Ulbig (with colleague Ms Klüβ, PTB) discussed moisture in grain and the relationship to CMCs. The short introduction described the nature of grain and why the determination of moisture is so important. Dr Ulbig also described the critical limits with respect to the grain being either too dry or too wet and the detrimental effects that can occur during storage. This leads to critical economic considerations as many countries have legal requirements for grain moisture measurements and a simple measurement uncertainty of only 0.2 % is equivalent to elevated costs of 900 million Euro to the grain economy due to the extremely large volume of traded grain ($700 billion globally). Grain moisture is methodologically defined and is based on ISO standards 711, 712, 6540 and 665 for various cereal and grain seeds. The fundamental requirement is the removal of moisture from the product while avoiding any alteration in its chemical composition. This is achieved by advocating that specified grinding and drying conditions be utilized. The difficulty, illustrated for cereals, is that ISO 711 specifies one set of conditions whereas ISO 712 (reference method) specifies different conditions. In 2006, PTB conducted a German inter-comparison specifying apparatus and procedures which resulted in values in the range of ± 0.15 % with a ± 0.5 % verification limit. As a consequence, ISO 712 was modified to specify the temperature range and type of grinding mill as well as cooling time before weighing. Dr Ulbig considered the 2008 COOMET comparison project No. 436/RU/08 on humidity in barley which involved 5 countries utilizing protocol ISO 712. Results were in agreement within a range of ± 0.15 %, but it remained unclear as to whether a correct value had been achieved. A number of final proposals arose from a consideration of these issues, including: the metrology within ISO 711 should be further developed by OIML TC17/SC1 with agreement among all parties involved at OIML that such a reference procedure is required; a pilot comparison study based on such a standard should be organized with further steps dictated by the outcome of the study.

Dr Kaarls remarked that the issue is of interest not only to COOMET countries but to many others around the world. It is recognized that the measurand is method dependent and thus a globally accepted measurement procedure must be developed and applied. This is recognized by the CCQM as necessary to move forward, and a reference level

methodology is needed, not a field method, but the connection between the two must be readily evident. Earlier in 2011 a meeting with representatives of the OIML was held but one question remained outstanding – is the OIML the best organization to develop a globally accepted procedure because the role of ISO must also be considered. Dr Ulbig replied that within OIML TC17SC1 there are a number of NMIs and, as metrologists, these members could develop a paper based on ISO 711; in addition, there are numerous contacts between OIML and ISO, currently it is unknown to what extent it will be necessary to change ISO 711. Dr Wielgosz asked for clarification of whether ISO 711 is accepted by CODEX. Dr Emons stated that there is a clear mandate to specific international organizations for the development of such standards and that the CCQM should not interfere with this process. Dr So raised the question as to why this topic is on the CCQM agenda. The issue is understood to be an important measurement, but the measurand should be of interest to the CCT. Dr Kaarls reiterated that no information or help has been forthcoming from earlier discussions within the CCQM or CCT groups which had expressed no interest or competence in the issues and the issue had to be addressed because it underpins some CMC claims. Dr Kaarls emphasized that there is a need to find a solution to this issue and that the purpose of this presentation is to propose a way forward, through the development of a standard methodology. Dr Fajgelj noted that this problem is faced by every inter-laboratory comparison wherein a material must first be dried; he suggested that the term "primary" method be changed to "reference" method. Dr Besley noted that the CCQM might contribute to this issue by the preparation of a reference material to support such measurements. Moreover, infrared (IR) measurements are used in the field in Australia to make (immediate) measurements of moisture and perhaps this is worthy of further consideration. Dr May agreed with the earlier comments made by Dr So and noted that this issue had also been discussed by the OAWG during its meeting in Korea; the consensus there was that this is not something that falls within the scope of the CCQM, primarily because the measurand is ill defined. If the measurand had been water and not moisture, then this would be a different issue. Every problem of international scope that involves a chemical measurand is not necessarily something that the CCQM should become involved with and if there is a group of NMIs with a common interest then they could proceed to discuss and resolve the issue but not within the remit of the CCQM. Dr Kaarls expressed his disagreement with this argument. He stated that when there is a group of NMIs that wish to claim CMCs, the way forward is to standardize and hence the necessity to become involved. Dr Güttler stated that a well defined procedure is needed and that current ISO guides are not sufficient for this purpose. What is needed is a coordinated effort to develop a suitable reference procedure. Dr Güttler questioned if this work was done, would the CCQM be able to undertake a comparison in support. Dr Kaarls noted that there are many measurands that are methodologically defined and they cannot be neglected simply for this reason. Dr Kaarls suggested that, in this case, OIML should lead in the development of a globally accepted procedure in close cooperation with other stakeholders such as CODEX and ISO. Dr Besley asked if OIML would seek assistance from the CCQM on this issue; Dr Kaarls was uncertain. Dr Besley stated that the CCQM should not enter into the development of such standards, but that it does have a role in developing reference standards that can be used to support such measurements.

Furthermore, Dr Besley disagreed with the suggestions made by Dr So and Dr May that this issue does not fall within the scope of the CCQM. Again, Dr May disagreed because water is not the measurand. Dr Besley agreed but noted that water could be the measurand for the CCQM to use, and on which to base a future reference material. Dr Kustikov thanked the members for their consideration of this matter and concluded that this important problem could be solved with help from the CCQM. Dr So returned to the idea of interested NMIs cooperating to participate together with COOMET on a measurement comparison. Dr Kaarls reiterated that his conclusion is that agreement is needed on a globally accepted standard measurement procedure and that CCQM is not a standards writing body, and for this reason the CCQM needs to return this issue to OIML, ISO and CODEX. The current proposal describes the OIML taking the lead in this issue. Dr Kaarls summarized once again that a number of NMIs had some interest in this measurand and he recommended that these NMIs discuss and consider the development of parallel work on potential suitable measurement procedures.

9. REPORTS OF CCQM WORKING GROUPS

9.1 Gas analysis

Dr Milton summarized the activities of the Gas Analysis Working Group (GAWG) since April 2010. The 24th meeting was hosted by NMC A*STAR and HSA (Singapore) in November 2010 and the 25th meeting was held at the BIPM in April 2011. Six comparison reports have been moved to the KCDB and 4 new comparisons were agreed. Dr Milton described the complete range of key comparisons, from the core (binary) mixtures to fuel gases (mainly natural gas, but recently synthetic refinery gas), forensic and indoor air quality gases regulated in different areas around the world (ethanol and VOCs), emission level studies and gases associated with air quality and also those concerned with atmospheric monitoring, which are being developed in close collaboration with the Global Atmosphere Watch Programme of the WMO.

Dr Milton then discussed CCQM-K66 (purity of methane, coordinated by NMIJ), the first comparison specifically targeting gas purity analysis. This study had proved to be difficult to organize because of inhomogeneity in the standards used, with the result that the KCRV had been calculated using the excess variance method (discussed by Dr Cox, see section 9.8).

CCQM-K74 (nitrogen dioxide in nitrogen, coordinated by BIPM) had strong participation with excellent results. Particular challenges faced in this comparison included the storage of NO_2 in cylinders and its inter-conversion to other species. Standard relative uncertainties approaching 0.3 % were shown to be achievable for this difficult system. The same standards were used for CCQM-P110 (coordinated by BIPM) in which FTIR methods of analysis with traceability to spectroscopic line strength data were used to obtain results in agreement with the reference value, but with relative uncertainties of

around 5 % (10 % for less experienced laboratories). This finding is significant as this is the first such side-by-side comparison of these methodologies conducted impartially.

CCQM-K76 (sulfur dioxide in nitrogen, coordinated by NIST) obtained results which illustrated good capabilities for the majority of NMIs, with uncertainties in the order of less than 1 %. Such capabilities could not have been anticipated five years earlier.

CCQM-K77 (synthetic refinery gas, coordinated by VSL) served as an example of a class of fuel gases and was significant for carbon trading and industrial energy costs. Many plants use by-product gases as fuels and mixtures can be complex, including eight hydrocarbons, hydrogen, nitrogen and helium. Credible results were achieved.

Planning is under way for a suite of comparisons underpinning a strong relationship with the WMO, one of these being CCQM-K82 (methane in air, coordinated by BIPM and NIST). This measurand has been monitored by WMO and NOAA for several decades as methane is the second most important greenhouse gas, and a resolution of 1 ppb is needed at concentrations of 2 ppm to examine annual cycles. Special consideration is being given to the balance gas (either real or synthetic air) as matrix effects can be significant at this level of accuracy. This comparison will run in preparative mode where laboratories send samples to the BIPM. The BIPM is currently validating its measurement facilities with a suite of standards prepared by NIST.

CCQM-K90 (formaldehyde in nitrogen, coordinated by BIPM) is important for atmospheric monitoring as well as indoor air quality. A facility has been assembled at the BIPM to generate HCHO dynamically as well as to determine its purity and concentration by cavity ring down spectroscopy.

Euramet 1002, involving NPL, PTB, NIST and NMIJ, involved a comparison of standards for trace water vapour, which is of interest because each NMI utilizes a different in-house system to realize their national standard. This necessitates that a stable instrument (cavity ring down spectrometer) is used as a transfer standard. Over a period of three years, a reference consensus value was established with consistent results, well within 5 %, and suitable for customer needs. The amount fraction values investigated were reduced to 10 nmol mol^{-1} with corresponding dew points in the range of −100 ^{o}C.

Two proposals have been received for new comparisons within the CCQM; the first is a preparative comparison for ethanol in nitrogen (coordinated by NPL), the second being dimethyl sulphide in nitrogen (coordinated by KRISS), of interest to only a few NMIs but offering support to the WMO.

Dr Milton then considered Cycle XII CMCs and the KCWG. During a review undertaken earlier in the week (April 2011) an issue arose concerning the claimed uncertainties on CRMs that needs to be addressed. This will be discussed in future meetings. Alignment with the way this is done within ISO TC58 will be targeted. Some claims of core CMCs were made and suggestions offered to the KCWG for re-review in Cycle XIII, including NO, SO_2 and propane, thereby completing the re-review of the first set of CMCs.

CMCs for core mixtures were examined and an agreed range for measurands established for a number of compounds (CO, CO_2, O_2, methane, propane, NO, SO_2), each in air or

nitrogen. This streamlines the process and removes the need to repeat older Key Comparisons while it retains the HFTLS approach based on existing principles.

With respect to international issues, the absorption cross-sections for ozone and the impact of setting ranges for atomic weights were examined. With respect to ozone, the traceability for many measurements depends on spectroscopic instruments and cross-section information normalized at various wavelengths to those defined by Hearn at 253.7 nm. During preceding years, the absorption cross-sections have been re-examined and in 2012 it is proposed that the recommended values will be derived from the Reims group, instead of the current widely used Bass and Paur values. This will result in a reduction of 1.5 % in the bias between UV photometry and gas phase titration techniques. As a consequence, all urban ozone values established previously will change by 1.5 %. The BIPM has contacted ACSO (Absorption Cross Sections of Ozone), an *ad hoc* commission held under the auspices of the WMO, in an effort to have the impact of this decision on current measurements considered and uncertainties of the proposed values provided.

A second international issue is related to the changes implemented by IUPAC on the atomic weights of the elements in 2009. Gas laboratories determine concentrations based on knowledge of atomic weights, as they typically do not determine isotopic compositions. In the past, the uncertainties of the atomic weights were typically 5–10-fold smaller than comparison uncertainties, but various laboratories used different atomic weight values with no justification (some used 2005 atomic weights). The 2009 values recommended by IUPAC (document CCQM/11-07) indicate either ranges on standard atomic weights for a number of elements, with the suggestion that the associated uncertainty need not be derived from a simple rectangular distribution, or provide conventional atomic weights and uncertainties. The GAWG considered this situation and recommends that appropriate conventional uncertainties are established and used for atomic weights within the gas community. The GAWG will communicate this to ISO TC158 and invite them to provide input from the industrial community.

Dr Milton outlined the 2009-2012 gas metrology programme at the BIPM, covering BIPM.QM-K1 (ozone), greenhouse gas measurements (CCQM-K82, methane in air) and planning for the work on formaldehyde. A comparison of NO_2 coordinated by the BIPM was successfully completed. Further information on the programme will be given during a presentation by Dr Wielgosz.

The 26th meeting of the GAWG will be held in Boulder, CO, USA, and hosted by NOAA for a session devoted to activities of mutual interest, including a tour of the NOAA facilities. A second session hosted by NIST will cover other aspects of the agenda not directly of interest to the atmospheric monitoring community. This will provide an opportunity to reinforce the agreements established with the WMO on how to progress with standards and develop some of the resolutions made in a practical way.

No questions or comments were raised for discussion and Dr Kaarls thanked Dr Milton and the GAWG for the significant progress made during the past year.

9.2 Inorganic analysis

Dr Sargent presented an overview of the activities of the Inorganic Analysis Working Group (IAWG) during 2010-2011, noting the interim meeting hosted by Boras SP on 29 September–1 October 2010 as well as meetings held during April 2011. Both occasions permitted joint meetings with the EAWG. Since 1998, 34 Key comparisons have been undertaken with 28 approved, 3 in progress, 2 planned and 1 report in progress. A comprehensive summary of the Key Comparisons in progress as well as Pilot studies in progress was given; most Pilot studies had been conducted in conjunction with Key Comparisons. Participants in the IAWG had been asked to ensure that draft reports were produced within a reasonable time frame after the study was completed. A summary of four regional comparisons, which are now being tabulated and treated in the same manner as CCQM Key Comparisons, was presented and included core competency considerations. Dr Sargent proceeded to briefly highlight 3 CCQM and 1 regional Key Comparison.

CCQM-K87 / CCQM-P124 (Elemental calibration solutions, coordinated by PTB) is significant because a large number of NMIs have CMCs for this activity. Nine solutions containing Cr, Co and Pb were prepared by PTB, which allowed a calculated KCRV for each case, based on gravimetry, to be undertaken. A prepared calibration solution, an unknown sample and a commercial calibration solution were made available which permitted an assay of the unknown using the provided calibration solution as well as by the participants' calibration standard. As this was a benchmarking exercise, 19 NMIs participated in the study with a further 4 NMIs and 2 industrial laboratories undertaking a parallel Pilot study. The identity of the industrial laboratories remained anonymous. The performance of most laboratories was excellent, within the targeted uncertainty of 0.5 %.

CCQM-K88 / CCQM-P125 (lead in lead free solder, coordinated by NMIJ, assisted by NIM and KRISS) addressed issues relating to the RoHS Directive for Electronic Materials. A robust number of participants were engaged, most relying on mass spectrometry or emission techniques for the measurements and a median was adopted for calculation of the KCRV.

CCQM-P96.1 [As and arsenobetaine (AsB) in an AsB standard solution and fish, coordinated by NMIJ] was pursued subsequently to CCQM-P96 because of the difficulties encountered with the latter comparison, for which discrepancies between two commercially available AsB standards existed. Excellent agreement was achieved when participants utilized the in-house AsB standard to determine AsB in the standard solution, even when coupled with the need to extract AsB from the fish matrix and separate it using liquid chromatography. Reference values are based on calculations of the median as a simple and robust statistic. It was concluded that the performance is sufficiently good to advance to a Key Comparison in which participants will use only their own in-house standards for quantitation of AsB in an unknown fish tissue.

SIM.QM.S2 / SIM.QM.P22 (Trace metals in water, coordinated by NRCC) comprised a gravimetrically spiked high purity water sample distributed to a wide range of NMIs, at least half located outside the SIM countries. This suggests that the comparison should have

been conducted as a regular CCQM Key Comparison. In future, such comparisons will be incorporated into long range plans for IAWG activities because they consume significant time and resources and it is recommended that SIM will define and agree with CCQM the precise scope for comparisons undertaken in support of CMCs before inviting participation. The KCRVs were based on gravimetry and excellent performance was achieved, the majority of participants used inductively coupled plasma mass spectrometry (ICP-MS), frequently in high resolution mode.

Dr Sargent then considered recently agreed studies, which included a Key Comparison for assay of dichromate (coordinated by SMU and KRISS) the results of which are due by late 2011. A Key Comparison for selected elements in bioethanol (coordinated by INMETRO and separate from BIOREMA studies) will start in the near future; Key Comparisons and parallel Pilot studies for the determination of AsB in solution and fish matrix (coordinated by NMIJ and NIM) are scheduled to be completed by early 2012. A comparison on isotopic measurements of lead in solution and bronze (coordinated by BAM) is due for completion by September 2012, and a Pilot study (coordinated by PTB) for purity determination of KCl, based on quantitation of Br^-, NO_3^- and SO_4^{2-} is due to report results by June 2012.

An overview was presented of the specialized techniques workshop which took place on 12–13 April 2011. Its purpose was to focus on the use of emerging or novel techniques which are applied or are relevant to the IAWG studies as well as to revisit the more traditional but infrequently used esoteric techniques (cf. document CCQM/11-23). Emphasis was given to the application of laser ablation for the direct analysis of solids, multi-element analysis and tagging for speciation, bio-imaging and geochronology. Expert speakers (Dr Günther, ETH, Dr Jakubowski, BAM, Dr O'Reilly, LGC and Dr Millot, BRGM, France) were invited to make the presentations. Several specialized techniques which play a key role in the elucidation of purity of inorganic substances were presented by Dr Kipphardt (BAM), Dr Bode (TNW), Dr Sturgeon (NRCC) and Dr del Rocio Arvizu (CENAM) covering the areas of NAA, GD-MS and carrier gas hot extraction for determination of O, N, S and C. It was noted that many specialized techniques such as NAA, coulometry, GD-MS and techniques for detection of non-metallic impurities are vulnerable to disappearance from the community due to lack of budget or expertise in the future. Dr Sargent stated that the Working Group believed it is important that the CCQM draws attention to the role of these techniques to encourage NMIs to maintain facilities and give consideration to new R&D programmes to address current needs in inorganic analysis, in an effort to ensure that these techniques are not permanently lost from the community. Dr Sargent proposed that a recommendation on this be supported by the CCQM (Recommendation Q2, Appendix).

Dr Sargent reviewed the key aspects of the IAWG strategy, including a core capabilities approach (which will continue to be developed and refined) for the planning of future comparisons and a "Report Card" format to demonstrate support for CMCs. A rolling five-year plan will include occasional 1:1 Key Comparisons targeting support for specific CMCs in addition to a benchmarking of performance of all active participants on a regular basis. Dr Sargent noted that all new IAWG Key Comparison proposals, as well as

Regional Key Comparisons, will be accompanied by draft core capabilities tables and that these have already been implemented for CCQM-K75 (toxic metals in algae) and CCQM-K70 (Hg in natural water) and are being prepared retrospectively for CCQM-K56 (trace elements in soybean powder), CCQM-P106 (Cd, Cr, Hg and Pb in polypropylene), CCQM-K60 (Se and SeMet in wheat flour) and CCQM-K64 (analysis of copper alloy). Dr Sargent provided an example of a fictitious "Report Card" which covered the previous 5 years of performance of an NMI, and which would be designed to accompany CMC claims. The draft five-year plan was introduced for the IAWG covering the period to 2014; it outlines the studies needed to support the various categories of all CMCs.

Future activities will include a joint meeting with the EAWG planned for 31 October–4 November 2011 in Sydney, Australia, hosted by NMIA, completion of the core competency white paper and KC Report Card formatting, undertaking a joint workshop with the OAWG together with the chair of the KCWG on the implementation of core capabilities, and continuous updating of the rolling five-year plan, which will introduce Pilot studies in new measurement areas. It was concluded that good progress has been made with comparisons, and that the new IAWG strategy will provide for a more efficient link between Key Comparisons and CMCs. Pilot studies continue to play a significant role in supporting less experienced NMIs, while the introduction of new measurement areas and two meetings per year are cost effective while the number of actively participating institutes continues to rise.

Dr Kaarls thanked Dr Sargent and praised the development of the core capabilities concept and its implementation by the RMOs, stating it will more efficiently verify CMCs. Dr Kaarls gratefully acknowledged the earlier work of Dr Turk together with the EETWG (efficient and effective testing of CMC claims, established in April 2007, now closed) which led to this development and mentioned the BIPM award certificate presented to Dr Turk in recognition of these significant contributions. The President noted a request for a recommendation to NMIs concerning the preservation of highly specialized measurement capabilities and suggested that a written proposal is made available for consideration by the CCQM during the current meeting. Dr Kaarls repeated that Key, Supplementary and Pilot study comparison reports should be made available as soon as possible after their completion. The floor was opened to discussions.

Dr Unger asked if there were future plans to address nanoparticles to which Dr Sargent replied that laser ablation techniques may provide a viable approach but that joint discussions with experts in other working groups will be required to integrate cross-cutting techniques. Dr Kaarls agreed and encouraged discussion among the working groups.

Dr Mitani raised the issue of participants using the same calibration standards for quantitation of measurands during comparisons and asked what the impact might be with respect to traceability and uncertainties. Dr May pointed out that with respect to the use of one single calibrant the CIPM MRA is compatible with an NMI using another NMIs primary calibrant. With respect to the SIM.QM.S2 / SIM.QM.P22 studies, because of the number of NMIs which do not participate in the CCQM, in addition to those that do participate but have not done so in the most recent comparisons, there is a need to

undertake a supplementary comparison since the only other option is to bring forward a proposal to the CCQM and have it rejected because it had already been carried out previously and it will not be repeated. Dr Sargent stated that it may be sensible to attend the CCQM WG first to see what support there might be, but Dr May reminded him of the potential loss of time in following this process when the issue was pressing. Dr Kaarls stated that RMO comparisons must be properly announced and proper protocols followed, and this has the advantage of relieving some pressure on the CCQM WGs. Dr Güttler returned to the issue of nanoparticles and noted that a recent European Metrology Research Programme had targeted a study of nanoparticles in water and proposed this as an appropriate future topic for the IAWG.

9.3 Electrochemical analysis

Dr Máriássy presented a report of the CCQM Working Group on Electrochemical Analysis (EAWG), which has met twice since the last meeting of the CCQM: 30 September-1 October 2010 in Hindas/Boras, Sweden, which attracted eight participants from eight countries; and during early April 2011 at the BIPM which hosted 22 participants from 16 countries, the largest ever number of participants. Dr Máriássy noted that the next meeting is scheduled to be held in Sydney, Australia, in November 2011 and that in future, unless a sufficient volume of work is available for discussion, some of the autumn series of meetings may be disbanded. APMP.QM-K9 (pH of phosphate buffer, coordinated by NMIJ) attracted 10 Key Comparison participants and 13 Pilot study contributors. Results obtained at all temperatures were similar and both glass electrode and Harned cell measurements were used. Some outliers were present and ascribed to underestimation of the reported uncertainties. The links between the results of this study and that of CCQM-K9 were highlighted.

A revisit of CCQM-K73/CCQM-P19.2 (Assay of HCl, coordinated by NIST) detailed studies undertaken to resolve the differences in the reported results from a suite of high precision laboratories which exhibited disagreement within their reported uncertainties. An exhaustive investigation which examined the impact of potential sample inhomogeneity, instrumental changes, influence of CO_2 and other possible sources of bias led to the conclusion that no reasonable explanation was evident. Based on these findings, and discussions with Dr Ellison, Dr Duewer (NIST) and Dr Pratt (NIST), three options were offered: declare the comparison a failure; undertake additional experiments to elucidate the cause of the bias; accept the results and apply appropriate robust statistics to move forward and close the comparison with the determination of an appropriate KCRV. The final option was selected and an estimator based on a DerSimonian–Laird approach provided a KCRV and associated uncertainty which served to encompass the results of the majority of the participants.

CCQM-K92 (Electrolytic conductivity, coordinated by SMU) is under way and has been designed to fill the gap in completed comparisons (two samples with targets of 0.05 S/m and 20 S/m) that extend the conductivity range to cover current CMCs (some claim up to

50 S/m, 100-fold higher than the in last Key Comparison). Sixteen participants from 15 countries are engaged in the study but problems have been experienced with customs handling of the samples and their potential stability.

Pilot studies were updated. CCQM-P37.1 (AgCl electrode study, coordinated by NPL) was updated in 2010 at the 16th meeting of the CCQM but in the interim a questionnaire has been circulated among the participants in an effort to discern the source of problems which had been encountered during the preparation of electrodes in an effort to enhance the accuracy of pH measurements. A Draft A report has been released and comments received and a Draft B report will be prepared for publication by the end of May 2011. Proposals for follow-up studies in the P37 series (P37 and P37.2) to undertake a rolling comparison of pH/Harned cell comparability and comparability of Ag/AgCl electrodes, respectively, which will be coordinated by NPL, were received.

CCQM-P112 (Assay of EDTA, coordinated by SMU, PTB and BAM) was revisited. This study began in 2009 but ongoing efforts to identify the sources of bias among participants has been undertaken to determine whether one sample (sent to INTI) had been contaminated with a calcium impurity. BAM confirmed this scenario. Additionally, a calibration error with a burette used by METAS was discovered. Corrections for these errors improved agreement among participants. The report has been finalized but further work into the details of this comparison is ongoing.

Dr Máriássy proceeded to outline the overall draft strategy of the EAWG, which will lead to the most information being obtained for the least amount of work. The principal changes include statements relating to how long the data should remain valid (up to 10 years); KCRV calculations carried out in compliance with recommendations of CCQM/09-15; using the performance mean of the two latest comparisons, if more than one is available, to support a CMC, and a relevant comparison will be undertaken every three years if possible.

A brief summary was given of several technical presentations; these were the preparation of Ag/AgCl electrodes from different materials and the impact of these on the results. A second presentation focused on the slope of the acidity function where the results reported by DFM in comparison CCQM-K19.1 were re-examined and speculated to be due to uncontrolled amounts of chloride present in the buffer solution. This was attributed to sample weighing and transfer errors.

Agreed and planned studies and comparisons were considered; many of these are noted above. These include CCQM-K91 (pH of phthalate, coordinated by PTB), the first repeat comparison, CCQM-Kxx (Assay of dichromate), and CCQM-P37.2 (Ag/AgCl electrode study), all planned for 2011. Pilot study CCQM-P111.1 will be conducted with a parallel Key Comparison on the conductivity of seawater. The next pH comparison using a phosphate buffer at physiological pH will be CCQM-Kxx due in 2012–2013. COOMET has indicated the desire for a regional Key Comparison to link to CCQM-K36. The coordinating laboratory has still to be confirmed, but VNIIM is proposed. A draft protocol will be circulated within the group outlining procedures for comment before any actions commence.

Dr Máriássy considered CMCs. The resubmission of the complete set of CMCs was carried out in 2010. This has now been approved and is ready for publication. A few issues have arisen from the current cycle, notably pHe, an operationally defined measurand relevant to biofuels, and it was agreed within the group that it may be best to not enter this into Appendix C but instead to simply register it with the appropriate accrediting body for the institute using it.

The final topic addressed by Dr Máriássy was the issue of the new atomic weight data presented by IUPAC and the change of format to relative increase in the size of the ranges for some elements in the 2009 data compared to values and uncertainties associated with the 2007 data set. The question posed was: what can be done to propagate uncertainties in the future; several scenarios were presented using the real-life example of NIST SRM350b (benzoic acid) with the ultimate recommendation that amount content should be used in all CRM certificates since the user does not need the molar mass for CRM in that case. When used simply as a scaling factor to calculate mass fraction, it cancels out as long as the same number is used in the back conversion to amount content, and thereby does not affect the uncertainty. In principle, since any value can be used for the molar mass, the measurand can be expressed as mass fraction with the proviso that a specific molar mass is utilized for calculation in its use, the problem being that the user has to realize that he has to use a different molar mass for the sample using a specific molar mass. Dr Wielgosz noted that the IUPAC recommendation to present intervals for atomic weights of the elements causes some problems; concerns were expressed earlier by the GAWG and now by the EAWG. The question is: is this a generic problem experienced within the wider chemical community and, if so, should further guidance be developed. Prof. De Bièvre proposed that the issue is taken for further discussion to the commission on atomic weights at the IUPAC General Assembly in mid 2011. Dr Fajgelj agreed with Dr Wielgosz that the impact is likely to be widespread. Dr Milton noted that in conversations with Dr Meija (NRCC) that the commission on atomic weights may be able to compile a set of uncertainties which will be specifically useful for those elements of relevance to the GAWG and their work. Dr Kaarls suggested that the EAWG addresses Dr Meija. Prof. De Bièvre reiterated the need for a generic solution and once again urged consultation with the commission on atomic weights, which meets in Calgary, Canada, prior to the IUPAC General Assembly meeting in mid 2011. Prof. De Bièvre is willing to bring the issue forward if he is provided with a clear formulation of the problem.

9.4 Organic analysis

Dr May presented a report of progress made by the CCQM Working Group on Organic Analysis (OAWG), which has met twice since the last meeting of the CCQM; on 4-5 November 2010, at the Orchard Hotel, Singapore, and during April 2011 at the BIPM headquarters. The former meeting attracted 45 participants from 24 institutes and the latter was attended by 47 participants from 33 institutes and 27 countries/economies. Greece and

Italy participated for the first time. The primary focus of OAWG activities is the critical evaluation and benchmarking of NMI capabilities for the execution of "higher order" measurement procedures for well-defined organic molecular entities for which the SI-traceable amount of substance can be determined. Dr May described an operational procedures document that summarizes current practices and guidelines of the OAWG. These were summarized in a recent draft intended to provide transparency and harmonization in practices and to serve as a reference for new and current members. The draft is being revised in response to comments received; the revision will be distributed to OAWG members for further input by 1 July 2011; further comments are due 15 September 2011 with a penultimate draft to be distributed 15 October 2011 for discussion at the autumn 2011 meeting. The final report will be presented to the President of the CCQM and shared with other WG chairs. As CCQM institutions expend enormous resources to work within the CIPM MRA, a poll was conducted during the autumn 2010 meeting to enquire what the expectations and gains were for each member institution arising from participation in CCQM activities. Some of the major consensus points from the input received were presented, including a belief that the CMC process and its associated Key Comparison benchmarking activities were working well; that the process facilitates networking and knowledge transfer; that there is a clear advocacy of the concept of measurement traceability with other organizations; that it presents opportunities to investigate the efficacy of new analytical techniques/methods for providing traceable measurements; and that collaborations to address mutually interesting measurement problems are facilitated.

Over the past 11 years, the OAWG has completed 18 Key Comparisons with 5 in progress and 36 Pilot studies with 2 in progress, thereby averaging 6 comparisons per year. Within the past year, 10 studies were active, 3 reports were published in the KCDB and 5 Draft A reports were submitted, while results for 3 new studies were discussed. It was identified that there is a clear need to develop a strategic framework for comparison studies to alleviate the unsustainable growth in comparison studies. The focus in the future will be on core competencies needed to deliver services to the community. Dr May outlined a four-track strategic approach for comparison studies: (A) Key Comparisons that test core competencies for the delivery of measurement services to customers, which are planned to be limited in number in which NMIs with relevant claims must participate; (B) Key Comparisons that assess the equivalence of measurement services actually provided to customers, the needs for such being determined by the KCWG; (C) Key Comparison studies in emerging areas of global interest and importance with an accompanying Pilot study and (D) capability assessment studies of measurement capabilities being established in new areas for NMIs/DIs which will not be used for the assessment of CMCs.

Track A activities would entail approximately 10 KCs every 5 years to test core capabilities, which would be repeated with different analyte/matrix combinations at 5 year intervals. One of the forefront areas being tackled in this track is purity assessment, which supports all traceability assignments of organic primary calibrators and is exemplified by the BIPM programme of work. The approach used is based on mass balance, direct assay and their combination. To cover this "space", a molecular weight-polarity relationship

(octanol–water partition coefficient) is examined so as to ensure a full spectrum of coverage. A KCRV for the mass fraction of the major component is adequate for the assessment of overall performance of participants when direct assay is used, but this is insufficient when mass balance is attempted due to the possibility of fortuitous cancellation of errors. It is thus recommended that, when doing the mass balance approach, the KCRV be developed for the major component, total structurally similar impurities, water, total volatiles content (primarily residual organics from synthesis) and total non-volatiles content.

CCQM-K55.b / CCQM-P117.b (purity assessment of aldrin, coordinated by BIPM) examined approximately 95 % purity recrystallized aldrin and all NMIs having purity related CMCs were expected to participate. Most laboratories were clustered in that qNMR results were lower than those reported using a mass balance approach, suggesting that there may be an impurity that the bass balance approach was not detecting. An in-depth discussion of the comparison over the past year concluded that there was a high molecular weight non-volatile polymeric material present (>1 %) that was completely unexpected and hence undetected. KCRVs were established for aldrin, the major component, as well as for each of the four classes of impurities required for Track A comparisons. The OAWG is proposing a "Report Card" for a given institute which would cover not just this comparison but all similar ones, and examples were presented of summarized DoEs representing some dozen or more Key Comparison and Pilot study results.

For Track B studies, reference materials or PT samples that are produced by the various NMIs are analyzed by one coordinating laboratory under repeatability conditions. CCQM-K80 provides an example of this wherein NIST undertook determinations of creatinine in serum. This type of exercise is useful to the analytical chemistry community as they can see how the various CRMs from different producers compare. The statistical analysis of such data is not trivial and hence significant input from researchers at NIST, PTB, BAM and LGC have devised a metrologically consistent approach to the treatment as well as a guidance document ("OAWG Track B Design & Evaluation: Comparison of value-assigned CRMs and PT materials: experimental design and data evaluation") which will allow other laboratories to conduct similar studies.

Track C studies, which target Key Comparisons in an emerging area of global interest and importance with an accompanying Pilot study, were exemplified by CCQM-K85 (Antifungals in food: malachite green in fish tissue, coordinated by LGC). Malachite green is important due to its potential carcinogenic properties. This was a challenging study because inter-conversions can occur between the different measurands during the extraction and analysis process. As for a HFTLS statement, success in this study implies the ability to undertake measurements of trace contaminants of labile measurands in fish tissue. This study started in 2005 and the first material prepared was inhomogeneous, requiring the study to be restarted. Six NMIs registered as Key Comparison participants and determined malachite green and leucomalachite green. Results were discussed during April 2011 and a draft report based on the calculation of KCRVs using various statistical models was undertaken. Participants will summarize their demonstrated core capabilities.

Track D studies were exemplified by CCQM-P129 (Ethanol and water in a bioethanol material derived from sugar cane, coordinated by INMETRO and VSL) which attracted 13 participants. This study was similar to a purity determination in which the mass fractions of both ethanol and water were determined using either the mass balance or direct approach. Neither approach yielded any discernable differences, and agreement between them was excellent, with an RSD of 0.4 % amongst the results for ethanol content for all participants. For the mass fraction of water, two groups of results were evident, possibly a consequence of the hygroscopicity of the ethanol making the relative humidity and temperature a factor at the time of analysis which was dependent on the methodology used. No reference value for water will be provided in the report and further investigations are needed.

Dr May then considered the strategic planning undertaken by the OAWG, focusing on Track A activities comprising Key Comparisons to test core competencies for calibration reference services and accuracy control reference services. Within the next 5 years, 10 Key Comparisons (2 per year) are anticipated; thereafter, such studies would be repeated on a 5 year cycle. Dr May outlined specific scenarios involving a range of measurands to cover polarities and molecular weights along with identified coordinating laboratories. For each study, each participant will complete a report template targeting various aspects of the comparison which are deemed to be challenging.

Dr May announced his intention to establish an e-mail list for the OAWG based on two people per institute designated by each NMI/DI that is a member of the CCQM. The people designated by their institutes will then be responsible for distributing OAWG communications to relevant persons within the NMI/DI.

Dr May concluded by announcing that the autumn 2011 meeting will be hosted by NMIA in Sydney, Australia, during which there is a plan for joint technical meetings with the IAWG and EAWG as well as a half-day symposium, potentially devoted to clinical measurements.

Dr Wielgosz remarked that the issue of communication to working group participants should be dealt with in a systematic and uniform way by all working groups. Currently the CCQM working groups had participants and not members (no members were listed in the Consultative Committee Directory maintained by the BIPM), and the BIPM has no email list for participants other than those that register for its meetings. A contact list for NMIs/DIs could be established, and Dr Wielgosz suggested that the BIPM cooperates with the Working Group Chairs to do this. Dr Kaarls endorsed this proposal. Dr Sargent commented that the OAWG's core capabilities are independent of the technique used, which is the opposite approach to that taken by the IAWG. Dr Sargent cited CCQM-P129, wherein four independent techniques were used in one study. Dr Parris noted that the OAWG competency form listed the individual technique but that the idea was to test everything as most of the uncertainty derives from the sample preparation step. Dr Mackay, chair of the KCWG, attempted to clarify that for the OAWG the different core capability forms will specifically address the technique used when purity analysis is being assessed but for matrix studies the emphasis is on the correctness of the result not the

analytical technique used.

9.5 Surface analysis

Dr Unger presented a report of progress of the CCQM Working Group on Surface Analysis (SAWG). The SAWG now comprises 13 active members from a total of 18 participants. Dr Unger reviewed the scope of the WG and included a brief description of the various instrumental techniques most commonly used in order to illustrate the relationships between spatial resolution (spanning the 0.1 nm to 10 μm dimension) and information capabilities (elemental analysis, chemical state analysis and analysis with some structure). A description of recent comparisons was provided.

CCQM-K67 / CCQM-P108 (Amount of Fe and Ni in (200 nm) Fe–Ni alloy film on Si, coordinated by KRISS) was completed in 2008 and a report has been uploaded to the KCDB, permitting CMC claims to be formulated. Dr Unger noted that a paper based on this analytical approach has been submitted to the journal *Surface and Interface Analysis* for publication. The arithmetic mean of AES, XPS and EPMA techniques submitted by six participants was used to calculate the KCRV, which had an associated expanded relative uncertainty of 1.23 %. Overall, the exercise was deemed successful, demonstrating capabilities for analysis of chemical composition of a nano-scaled alloy with relative uncertainties of ~5 %, with minimal matrix effects accruing from use of an alloy calibrant rather than use of the pure elements.

Pilot studies within the SAWG included CCQM-P80, CCQM-P81 and CCQM-P95 which addressed calibration issues for electron probe microanalysis (EPMA), an extremely important technique for industrial applications. Quantitative measurements are accomplished using a standards/matrix correction methodology whereby the unknown is measured under identical conditions relative to a suite of standards. CCQM-P80, CCQM-P81 and CCQM-P95 demonstrated that use of this method resulted in differences in measurements larger than the reported expanded uncertainties, highlighting the need for better standards and CRMs in this field. Dr Unger concluded that the SAWG is not ready to go forward with a Key Comparison based on the use of EPMA.

Pilot study CCQM-P130 (WD and ED electron probe micro-analysis on Au–Cu alloys, coordinated by BAM and NIST) was launched in 2011. Protocols for EDS (BAM) and WDS (NIST) were established earlier and four samples of Au–Cu alloys along with pure Cu and pure Au calibrants were made available. Participants are to deliver their intensity data to the coordinators which will use data reduction procedures to identify the origins of potential problems. A total of 9 NMIs utilizing 17 instruments are involved, and the results are expected to be of significant interest to industry.

Dr Unger considered potential Pilot studies focusing on engineered nanoparticles which had previously been discussed by the WG during the preceding days. At issue was the selection of the nanoparticles, the measurands and the coordinating laboratories. It was noted that a potential selection of test particles could be taken from the current OECD list.

KRISS proposed a Pilot study involving a thin-film of $CuInGaSe_2$ on a silica substrate as being relevant to the solar cell industry wherein the composition of a 2 µm thick layer would be determined by depth profiling using dynamic SIMS and possibly AES. KRISS would provide traceability through parallel measurements made with ICP-MS. If the thickness of the layer can be reduced further, additional participants may be encouraged to participate.

Dr Unger introduced the Euramet European Metrology Research Programme (EMRP) and its impact on the SAWG activities, noting the 2010 call to industry for the Joint Research Programme "SurfChem" which aims at traceable quantitative surface chemical analysis for industrial applications. Dr Unger outlined the technical work packages which may provide a good basis for future Pilot studies. Work Package 1 (WP1) - inorganic reference materials and methods of surface chemical analysis, could involve calibration of X-ray EDS as well as ARXPS for metal layers on silica as a Pilot study. Work Package 2 (WP2) - reference materials and methods for surface analysis of organic surfaces suggested high potential for the first SAWG Pilot study on organic materials, including thickness and quantitative compositional analysis. This WP was interesting because it may lead to studies of fluorescent dyes carrying specific marker atoms amenable to XPS detection, and liposome labels for multiplexed biomolecule detection with ToF-SIMS using large micro-arrays for large scale information interrogation. Such studies permit a direct link to the activities of the BAWG.

Development of a foresight document was then addressed by Dr Unger as he undertook a quick survey of the most relevant working areas for metrology in surface micro/nano analysis in order to identify the most urgent topics with the highest number of participants, as well as important areas not recently covered by the SAWG. Information has been gathered on NMI/DI programmes from about 75 % of these facilities with the rest due to report by 1 September 2011. Dr Unger completed his presentation by drawing attention to a paper recently published in *Nanotechnology,* **22**(6), 2011, on the European Metrology Landscape with input from NPL, PTB and BAM.

Dr Emons mentioned that Dr Unger stressed a need for high quality test materials for nanoparticles in future studies and asked for clarification of the term, to which Dr Unger replied that information was needed on the diameters and core shell composition. Dr Emons remarked that a mono-particle size distribution was likely to be the more important parameter. Dr Unger agreed and noted that it is important and, moreover, that only binary mixtures are currently of interest and not multi-component nanoparticles. Ms Parkes expressed concern about the fact that the BAWG had moved away from use of microarrays but Dr Unger stressed that the studies outlined were not restricted to applications with microarray formats. Ms Parkes stressed that it was an appropriate time to undertake another joint symposium between the SAWG and BAWG.

9.6 Bioanalysis

Ms Parkes presented a report of the progress made by the CCQM Working Group on

Bioanalysis (BAWG), highlighting an extremely active year with increased interest and participation from NMIs and other expert laboratories. The BAWG has met twice since the last meeting of the CCQM in April 2010. The 18th meeting was held in November 2010, organized by HSA/A*STAR, Singapore, and the 19th meeting was held in April 2011 at the BIPM headquarters. The latter attracted 50 participants from 25 organizations. Ms Parkes noted that considerable bioscience expertise in nucleic acid, protein and cell measurement capabilities with a diversity of measurement technologies is now assembled, arising from a growth in Euramet, APMP and SIM participation. A symposium on "Biomeasurement innovation: supporting healthcare for the future" was run in conjunction with the Singapore meeting and was aimed at highlighting the underpinning importance of biomeasurement comparability in supporting innovation in the global biopharmaceutical, biotechnology and healthcare industries. This provided an opportunity to spotlight research areas at NIST, KRISS and LGC.

A number of procedural issues were discussed, including concerns over CIPM MRA requirements that DIs must submit CMCs within 5 years. This is anticipated to have a negative impact because of the generally slow progress to CMCs within the BAWG. It was suggested that perhaps a demonstration of participation in comparison studies could be sufficient to satisfy the requirements of the CIPM MRA. As a second point, traceability issues, continue to be problematic for all CMCs in the bio area. Ms Parkes stated that a subgroup had been formed to review intellectual property concerns since the BAWG was operating at the forefront of technology and guidelines needed to be developed and legally reviewed (many NMIs/DI are pursuing patents). Intellectual property concerns may place limitations on the use of comparison results and Ms Parkes noted that Dr Kaarls will refer the matter to the CIPM.

Ms Parkes then considered progress made during 2010–2011, during which time 7 comparisons were undertaken. Ms Parkes briefly mentioned new proposals that included CCQM-P103.1 (Measurements of multiple RNA transcripts, coordinated by LGC/NIST) and CCQM-Px (Investigation of comparability of enzyme (amylase) catalytic concentration, coordinated by NIMC) which would utilize an IFCC protocol.

CCQM-K86 (Quantification of the relative quantity of two genomic DNA fragments in a biological tissue, coordinated by IRMM) is the second Key Comparison for the BAWG and supports competence in both DNA extraction and quantitative PCR techniques. However, within the restrictive guidelines for CMCs, there is a need to refine the scope of the claims and it may necessitate identification of only maize seed materials as well as restrict it to a particular sequence and number of nucleotides. The study is completed but the report has not been posted to the KCDB and will not be posted until the issue of scope for CMCs is resolved.

CCQM-P94.1 (Quantification of DNA methylation, coordinated by KRISS) is significant as it has implications as a marker for cancer diagnostics. The study design was based on the gravimetric mixing of CDKN2A gene with methylated CDKN2A gene to establish the reference value for a target of 1 % methylation in the mixture. Participant results showed considerable deviation from the expected. Considerable debate over the measurement

uncertainty developed and there is a clear need to examine the methodologies used. Polymorphisms that may be present may introduce bias in the results using qPCR which will thus impact clinical results. Possible publication of these issues is being considered as a way to draw attention to these potential problems.

CCQM-P55.1 (Peptide/protein quantification, coordinated by NIST/LGC/PTB) study results were discussed. These were aimed at determining the concentration (mol g^{-1}) of four peptides in solution through amino acid analysis using valine, proline, isoleucine and phenylalanine with calibration against NIST SRM 2389a amino acid and in-house standards. Problems with the spread in results were tentatively ascribed to varying degrees of sample hydrolysis (tryptic digestion) although the impact of instrumentation also needs to be examined. It was concluded that CMC claims may be made on the quantitation of peptides.

CCQM-P102 (Quantification of $CD4^+$ cell enumeration and fluorescence calibration, coordinated by NIBSC/PTB/NIST) focused on the development of biological reference standards for fluorescence calibration of diagnostic flow cytometry assays. All test materials were supplied by various NMIs and 15 laboratories participated, including a number of commercial clinical laboratories. The end result of the testing was the ability to relate the enumeration of $CD4^+$ lymphocytes (expressed as cells per µl) to equivalent fluorescein fluorophore value (EFFV).

CCQM-P123 (Number and geometrical property of cells adhered to a solid substrate, coordinated by INRIM/NIST/LGC), currently in progress, is of importance to cell enumeration, and has applications in many clinical areas. Ms Parkes reviewed enumeration techniques and challenges which have arisen due to layering on surfaces. The precise measurand is the number of cells per unit area and the sources of measurement uncertainty have been carefully examined. The study plan was discussed at the 19th meeting of the BAWG.

As noted earlier, the BAWG is unique in many ways and operates at the forefront of research and technology. As a consequence, unique problems frequently arise. Most comparison studies have been well supported with typically >10 participants. Most Pilot studies have several coordinators to share problems and costs, and involve significant preliminary research. The majority of measurements are not traceable to the SI. Pilot studies have been very useful to advance understanding of uncertainty sources and to highlight measurement methods and measurand definition issues but progress has been slow in the development of Key Comparisons. Key Comparisons undertaken to date have been successfully conducted but have proved too restrictive in supporting generic CMCs. There is thus a need to review the development of Key Comparisons while supporting NMIs in demonstrating their measurement comparability, developing appropriate bio-measurement methods, reference materials and traceability and ultimately supporting CMC claims. With these cautions in mind, Ms Parkes turned to a discussion of BAWG strategy in which comparability of measurement results is an important focus which facilitates the introduction of metrological principles to the community. The BAWG is currently struggling with how to achieve multi-parametric traceability – structural

uncertainty combined with amount of substance. The BAWG is now working on tools to fill this gap through use of position papers to more clearly identify needs and propose frameworks before conducting further collaborative studies and via the use of investigative studies to establish frameworks for comparability assessments, noting that these will not constitute Pilot studies and that the endpoint may not necessarily be a Key Comparison.

Ms Parkes concluded by noting that the next meeting of the BAWG is scheduled for 3-6 October 2011 to be hosted by CENAM, during which a symposium on "Biometrology in Support of Clinical Diagnostics" will be arranged.

Dr Kaarls agreed that progress is being made in this area of metrology but clearly more needs to be done and to be learned. Dr Wielgosz asked about a proposed amylase Pilot study, noting that this is one of the JCTLM relevant measurands and is included in the IFCC-RELA comparisons which are organized annually. Dr Wielgosz asked if the IFCC RELA organizers have been made aware of the proposed pilot study, as the JCTLM will be inviting NMIs to participate in these comparison schemes. Ms Parkes responded that the link is through activities with Dr Schimmel and Dr Emons. The impetus for the study is via PTB as there is interest in this area from China. A problem is that this is a very descriptive method. Dr Wielgosz stated that the opportunity to link this study to the IFCC-RELA scheme should be investigated.

Dr Güttler added that general procedures and a common protocol need to be developed for such enzyme activity studies, and that currently it is not traceable to the SI. Dr Kaarls remarked that a method dependent result is not automatically non-traceable. Dr Emons commented that an IFCC methodology exists and thus questioned what value is being added by the proposed Pilot study; perhaps it only gives NMIs a chance to test their capabilities. Prof. De Bièvre complimented the presented overview and the technical progress being made in this difficult area but noted that the concept of prescriptive reference procedures has been presented to the VIM and that traceable procedures can in fact be achieved. Dr Güttler stated that enzyme activity studies are designed to cover clinical applications and a Key Comparison could now be formulated. The unique contribution of the CCQM is to link other areas that require enzyme activity measurements.

Dr Wielgosz asked about participants in CCQM-P102 (Quantification of $CD4^+$ cell enumeration and fluorescence calibration) particularly whether BC (Beckmann Coulter) was a commercial laboratory. Dr Wielgosz noted that this is the first time the CCQM has addressed intellectual property issues and that a policy on intellectual property issues needs to be developed in the context of comparisons. Dr Besley expressed support for BAWG activities and pointed out that the BAWG need not be unduly defensive about its operations. It is doing a fine job and can compare its progress to that of the CCQM in its infancy when tools were first developed in general metrological areas.

9.7 Key Comparisons and CMC Quality

Dr Mackay presented a report on the work of CCQM Key Comparison and CMC Quality

Working Group (KCWG) which convenes once a year. The Working Group, comprises 21 members (plus a Rapporteur) who are drawn from all RMOs. The KCWG met in April 2011 and discussed the concerns with submitted CMCs and related procedures. It was noted that most CMCs are now passing through the fast track approval process which indicates that NMIs and RMOs are generally doing a better job of preparing them for submission. The current status of chemistry CMCs was summarized (4846 entries in Appendix C of the KCDB). This year included a second year of formal reviews of existing CMCs covering all high purity metals and metal alloy claims. It was noted that pH and electrolytic conductivity CMCs (categories 6 and 7) were reviewed at the 2010 meeting and will now be updated the KCDB. With respect to all metal and metal alloy CMCs, 299 were examined (11 in category 1.3 and 288 in category 8) and all are ready for entry into the KCDB. Dr Mackay called for further comparisons to underpin this measurement area and requested that the planned comparison CCQM-K72 (Purity of zinc, coordinated by BAM) to proceed and commented on the need for additional evidence in the form of more KCs to support some CMCs. For 2012, the plan is to review inorganic solutions (category 2) which will underpin a large number of CMCs (330) and to cover another subset of gases, NO, SO_2 and propane, (category 4) and also fuels (category 12). A review of CMCs in the bioanalysis area was carried out by the CCQM BAWG beginning at the Singapore meeting in November 2010. Issues relating to the need for more evidence to support claims or the need to limit the scope of some claims were raised. Claims considered included peptides in aqueous solution via amino acid LC-ID-MS (claimed by LGC, NIM and PTB), hGH in serum by LC-ID-MS-MS (claimed by PTB), Bt gene mass fraction in rice via real-time PCR (claimed by NIM) and relative molecular weight determinations of peptides/proteins (claimed by NIM).

Dr Mackay informed the meeting about the Guidance Document for CMCs within CCQM which is available on the restricted access KCWG website but which will soon be made available on the general BIPM website.

Dr Mackay considered the updated CIPM traceability requirements, which are now embedded in the Guidance Document and have been formally used to evaluate reviews of CMCs, especially with respect to the traceability of primary calibrants during this cycle of submissions. There are two methods of claiming traceability; (i) through a primary realization of the unit of measurement or (ii) by applying higher-order methods, in which case traceability by an NMI must be declared to its own demonstrated realization of the SI or via another NMI or DI having CMCs published in the KCDB. Note 4 is an important aspect for CCQM which covers the in-house value-assignment of reference materials, particularly pure calibrants, and the assessment of such capabilities. A Traceability Exceptions Template can be downloaded from the BIPM website and used to request special exemptions from these rules.

Dr Wielgosz noted that the Traceability Exceptions Template must be presented as an open access working document.

Dr May cautioned about the perils of generic claims/concerns but emphasized that it is impossible to have 1:1 Key Comparison support for all CMCs and perhaps some thought

should be devoted to restructuring the KCDB so that exceptions will not be needed. Dr Kaarls agreed that this warrants thought, but suggested that some reflection is needed on whether the KCDB provides useful or suitable information for customers. It is necessary to know what customers require. Dr Emons supported the concerns and reiterated comments that it is difficult to retrieve specific information from the KCDB. Accreditation bodies are moving towards permitting more flexibility in scope with the result that a more generic approach to CMC claims is desirable. Dr Quinn stated his agreement with the comments of Dr May and suggested a return to the text of the CIPM MRA relating to the purpose of a Key Comparison which is to convey confidence in a NMI to make a measurement, and suggested that perhaps it is time for the CIPM to make a strong statement emphasizing that the purpose is to demonstrate confidence and that a 1:1 correspondence of CMC claims with supporting Key Comparison evidence is not needed, because it is unsustainable. Dr Milton expressed an opinion that the issue could be overcome by more effective use of the information that is already available. Dr Mackay stated that the new core competency approach may alleviate many of these concerns. Dr Mitani agreed that it is important to refine the HFTLS approach, particularly with respect to purity assessment. Dr Mackey replied that all evidence is taken into consideration.

Dr Kaarls suggested a brainstorming session of all WG Chairs regarding this issue with recommendations to be delivered to the CCQM at its next Plenary meeting in 2012. Dr Kaarls thanked all the WG Chairs and approximately 250 experts who have participated in the enormous amount of work achieved to date.

9.8 CCQM AD-HOC WORKING GROUP ON THE KCRV

Dr Cox, chair of the *ad hoc* Key Comparison Reference Value Working Group (KCRVWG) began his report by remarking that comments to document CCQM/10-03 (determining consensus KCRV and DoEs) had been received and an updated version is in progress. Document CCQM/11-18 was produced and submitted to the KCRVWG, with the suggestion that the original CCQM/10-03 is kept and used as a background document. Dr Cox reviewed some of the data evaluation principles (points 6 to 9) presented in document CCQM/09-03 and then proceeded to outline a model-based approach which incorporates the possibility of excess variance. Dr Cox explained that document CCQM/11-18 is based on the realization that inconsistencies can exist in comparisons and that this can be accounted for by evoking a consideration of excess variance. Within this model, the data are initially screened and discrepancies resolved by the appropriate WG. All remaining data are then considered as credible. The weighted mean is then used for calculation of the KCRV with weights based on augmented variances, to produce a result which is different from the simple uncertainty-weighted mean. The uncertainties associated with the KCRV and the DoEs are then calculated in the usual fashion. As a consequence, most DoEs will appear acceptable, as random effects attributable to a possible test item inhomogeneity or short-term variation in laboratory deviation are now accounted for. The model will be relevant to all CCs, not just the CCQM.

Dr Cox used CCQM-K25 (PCB170 in sediment) as a working example, employing maximum likelihood, Mandel–Paule and DerSimonian–Laird techniques as estimators of excess variance. KCRV estimates were all consistent and calculated excess variance was greater than standard uncertainty estimates in all cases, thereby expanding the number of NMIs which demonstrated acceptable performance.

Dr Cox concluded by summarizing that CCQM/11-18 applies to use of an excess variance (random effects) model for establishing the KCRV and its uncertainty can be arrived at using different estimators. The model ensures mutual consistency with generally acceptable DoEs, noting that small excess variance is equivalent to a classical weighted mean approach whereas a large excess variance is similar to that arising when an arithmetic mean is employed. It remains for the CCQM WGs to decide if the model is appropriate for their use and in the event that all CCQM WGs are in agreement, the KCRV WG will provide the supporting software to permit the calculations.

An extremely lively and controversial debate ensued. Prof. Kühne opened questions by noting this problem occurs frequently and, in the case of CODATA, some techniques are used to deal with discrepant results to arrive at a value for a fundamental constant; Prof. Kühne wondered if such techniques were similar to those suggested here. Dr Cox replied that he was not entirely certain of the approach taken by CODATA but believed that a weighted mean may be involved. Dr Quinn remarked that the approaches were similar but also different in some important respects in that CODATA has something similar to excess variance but it is not added but rather multiplied and hence there is no change in the weight and thus no change in the mean value but the uncertainty of the final result is changed. In this way, values with small associated uncertainties do not dominate and thus the CODATA approach is more desirable. Dr Cox noted that multiplication may be a better approach, but generally it is a problem that NMIs are understating their uncertainties and if all uncertainties are inflated a single NMI which devoted considerable effort to reduce its uncertainty would not be pleased with such an approach. Dr Emons returned to the example of the CCQM-P170 data set and asked why one seeming outlier was rejected, to which Dr Cox replied that he did not know, it had been rejected by the WG before he had been given the data but that it was likely that the rejection was for a technical reason. Dr Ellison stated that if there was a belief that the reported uncertainty is underestimated by NMIs by a constant factor then it would not be wise to change the weighting factor as this would distort the results. Dr Ellison remarked that nothing in the model is “preventing thought” and the WG has a clear responsibility to evaluate the integrity of the input data to begin the process. Dr Milton remarked that if the DerSimonian–Laird model can be used on results for which there is a suspicion that a comparison had revealed potential inhomogeneity in the test samples, then he would be very pleased to incorporate such unexplained errors and some elements of the model would be very useful. Dr Milton then asked Dr Cox to comment on an additional issue, which is that after 2–3 years of discussions and successful outcomes there have been a number of occasions where the DoEs and the uncertainties of DoEs exhibit a correlation between the uncertainty in the reference value and the uncertainty in the submitted laboratory value. When calculating the uncertainty of the DoE, which is needed for

support of the CIPM MRA, it has some unusual properties with which CMC claims are evaluated. Thus, is a better understanding of what it is that should be reported in terms of the uncertainty of the DoE needed? Dr Cox replied that that the model introduces the concept of excess variance so as to provide an overlap of the NMI data with the zero line of the DoE graph and it is up to the KCWG to decide if the assumptions made are valid. Dr Sargent commented on the increasing complexity of models that are being used for data treatment and recalled that the Key Comparisons are a snap-shot in time and that if repeated the results will change. Dr Sargent advocated the use of the simplest possible approach to calculate the KCRV, noting that models may be valuable and should be available for guidance, but the final decision on how to approach the calculation should be left to the individual WG, yet remain wary of weighted approaches and the idea that excess variance adds further weight. Dr Wielgosz returned to the example graph of DoEs presented for CCQM-P170 and noted that the use of two graphs should be encouraged, i.e., the DoEs and the graph of results and uncertainties quoted by the participating laboratories. This will allow more easy interpretation of agreement (or not) with the reference value, the uncertainty quoted by a participant, and comparison to the uncertainty of the reference value. Dr Cox agreed with this conclusion and reminded everyone of principle 8 of CCQM/09-03, which encourages the use of the simplest estimator. Dr Sargent is of the opinion that a problem ensues if it appears that these procedures are the only ones that can be utilized and suggested that the document makes it very clear that the excess variance approach is optional. Dr Cox replied that the WG was not mandating anything. Dr Magnusson asked how much excess variance can be tolerated, to which Dr Cox replied that he was unable to answer this question other than to note that a careful initial screening of the data should be undertaken and if there is still too much excess variance then the data need to be re-screened. The excess variance compensates for how well the screening action is undertaken. Prof. Kühne enquired about the influence of excess variance on CMC claims because individual NMIs make claims based on their uncertainty capabilities; will their own uncertainties be used or will these be altered to reflect the component of excess variance? Dr Cox stated that the DoE will not express their claims accurately if excess variance is used. Dr May was uneasy over this proposal as the DoEs are only estimates to begin with and they will change with time for no apparent reason, hence uncertainties reported by NMIs are not absolute. Dr Cox responded that comments by Dr May precisely support the need for an excess variance model as it will account for such randomness. Dr Ellison stated that if there is a desire for the DoEs to reflect the laboratory uncertainties, then the laboratory uncertainty must be included in the calculation of the KCRV uncertainty. Outliers must be handled before the data set is treated. Accounting for laboratory uncertainties by use of an excess variance model tends towards the arithmetic mean. If a median is needed, then there are likely outliers that need to be considered and resolved. The DerSimonian–Laird approach is best used when data from all laboratories are assumed to be equally valid. Dr Fajgelj supported this approach as a step forward without unduly complicating the calculations; since the adjusted uncertainties would now be larger, this would likely be a better reflection of reality. Dr Wielgosz returned to Prof. Kühne's concern about the impact of the use of excess variance terms and the relationship to claimed uncertainties in CMCs, noting that it is clear

from the plot of the DoEs that agreement exists, or not, if the uncertainties cross the zero line. However, the excess variance needs to be attributed to a cause. If this cause is not due the sample properties, then there must be unknown effects in the methods applied, and then the uncertainties claimed by the participants are not comprehensive and it is necessary to obtain some guidance from the WG on whether to quote a minimum achievable uncertainty (derived from the excess variance) or not. Prof. Kühne stated that until there is a clear understanding of where the discrepancies arise, then the CMC claims with the smaller uncertainties reported by the individual NMIs cannot be supported because if this is done, we could be accused of making the comparison data look consistent and claim a measurement capability that is not supported by the comparison. If we are to err, then we should err on the side of caution.

Dr Kaarls briefly summarized the discussions noting that the document is not yet in the final phase but the draft is in place and now the working group requires feedback. Noting comments from Dr Cox that software is available to enable the calculations, Dr Kaarls invited all the WGs to consider the application of the model and to test it and provide feedback to Dr Cox and Dr Ellison.

10. JCRB REPORT

Mr Ahmet Ömer Altan (executive secretary of the JCRB) presented a report on the Joint Committee of the Regional Metrology Organizations and the BIPM (JCRB) which covered its previous two meetings. The 25th meeting (the minutes of which will be made publicly available in the near future) was held in Egypt in September 2010. Resolution 25/1 was passed during the meeting and concerned CMCs which have been greyed-out for more than 5 years. It is proposed that at the end of this time period a reminder will be sent by the BIPM to the RMOs and the NMIs with a second reminder sent three weeks later. Absence of reply will result in the deletion of the CMCs from the KCDB. It was also agreed that each RMO will be free to set its own on-site peer review procedures. Action 25/8 will require the BIPM to prepare a draft programme for a "Workshop on the best practice for the review of CMCs" to be presented at the next meeting.

The 26th meeting of the JCRB was held in March 2011. Resolution 26/2 served to approve the proposed procedure for the deletion of greyed-out CMCs pending minor modifications to the delineation steps and assigned responsibilities. A one year extension of greyed-out CMC status may be granted if there is a plan presented for reinstatement. Action 26/2 recommends that a session be held at the 27th meeting of the JCRB to clarify the requirements for the planned workshop on CMC review practices. It proposes that a workshop is held in conjunction with the 28th JCRB meeting. Information on the CMC review practices by CCs will be collected by the BIPM and the RMOs will do the same with regard to their TCs. Action 26/3 requires that the scope of DIs needs to be made available to the BIPM and there is an expectation that all DIs will actively participate in the CIPM MRA, but that there are no requirements for them to have CMC claims. The BIPM will advise all new participants in the CIPM MRA of expectations concerning their

active participation in the activities of the CIPM MRA. A proposal from Dr Kaarls concerning guidelines for authorship of comparison reports, which suggested adoption of current practices at NIST, NRCC and PTB, constituted Action 26/7, which solicits comments from RMOs for discussion at the next JCRB meeting.

Changes to CIPM MRA Documents, approved by the CIPM in October 2010, are available on the BIPM website. The changes concerned CIPM MRA-D-04 ("Calibration and Measurement Capabilities in the Context of the CIPM MRA"); CIPM MRA-G-02 ("Guidelines for the Monitoring and Reporting of the Operation of Quality Systems by RMOs"); and CIPM MRA-D-05 (Measurement Comparison in the CIPM MRA") which consolidated a number of existing documents.

There have been six new CIPM MRA signatories since the last meeting of the CCQM: Ghana (2010), Seychelles (2010), Zimbabwe (2011), Zambia (2011), Mauritius (2011) and Bangladesh (2011).

Dr Wielgosz queried Action 26/3, asking if any rules will be developed regarding the type of information that would need to be collected by the BIPM on the scope of DIs, suggesting that the current 14 categories used by the CCQM may be sufficient if the DI simply indicates its main activity is associated with a particular category. Mr Altan agreed, citing the example of Slovenia which has five DIs. More information was need on each DI and since only one could legally hold a given national standard this had to be specified. Ms Parkes remarked that the current list of categories is limited, especially in the bio-area and that the activities of a DI may not conveniently fit into one category. Dr May noted that such structure is meaningless if there are no CMCs to support. Dr May suggested that JCRB membership may need to be reviewed so that, for example, it includes capability in the bio-area, but more broadly, that there needs to be representatives present who have technical knowledge of the impact of any proposed changes. Prof. Kühne pointed out that irrespective of the receipt of information on the scope of a DI, such a request from an NMI to appoint a DI cannot be denied. DIs can only be requested to provide information but if it is not forthcoming then there is no further action that can be taken. Dr Kaarls disagreed stating that it is mandatory that DIs indicate their designated area, otherwise the situation is unacceptable. Dr Güttler reiterated that the current collection of categories was not designed to support the activities of DIs, many of which may have very specific functions. Hence, it is appropriate that every NMI which appoints a DI should very clearly define the intended scope of the DI to the BIPM. Dr Wielgosz reminded the Committee that a designation is required because within the CIPM MRA there can only be one national holder of a standard, i.e., only one institute within a given country that has a particular highest level measurement capability. For example, PTB and BAM participate in the same comparisons but do not have claimed CMCs over the same range. The real problem is caused by not knowing what a DI is being designated for. Dr May pointed out that when NMI and DI quality systems are reviewed this information should be readily available. Dr Kaarls remarked that this information often arrives much later, before CMC claims are made, but after participation in comparisons. Ms Parkes noted that in rapidly evolving areas it is difficult to select a category because the descriptions of activities frequently change. Dr Güttler commented that the situation is often complex and not entirely clear,

even with respect to the analyte. However, if a contract exists between a NMI and a DI, the scope should be clear. Prof. Kühne stated that this would be a good idea but the CIPM MRA does not require a NMI and a DI to enter into a contract, so this is not a mandatory requirement. All that can be done is to ask the RMOs and the signatories to extract this information from the relevant Quality Systems and supply it to the BIPM.

Dr Wielgosz raised the issue of authorship and pointed out that several years ago the CCQM decided that all NMIs participating in a comparative study should appear in the author list. However, working practices vary, with either all participants listed or only the names of the coordinating laboratories. The CCQM should either reaffirm its original decision or defer to the JCRB decision. Dr Kaarls responded that the issue is in discussion and will be addressed later (*cf* section 13).

11. TRACEABILITY IN THE CIPM MRA (AND CCQM LIST OF EXCEPTIONS)

Dr Kaarls announced that there were no further comments to add regarding this issue as it had already presented by Dr Mackay during discussions of the KCWG and noted that with regard to exceptions, that these must be tabled to the CCQM and the CIPM. If an exception is agreed upon then it will be published by the BIPM. No exceptions have yet been received.

Dr Kaarls requested that Dr Wielgosz read out each of the Recommendations that had been proposed during the past day so that discussions could continue over the ensuing lunch hour and the final versions are prepared before the end of the plenary session.

12. UPDATE ON THE BIPM KCDB

Dr Thomas presented an update on the current status of the KCDB (as of 11 April 2011), noting that it now contains 23,890 published CMCs, an increase of ~1000 in the last year. Currently, 374 CMCs are greyed out and temporarily removed from the KCDB. Nearly 1000 comparisons are registered, among which ~74 % are Key Comparisons. Approximately 64 % of all registered comparisons have been completed with final reports posted. It was noted that tables of numbers and graphs of equivalence (~1580) are shown for Key Comparisons only. During 2009, there were 90,000 visits recorded to the web site while in 2010 this decreased to 85,000 but the number of web pages opened increased by about 50 % and the duration of each visit (now averaging 6 minutes) increased, demonstrating a healthy interest in the site.

The most recent KCDB newsletter (number 14) was issued in December 2010 and included a comprehensive report on BIPM Key Comparisons. The 15th issue, scheduled for release in June 2011, has the theme “Chemistry and the KCDB”.

The KCDB Quality Management System Procedures are constantly updated, although the majority of the Procedures are confidential and are therefore not available on the BIPM web site.

After a number of years of operation, the KCDB is coming to the end of its transitional period as it is believed that all possible scenarios have now been encountered. A decision must now be taken on what information is actually being used and what is most useful to the user. There is a desire to reduce the work of NMIs with respect to report preparation, publishing the data, etc., and this will be the focus of activities for 2011 together with "modernizing" the pages.

Dr May suggested that counting visits to the website is not a good indicator metric as this may simply be browsing. Dr May suggested that perhaps visitors to the site could be asked to rate both the availability of the KCDB and the consequences of it not being there so that a cost/benefit scenario can be developed. Dr Ellison congratulated Dr Thomas and the KCDB staff on a job well done, and noted that the LGC is engaged in a review of its overall performance in comparisons and asked if the BIPM could collect Key Comparison data to simplify mining it for information, permitting, for example, the rapid comparison of the performance of one NMI relative to another over a range of comparisons. Dr Thomas agreed that this would be a useful feature to implement.

Dr Kaarls thanked Dr Thomas for the enormous amount of work devoted to maintaining and updating the KCDB, and agreed that improvements are needed.

Dr Kaarls then asked Dr Wielgosz to return to the resolutions promulgated earlier and provide a brief explanation of each. Dr Wielgosz read out the resolutions:

Resolution Q1: On the need for further guidance on the expression of measurement results based on counting (enumeration);

Resolution Q2: On the need to support established measurement techniques essential to metrology in inorganic chemistry;

A Statement: On the need for further consultation over the possible redefinition of the mole.

An additional draft resolution on the possible redefinition of the mole and the determination of the Avogadro constant had been drafted but was not adopted by the CCQM.

Dr Kaarls asked all participants to consider the draft resolutions and to submit comments for discussion later in the day, after which the final versions will be prepared.

13. AUTHORSHIP OF REPORTS AND PUBLICATION OF RESULTS OF CC COMPARISONS

Dr Kaarls briefly reviewed the requirements for authorship of CIPM MRA comparison reports, as raised earlier by Mr Altan in his report from the JCRB. With input from corresponding NIST, NRCC and PTB documents on this subject, in which there was a great similarity in their wording, the following was proposed. In order to qualify for authorship, an individual must make a substantial intellectual contribution in at least one of the following activities: conception, experimental design and evolution of the

comparison; scientific performance of the research, having executed at least one or more significant aspects of the comparison; creative analysis, interpretation and calculations of the measurement data; creative writing up of the manuscript and documenting the project with all its data and results (note: in general Key- and Supplementary comparison reports are not to be considered as reviewed original scientific research publications as published in scientific journals; original research and method development should be published separately). Thus, every NMI participating in a comparison can have their name on the resulting document. As an additional point, it was noted that not every comparison report may constitute a completely innovative approach and the sometimes routine nature of the subject matter renders publication as a peer reviewed article impossible. These aspects have been discussed at the JCRB and agreed with some minor amendments; although some further consultation will take place recommendations will be made to the CIPM, and when all the comments are received, it is hoped that a final decision will be made.

Dr Westwood suggested that all participants in a comparison should be contacted to ensure that each appropriate person from each organization is included in the authorship. Dr Kaarls agreed, but noted that the best route is one that minimizes bureaucracy. Dr May pointed out that each NMI is likely to have their own policy relating to authorship and a means of contacting a responsible manager in each organization is needed. Dr May noted that the author might approve his/her name but there may be others from the same organization that should be listed and this issue has caused concern in the past. Moreover, if any NIST staff member is listed as an author of a publication, then the document must pass through an internal review process. Dr May stated that within the OAWG the comparisons are the property of the WG and not the coordinating laboratory and thus it is the responsibility of the manager in the participating NMI to approve the authors. Dr Emons agreed that all organizations have internal authorship processes, and awareness of which is impractical for external laboratories, therefore it is the responsibility of the participating laboratory to ensure that the author list is comprehensive. Dr Mester pointed out that many organizations have internal copyright arrangements with publishers and internal agreement forms must be managed in such a process. Dr Besley believes that one of the purposes of reviewing this issue is to give recognition to the enormous amount of work undertaken by the coordinating lead laboratory (usually by a single individual) and this issue is not currently addressed. A remark about principal authorship in the document is recommended. Dr Kaarls agreed to note this point. Dr Sturgeon asked for clarification of whether these criteria are limited to the authorship of reports of comparisons to be posted on the BIPM database or whether they intended to be more comprehensive to include peer reviewed articles submitted to external scientific journals. Dr Kaarls clarified that these issues are limited to comparison reports. Dr May remarked that if in the course of participating in a comparison an individual undertook some novel method development then this aspect would constitute intellectual property and would be dealt with by procedures internal to the organization. Ms Parkes stated that the BAWG had developed internal guidelines which suggested that the number of authors be limited to 2 per institute, unless a good reason was presented to suggest otherwise, and acknowledgements were a means to include indirect contributors. Dr Fajgelj expressed his belief that within the original report from the participating institute to the coordinating laboratory that the names

of people potentially considered for authorship should already be noted and in this way no subsequent verification is needed. Dr May stated that it needs to be made clear that a CCQM policy is required, not one from each WG. Dr Kaarls noted that the intention is to have a policy approved by the CIPM, such that the criteria apply not only to the CCQM but to every Consultative Committee.

Dr Kaarls noted that the first responsibility for a comprehensive list of authors lies with the individual NMIs, and that internal procedures should guarantee that the names presented are correct. Dr Kaarls agreed with the comment by Dr Emons that this is the only reliable mechanism to follow.

14. BIPM PROGRAMME ON METROLOGY IN CHEMISTRY

Dr Wielgosz presented an overview of the BIPM chemistry programme, covering the period 2009–2012, noting three major themes:

- international equivalence of gas standards for air quality and climate change monitoring;
- international equivalence of organic primary calibrators;
- support for the CCQM and JCTLM and international liaison activities for metrology in chemistry and the bio-sciences.

It is noteworthy that over 144 NMI participations are expected in BIPM coordinated chemistry comparisons during this period. Dr Wielgosz proceeded to cover some of the key results obtained over the past year in the current programme and outlined the areas to be covered over the next four years. The focus will continue to be the three principal themes noted above.

CCQM-K74 / CCQM-P110 (nitrogen dioxide in nitrogen, coordinated by BIPM), as mentioned earlier by Dr Milton in his report, generated very good results and the pilot study enabled an in-depth evaluation of the uncertainties achievable with FTIR measurement results traceable to reference data.

In support of BIPM.QM-K1 (ground level ozone, coordinated by BIPM), the BIPM has made considerable progress in the development of a laser ozone photometer which can operate at three wavelengths, allowing relative measurements of absorption cross sections at the different wavelengths to be determined. A new set of absolute ozone absorption cross-section measurements is planned for 2012. To achieve this will require the generation of pure ozone in the laboratory, measurement of the purity using an on-line mass spectrometer, and accurate determination of the optical path length in the measurement cell.

CCQM-K90 is focused on the equivalence of standards for formaldehyde in air measurements, which is of interest to both the World Meteorological Organization/Global Atmosphere Watch (WMO/GAW) Programme and for indoor air quality measurements world-wide. The BIPM is currently validating a facility for the production of accurate

concentrations of formaldehyde via permeation tubes and a magnetic suspension balance and detection by cavity ring down spectroscopy.

CCQM-K82 (methane in air, coordinated by BIPM and NIST) is of interest to the greenhouse gas monitoring community including WMO and NOAA since methane is the second most important greenhouse gas, with data quality objectives set at 2 nmol mol^{-1} at concentrations of 2 µmol mol^{-1} to examine annual cycles. Real air is required for the comparison because there are known matrix effects with the measurement. This is achieved by preparing the comparison sample either by scrubbing air free of methane and then gravimetrically doping it back in, or synthesizing clean air and adding methane. The comparison will be run in the preparative mode wherein laboratories send their samples to the BIPM for analysis. BIPM is currently validating its facilities with a suite of NIST gravimetrically prepared standards.

In the organic area, primary calibrator purity comparisons are a focus for BIPM activities. CCQM-K55b / CCQM-P117b (Purity of Aldrin, coordinated by BIPM) examined recrystallized aldrin of approximately 95 % purity and all NMIs having purity related CMCs were expected to participate. Most laboratories were clustered, but qNMR results were somewhat lower than results derived from a mass balance approach, which suggests that there may be an impurity that the bass balance approach does not detect. An in-depth discussion of the comparison during the past year concluded that there is indeed a high molecular weight non-volatile polymeric material present (>1 %) that is unexpected and hence undetected by most mass balance approaches. KCRVs have been established for aldrin.

Dr Wielgosz pointed out that the next step in the process is to compare all of the data generated throughout a series of comparisons to establish a model for assessment of performance in purity comparisons such that CMC quality can be judged. It is evident that the mass balance method requires fit for purpose capability for each class of impurity and is thus very demanding analytically, and may produce artefacts in the results through the fortuitous cancellation of errors in which one impurity is overestimated and another unaccounted for. Dr Wielgosz presented a summary of DoE plots illustrating the performance of a number of NMIs and also the BIPM in a series of purity comparisons. A question arises as to what is the relationship between the demonstrated capability to achieve uncertainty of measurement for individual impurities and how this contributes to overall purity and the CMC claimed uncertainty for purity. The answer requires an understanding of how the uncertainty varies with the mole fraction of the impurity; this will be addressed in a paper being developed by the BIPM.

Work with larger molecule purity is exemplified by collaboration with NIST on angiotensin I, an oligopeptide and prohormone. Development of methods for purity assessment will be undertaken on 1 g of material supplied by NIST using both a mass balance approach and an amino acid analysis, based on 6 amino acids (proline, leucine, tyrosine, phenylalanine, valine and isoleucine) which have themselves been characterized by the BIPM. Of these, valine is likely to be considered as a future candidate material for a small molecule purity comparison. Dr Wielgosz showed some of the MS–MS sequencing

of this 1296 g mol^{-1} structure after hydrolysis using QTrap4000 and LTQ-Orbitrap XL instrumentation, to illustrate the importance of adequate mass resolving power.

Dr Wielgosz described future programme proposals covering the period 2013–2016. A programme will focus on international equivalence of gas standards for air quality and climate change monitoring targeting ozone, nitrogen monoxide and formaldehyde for gas comparisons. Use of the unique measurement capabilities and infrastructure available at the BIPM permits the coordination of comparison studies and achievement of a long-term commitment to such services. Facilities are available for measurement of not only greenhouse gases (O_3 and CH_4) but air quality gases as well (NO_2, NO and HCHO).

The programme of international equivalence for organic primary calibrators with extension to purity of large molecules fits well with the OAWG and BAWG programme strategies. With respect to large molecules, initially interest will focus on insulin due to its large global socio-economic impact. Current WHO standards for insulin are assigned in international units (IU) and are not based on biosynthetic human insulin used to treat patients. There is an industry driven urgent need to establish a new international reference standard value for insulin assigned to the SI rather than IU, which will result in more consistent dosing for patients as well as to improve the consistency and accuracy of clinical diagnostic tests that are currently limited by the lack of availability of a highly pure international standard. Dr Wielgosz outlined the work to be undertaken by the BIPM to achieve this goal, and noted the need to develop reference methods, undertake a comparison to demonstrate the competence of laboratories to apply the reference methods and, which may then be used to value assign Certified Reference Materials. Dr Wielgosz noted that the BIPM is well positioned to undertake work on not only insulin but other small proteins as well, including human growth hormone, insulin-like growth factor, parathyroid hormone, glucagons and human chorionic gonadotropin. The content of the report delivered earlier by Dr Marriott outlined a roadmap for metrology for the biosciences (*cf* section 7) as well as highlighting that the BIPM has material transfer agreements in place for insulin, and that the organization is in a position to fulfill these aims.

Dr Wielgosz concluded by stating that the proposed programme will maintain existing facilities, with the BIPM undertaking coordinated comparisons in the gases area, and extending the programme on the international equivalence of organic primary calibrators by including purity comparisons for larger molecules. It is anticipated that some 150 NMI participations in BIPM coordinated comparisons will occur during the 2013–2016 period.

Ms Parkes asked whether the list of proteins targeted for study, including hGH, is still far into the future or if it is in the planning stage. Dr Wielgosz replied that the proteins were being used for illustrative purposes and a similar approach to that developed for insulin will be used for these as well.

15. COMMENTS ON WRITTEN REPORTS OF RMO ACTIVITIES

Dr Kaarls noted that a majority of RMOs had already sent in written reports of their

activities. These actions are undertaken in order to maintain close cooperation and exchange of information with the CCQM. Dr Kaarls asked if there were any questions or if the RMO representatives wished to add anything further to the reports. No comments were forthcoming.

16. JOINT COMMITTEE ON TRACEABILITY IN LABORATORY MEDICINE (JCTLM)

Dr Wielgosz presented a brief summary of the status of the JCTLM database as of March 2011. At the JCTLM Executive meeting in December 2010, twenty new entries for reference materials were approved for inclusion in the database out of 42 submissions received in WG1 Cycle 7 (2010). Fifteen CRM entries were added to List 1, including high purity digoxin and estradiol materials, a CRM for electrolytes in serum and a CRM for arsenic species in serum. During the course of WG1 Cycle 6 nominations, 16 submissions were outstanding and 5 entries for pure electrolyte reference materials were added to List 1. With regard to reference methods, WG1 Cycle 7 approved 5 new methods for inclusion in the database from a total of 30 submissions received; there were 7 submissions outstanding from Cycle 6 of which only one (ion chromatography for ortho-phosphate) was accepted. With respect to Reference Measurement Services, 49 were delisted in May 2010 for those laboratories that did not fulfil the accreditation criteria. This leaves 11 reference laboratories populating the list.

The database now contains 247 Reference materials, 152 Reference Methods and 86 Reference Measurement Services. The JCTLM database is publicly available and a new version of the Nomination form for Reference Material (WG-1-P-02-F-01) has been posted, consistent with ISO 15194:2009 requirements. The database will permit highlighting of any listed CRMs that have been reviewed for compliance with ISO 15194:2003 rather than ISO 15194: 2009. Reference materials reviewed against the 2003 standard will greyed out as of 31 May 2012, the date from which listed reference materials need to be compliant with ISO15194:2009.

Currently, the JCTLM hosts two meetings per year, with the next scheduled for 23 July 2011 in Atlanta, USA, to be held in conjunction with an American Association of Clinical Chemists' (AACC) meeting. The JCTLM Executive Committee will convene on 8-9 December 2011 at the BIPM headquarters.

Dr Kaarls remarked that the JCTLM is functioning well but noted that more NMI participation would be welcomed, and cited as an example the work of the BAWG on the proposed amylase enzyme comparison. Dr Güttler indicated that PTB is attempting to become more engaged with the JCTLM and suggested that a Key Comparison on determination of creatinine in serum should engage several NMIs. Ms Parkes remarked that this is the third year that the JCTLM meeting will be held in conjunction with the AACC meeting and asked if it is possible to consider holding the meeting with some other conference in the interests of enhancing participation. Dr Wielgosz agreed that this issue will be considered at the next Executive meeting.

17. INTERNATIONAL YEAR OF CHEMISTRY (IYC 2011)

Dr Fajgelj presented a report on IUPAC activities relating to International Year of Chemistry (IYC 2011), noting that the 42nd IUPAC World Chemical Congress and 44th IUPAC General Assembly are scheduled for 27 July–6 August 2011 in San Juan, Puerto Rico. A new Executive Director has been appointed (Dr Terry Renner) and a chemical nomenclature and structure representation division was formed 2 years ago. The 3rd edition of the Green Book (Quantities and Units) was published and the Gold Book (terminology) was to be updated only in an on-line format. Dr Fajgelj reminded everyone that electronic copies of *Pure and Applied Chemistry* were freely available online and that the most recent issue of *Chemistry International* [**33**(2), March–April 2011], devoted to atomic weights, was now available.

With regard to the IUPAC International Year of Chemistry initiative, Dr Fajgelj demonstrated the home page to illustrate the diversity of activities under way in various countries and encouraged participants to visit the website (see http://www.chemistry2011.org) and to link to the page from NMI home pages.

Dr Fajgelj highlighted two documents of particular concern: the isotopic composition of the elements for 2009 [*Pure Appl. Chem*., **83**, 397 (2011)] covering best measurements of the isotopic composition, known variations in normal terrestrial materials, representative isotope abundances and associated uncertainties; and the 2009 atomic weights of the elements [*Pure Appl. Chem*., **83**, 359 (2011)], which illustrates the ranges that will be used in future compilations.

Dr Fajgelj then considered the IUPAC document "Metrological Traceability of Measurement Results in Chemistry: Concepts and Implementation", prepared by Dr De Bièvre, Dr Fajgelj, Dr Dybkaer and Dr Hibbert. He noted that extensive discussion of the contents had taken place with over 400 comments being received from 15 reviewers and that it is in proof status prior to publication in *Pure Appl. Chem*., **84** (2011).

Prof. Kühne commented that the BIPM celebrates World Metrology Day (WMD) annually on 20 May, the day on which the Treaty of the Metre was signed in 1875, and in 2011 the BIPM is highlighting the International Year of Chemistry. Comprehensive information about WMD is available on the BIPM web site, which links to the International Organization for Legal Metrology (OIML).

18. COMMENTS ON WRITTEN REPORTS FROM INTERNATIONAL ORGANIZATIONS IN LIAISON WITH THE CCQM

Dr Kaarls opened the subject by asking if there was any additional information to be tabled or any questions. Dr Emons, speaking on behalf of ISO REMCO, announced that for the first time the ISO REMCO meeting on 11 July 2011, will be open to other participants outside of REMCO members. The meeting will include a workshop on

commutability of reference materials, which will examine the clinical field and beyond. Further information can be obtained by contacting Dr Emons direct or via ISO.org. Dr Milton noted possible links between the concepts of commutability and 'how far the light shines' principles, asking if it was the intention of the workshop to accomplish this. Dr Emons admitted that there is a link, but it is not the formal intention to explore this.

Dr Louw spoke on behalf of CITAC / ILAC to say that 9 June 2011 is World Accreditation Day, on which date a workshop "Accreditation for the Needs of Regulators" will take place. An article on Dr Charlet will be published in June 2011 on behalf of CITAC.

19. CCQM WORKSHOPS

Dr Kaarls reiterated his intention to organize a CCQM workshop in 2012 on the redefinition of the SI in cooperation with IUPAC, IFCC and any others with an interest in the redefinition of the mole.

No suggestions were made for other workshops.

20. CCQM RESOLUTIONS

Dr Kaarls asked Dr Wielgosz to systematically read the resolutions and statements proposed earlier, and invited comments from those present so that a final version of the documents could be drawn up.

Resolution Q1 (2011)- On the need for further guidance on the expression of measurement results based on counting (enumeration): was addressed from the CCQM to the CIPM and was, for the most part, favourably accepted by the majority of members as being necessary and was thus accepted to go forward after the implementation of a number of changes. The final version is presented in the Appendix.

Resolution Q2 (2011)- On the need to support established measurement techniques essential to metrology in inorganic chemistry: was thoroughly discussed, modified, re-addressed to the CIPM for action and accepted. The final version is presented in the Appendix.

A CCQM Statement (2011)- On the need for further consultation over the possible redefinition of the mole), directed to the BIPM, was accepted after minor editorial changes and is posted in the Appendix.

A further recommendation on the possible redefinition of the mole and the determination of the Avogadro constant was withdrawn.

Dr Kaarls closed discussions on the recommendations, noting that the language of each document would be finalized outside of the plenary meeting, and published in the report of the meeting.

21. ANY OTHER BUSINESS

No issues were raised for discussion.

22. DATE OF NEXT MEETING

The next meeting of the CCQM is proposed for the week of 16–20 April 2012 at the BIPM. The KCWG will convene the Friday and Saturday before this date.

22.1 COORDINATION OF CCQM WG MEETINGS

With respect to the coordination of those CCQM WGs planning to meet during the second half of 2012, the WG Chairs will present their proposals and the relevant hosts will provide any information needed.

23. CLOSURE

Dr Kaarls closed the meeting at 16:20, thanking everyone for their reports, feedback, active participation and suggestions which help make for more effective support for our customers. He thanked the staff of the BIPM for their support and expressed best wishes for safe travel to all participants.

R.E. Sturgeon,

rapporteur 29 April 2011

revised: 20 July 2011

APPENDICES

RECOMMENDATION OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE – METROLOGY IN CHEMISTRY TO THE INTERNATIONAL COMMITTEE FOR WEIGHTS AND MEASURES

RECOMMENDATION Q 1 (2011) :

On the need for further guidance on the expression of measurement results based on counting (enumeration)

The Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM),

considering

- the increasing importance of methods of measurement based on counting (enumeration) notably in the biosciences and biotechnology,
- that units of measurement for counting (enumeration) are not currently dealt with in the SI brochure other than by mentioning the SI unit one,
- that the International Union of Pure and Applied Chemistry (IUPAC) and the International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) recommend the use of the unit one for number of entities,
- that results of measurements of number of entities are currently expressed in various local units,

recommends

- that the SI brochure should now be extended to provide guidance on units for the expression of measurement results based on counting (enumeration).

RECOMMANDATION DU COMITÉ CONSULTATIF POUR LA QUANTITÉ DE MATIÈRE – MÉTROLOGIE EN CHIMIE PRÉSENTÉE AU COMITÉ INTERNATIONAL DES POIDS ET MESURES

RECOMMANDATION Q 1 (2011) :

Sur la nécessité de fournir des indications supplémentaires concernant l'expression des résultats de mesure par comptage (dénombrement)

Le Comité consultatif pour la quantité de matière – métrologie en chimie (CCQM),

considérant

- l'importance accrue des méthodes de mesure par comptage (dénombrement), notamment dans le domaine des biosciences et de la biotechnologie,
- le fait que les unités de mesure de comptage (dénombrement) ne sont pas traitées dans la Brochure sur le SI qui mentionne seulement l'unité du SI « un »,
- la recommandation de l'Union internationale de chimie pure et appliquée (UICPA) et l'International Federation of Clinical Chemistry and Laboratory Medicine (IFCC) d'utiliser l'unité « un » pour le dénombrement d'entités,
- l'utilisation actuelle de différentes unités dans des domaines particuliers, pour exprimer les résultats de mesure par dénombrement d'entités,

recommande

- que la Brochure sur le SI soit étendue au domaine des mesures par comptage (dénombrement) afin de fournir des indications sur les unités devant être utilisées pour exprimer les résultats de ces mesures.

RECOMMENDATION OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE – METROLOGY IN CHEMISTRY TO THE INTERNATIONAL COMMITTEE FOR WEIGHTS AND MEASURES

RECOMMENDATION Q 2 (2011):

On the need to support established measurement techniques essential to metrology in inorganic chemistry

The Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM),

considering

- the fundamental requirement for primary calibrators of the chemical elements,
- the need for a range of complementary measurement techniques applicable to metrology in inorganic chemistry,

noting

- that the long-term stability and reproducibility of SI traceable values associated with reference materials are critical to all applications of chemical measurement,
- that few National Metrology Institutes (NMIs) have the capability to determine non-metallic impurities in pure metal primary standards,
- the lack of current research programmes to develop and extend metrological applications of established techniques for high purity metals, notably for the measurement of C, N, O, H and for measurements by glow discharge mass spectrometry (GD-MS),
- the uncertain future for NMI expertise in established techniques such as coulometry,
- the importance of complementary measurement techniques such as neutron and photon activation analysis in ensuring the validity of measurement results and hence the availability of high quality data,
- the recommendations and findings of the workshop on specialized techniques held by the CCQM Inorganic Analysis Working Group (CCQM/11-23),

invites the CIPM to take steps to draw the attention of NMIs to the need to

- review the use of inorganic instrumental analysis within their laboratories in order to identify activities where the present and future viability of the techniques is endangered by lack of essential R&D and/or continuity in maintaining specialized expertise,
- take action to address the potential loss of essential expertise and facilities,
- support facilities providing specialized measurement techniques which are essential to metrology in inorganic chemistry,
- consider the most effective mechanism to take forward the recommendations of the CCQM Inorganic Analysis Working Group in collaboration with other NMIs and/or expert institutes.

RECOMMANDATION DU COMITÉ CONSULTATIF POUR LA QUANTITÉ DE MATIÈRE – MÉTROLOGIE EN CHIMIE AU COMITÉ INTERNATIONAL DES POIDS ET MESURES

RECOMMANDATION Q 2 (2011) :

Sur la nécessité de soutenir les techniques de mesure existantes indispensables à la métrologie en chimie inorganique

Le Comité consultatif pour la quantité de matière – métrologie en chimie (CCQM),

considérant

- le besoin fondamental en calibrateurs primaires d'éléments chimiques,
- la nécessité de disposer d'un éventail de techniques de mesure complémentaires pour la métrologie en chimie inorganique,

notant

- le fait que la stabilité à long terme et la reproductibilité des valeurs traçables au SI associées aux matériaux de référence sont cruciales pour l'ensemble des applications métrologiques en chimie,
- le fait que peu de laboratoires nationaux de métrologie ont l'aptitude de déterminer les impuretés non métalliques présentes dans les métaux purs utilisés comme étalons primaires,
- l'absence de programmes de recherche visant à développer et étendre les applications métrologiques des techniques établies pour les métaux de haute pureté, notamment pour la mesure de C, N, O, H, et pour les mesures par spectrométrie de masse à décharge luminescente,
- l'avenir incertain des compétences des laboratoires nationaux de métrologie liées aux techniques éprouvées telles que la coulométrie,
- l'importance des techniques de mesure complémentaires, telles que l'analyse par activation neutronique et photonique, afin de s'assurer de la validité des résultats de mesures et par conséquent de la disponibilité de données de haute qualité,
- les recommandations et conclusions de l'atelier sur les techniques spécialisées organisé par le Groupe de travail du CCQM sur l'analyse inorganique (CCQM/11-23),

invite le CIPM à prendre les mesures nécessaires pour attirer l'attention des laboratoires

nationaux de métrologie sur la nécessité

- d'étudier l'utilisation de l'analyse instrumentale inorganique dans leurs laboratoires afin d'identifier les activités pour lesquelles la viabilité présente et à venir des techniques est mise en danger du fait de l'absence de programmes de recherche et développement et/ou de l'inexistence d'un maintien des compétences spécialisées,
- de prendre des dispositions afin de remédier à la perte éventuelle de compétences et d'équipements indispensables,
- de soutenir les programmes permettant d'établir des techniques de mesure spécialisées essentielles à la métrologie en chimie inorganique,
- d'étudier le moyen le plus efficace de mettre en œuvre les recommandations du Groupe de travail du CCQM sur l'analyse inorganique, en collaboration avec des laboratoires nationaux de métrologie et/ou des laboratoires spécialisés.

STATEMENT OF THE CONSULTATIVE COMMITTEE FOR AMOUNT OF SUBSTANCE – METROLOGY IN CHEMISTRY

STATEMENT (2011):
On the need for further consultation over the possible redefinition of the mole

The Consultative Committee for Amount of Substance – Metrology in Chemistry (CCQM),

considering

- the importance of both the mole and the kilogram to the chemical measurement community,

noting

- that Resolution 12 adopted by the General Conference on Weights and Measures (CGPM) at its 23rd meeting (2007) recommended that National Metrology Institutes and the International Bureau of Weights and Measures (BIPM) "initiate awareness campaigns to alert user communities to the possibility of redefinitions and that the technical and legislative implications of such redefinitions and their practical realizations be carefully discussed and considered,

- Recommendation Q 1 of the CCQM (2009): On the possible redefinition of the mole and the kilogram,

- Draft Resolution A on the possible future revision of the International System of Units adopted by the International Committee for Weights and Measures (CIPM) in 2010 and to be submitted to the CGPM at its 24th meeting (2011),

- that there is limited documented evidence of increasing awareness in the relevant communities of the proposal to redefine the mole,

decides to

- prepare a *mise en pratique* for the possible future redefinition of the mole for circulation by the end of May 2011,

recommends its members to

- identify the most influential national and international bodies with responsibility for chemical measurements, and particularly the teaching and standardization of chemical measurements,

- ensure that these bodies are kept informed about the proposal to re-define the mole as published on the website of the BIPM in Draft Resolution A,

- determine whether these bodies anticipate significant difficulties with implementing such a definition as early as 2015, in the light of the new *mise en pratique*,

- report the results of their consultation activities to the 18th Meeting of the CCQM planned for April 2012,

invites the BIPM Director to write to the President of the International Union of Pure and Applied Chemistry (IUPAC) to acknowledge the resolution in support of a new definition of the mole of the IUPAC Interdivisional Committee on Terminology, Nomenclature and Symbols (ICTNS) and the Executive Committee, inform her about the re-drafted *mise en pratique* for the mole and invite her to inform the BIPM about progress with the consultation over this redefinition amongst the member bodies of the IUPAC.

DÉCLARATION DU COMITÉ CONSULTATIF POUR LA QUANTITÉ DE MATIÈRE – MÉTROLOGIE EN CHIMIE

DÉCLARATION (2011):

Sur la nécessité de poursuivre les consultations sur l'éventuelle redéfinition de la mole

Le Comité consultatif pour la quantité de matière – métrologie en chimie,

considérant

- l'importance de la mole et du kilogramme pour la communauté de la métrologie en chimie,

notant

- la Résolution 12 adoptée par la Conférence générale des poids et mesures (CGPM) à sa 23^{e} réunion (2007) recommandant aux laboratoires nationaux de métrologie et au BIPM de lancer « des campagnes de sensibilisation pour alerter les communautés d'utilisateurs sur l'éventualité de nouvelles définitions afin que leurs implications techniques et juridiques, ainsi que leurs réalisations pratiques, soient discutées et examinées avec soin »,

- la Recommandation Q 1 du CCQM (2009) sur les éventuelles redéfinitions de la mole et du kilogramme,

- le projet de résolution A sur l'éventuelle révision à venir du Système international d'unités, qui a été adopté par le Comité international des poids et mesures (CIPM) en 2010 et qui sera soumis à la CGPM lors de sa 24^{e} réunion (2011),

- le nombre limité de documents permettant de savoir si les communautés concernées prennent réellement conscience de la proposition de redéfinir la mole,

décide

- de préparer une mise en pratique de l'éventuelle définition à venir de la mole et de la faire circuler d'ici fin mai 2011,

recommande à ses membres

- d'identifier les organismes nationaux et internationaux les plus influents qui ont des responsabilités dans le domaine des mesures chimiques, notamment en ce qui concerne l'enseignement et la normalisation,
- de s'assurer que ces organismes sont informés de la proposition de redéfinir la mole publiée sur le site internet du BIPM,
- de déterminer si ces organismes envisagent que la mise en œuvre d'une telle définition dès 2015 posera des difficultés significatives, compte tenu des indications fournies dans la nouvelle mise en pratique,
- de communiquer les résultats de leurs consultations au CCQM lors de sa 18^{e} session prévue en avril 2012,

invite le directeur du BIPM à écrire à la présidente de l'Union internationale de chimie pure et appliquée (UICPA) afin de reconnaître la résolution prise par l'Interdivisional Committee on Terminology, Nomenclature and Symbols (ICTNS) et le Comité exécutif de l'UICPA, l'informer de la nouvelle mise en pratique de la mole, et l'inviter à faire part au BIPM des progrès des consultations sur cette éventuelle redéfinition effectuées auprès des organismes membres de l'UICPA.

APPENDIX Q1.
WORKING DOCUMENTS SUBMITTED TO THE CCQM AT ITS 17TH MEETING

Working documents submitted to the CCQM at its 17th meeting are on restricted access.
Documents restricted to Committee Members can be accessed at the restricted website.

Document CCQM/	
11-01	Draft agenda for the 2011 CCQM meeting, 2pp
11-02	Timetable of CCQM meetings, 2pp
11-03	Draft CCQM *ad-hoc* Working Group on Moisture in Grain, 2pp
11-04	Moisture in Grain - background information, 4pp
11-05	Moisture in Grain presentation by UNIIM (IAWG 2009), 19pp
11-06	IUPAC-CIAAW "Atomic weights of the elements 2009" (TSAW), 38pp
11-07	IUPAC-CIAAW "Isotopic composition of the elements 2009" (TICE), 14pp
11-08	CCQM Workshop on relative molecular mass measurements for the identification of peptides, proteins and other molecules, 5pp
11-09	EURAMET TC MC report to CCQM, B. Guettler, 4pp
11-10	APMP TCQM report to CCQM, D. Sin, 18pp
11-11	SIM Chemical Metrology WG report to CCQM, G. Massiff, 6pp
11-12	ILAC update for CCQM, A. Squirrell, 4pp
11-13	ISO REMCO report to CCQM, H. Emons, 2pp
11-14	COOMET TC 1.8 report to CCQM, L. Konopelko, 5pp
11-15	AFRIMETS TCQM feedback to CCQM, S. Prins, 3pp
11-16	Ten reasons NOT to fix the numerical value of the Avogadro constant, N. Wheatley, 9pp
11-17	CCQM Microbiology Workshop - background information, R. Josephs, 9pp
11-18	Use of an `excess-variance` approach for the estimation of a KCRV, associated standard uncertainty and DoEs for CCQM KCs, M. Cox, 10pp
11-19	IUPAC-IUGS common definition and convention on the use of the year as a derived unit of time (IUPAC Recommendations 2011), P. de Bièvre *et al*, 4pp
11-20	CCQM RECOMMENDATION Q 1 (2011) - On the need for further guidance on the expression of measurement results based on counting (enumeration), 1pp
11-21	CCQM STATEMENT (2011) - On the need for further consultation over the possible redefinition of the mole, 2pp
11-22	CCQM RECOMMENDATION Q 2 (2011): On the need to support established measurement techniques essential to metrology in inorganic chemistry, 1pp
11-23	Conclusions of Workshop on specialized techniques held by the CCQM Inorganic Analysis Working Group (IAWG), 12–13 April 2011, 2pp
11-24	Basic understanding of terms in Mass spectometry, Z. Mester - J. Meija, 27pp

11-25	Techniques and Limitations of Molecular Mass Determination of Bio-molecules, Y.-H. Yim, 33pp
11-26	CCQM Workshop on Molecular weight Determination, G. O Connor, 53pp
11-27	Impact of mass determinations on identifications of proteins and peptides in proteomics and small molecules in metabolomics, S. Stein, 43pp
11-28	Traceability of Protein Molecular Weight CRMs, L. Wu, J. Wang, 37pp
11-29	On the possible future revision of the SI, C. Thomas, 8pp
11-30	Some key concepts not to be avoided by CCQM in the discussion on the redefinition of the mole, P. de Bièvre, 27pp
11-31	The proposal to redefine the mole, M. Milton, 18pp
11-32	CCQM Workshop on Metrology and the Need for Reliable Traceable Microbiological Measurements to Ensure Food Quality and Safety, R. Kaarls, 9pp
11-33	Study of Measurement Service and Comparison Needs for an International Infrastructure for the Biosciences and Biotechnology , J. Marriott, 30pp
11-34	Moisture of Grain and CMCs?, P. Ulbig, R. Klüß, 46pp
11-35	Report of the CCQM Gas Analysis Working Group, M. Milton, 25pp
11-36	Report of the Inorganic Analysis Working Group, M. Sargent, 47pp
11-37	Report of the WG on Electrochemical Analysis, M. Máriássy, 41pp
11-38	OAWG Report to CCQM, 14 Apr 2011, W. E. May, 45pp
11-39	Report of the CCQM Working Group on Bioanalysis, H. Parkes, 30pp
11-40	Report of the CCQM Working Group on Surface Analysis, W. Unger, 28pp
11-41	CCQM Key Comparison and CMC Quality Working Group Update, L. Mackay, 20pp
11-42	Report from ad hoc CCQM KCRV WG, M. Cox, 13pp
11-43	JCRB Report to the CCQM, Ö. Altan, 8pp
11-44	Traceability in the CIPM MRA, R. Kaarls, 5pp
11-45	The BIPM key comparison database, C. Thomas, 7pp
11-46	IUPAC Report to CCQM 2011, A. Fajgelj, P. De Bièvre, 11pp
11-47	BIPM Chemistry Department Work Programme update, R. Wielgosz, 58pp
11-48	Report on JCTLM activities, R. Wielgosz, S. Maniguet, 8pp